ALDERMAN AND KING HALL RENOVATIONS

THE UNIVERSITY OF NORTH CAROLINA WILMINGTON
WILMINGTON, NORTH CAROLINA
SCO ID: 22-24639-01A

PROJECT MANUAL

CD/GMP

FEBRUARY 10, 2023

MOSELEY ARCHITECTS

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ALDERMAN AND KING HALL RENOVATION – KING HALL
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Architect's Project No: 620589

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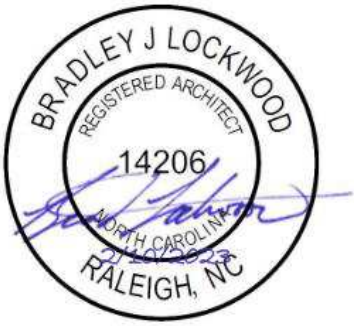

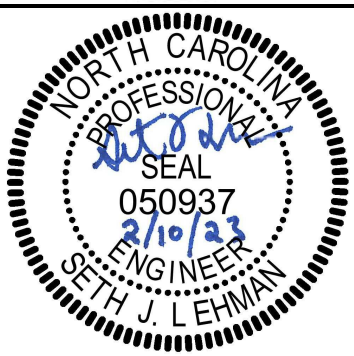

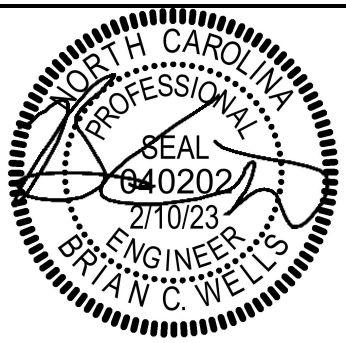

PROFESSIONAL SEALS

ALDERMAN AND KING HALL RENOVATION – KING HALL
UNC WILMINGTON
Architect's Project No: 620589

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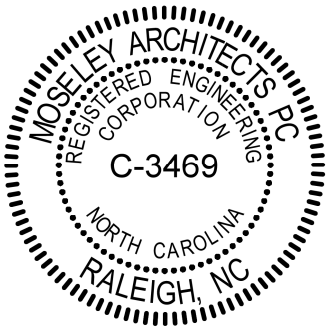

PROFESSIONAL SEALS

GENERAL CONDITIONS OF THE CONTRACT

STANDARD FORM FOR CONSTRUCTION MANAGER-AT-RISK PROJECTS

NORTH CAROLINA

DEPARTMENT OF ADMINISTRATION

STATE CONSTRUCTION OFFICE

Form OC-15CM

This document is intended for use on State capital construction projects and shall not be used on any project that is not reviewed and approved by the State Construction Office. Extensive modification to the General Conditions by means of "Supplementary General Conditions" is strongly discouraged. State agencies and institutions may include special requirements in "Division 1 – General Requirements" of the specifications, where they do not conflict with the General Conditions.

Second Edition January 2013

GENERAL CONDITIONS OF THE CONTRACT

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ARTICLE 1 - DEFINITIONS

a. The **contract documents** consist of the Request for Proposal (RFP); Construction Manager's formal response to the RFP; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the contract; the performance bond; the payment bond; insurance certificates; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.

b. The **Owner** is the State of North Carolina by and through the agency or institution named in the contract..

c. The **designer** or **project designer** means the firm or firms of architects or engineers or both (and their consultants) which have undertaken to design the project pursuant to a contract with the Owner, (hereinafter, the "design contract").

d. The **Construction Manager-at-Risk (CM) accepts a relationship of trust and confidence between himself and the Owner and undertakes to act as the Owner's fiduciary in the handling and opening of bids in accordance with the provisions of North Carolina General Statute (N.C.G.S.) 143-128.1.** The CM agrees to furnish his best skills and his best judgment to cooperate with the Owner and Designer for undertaking all necessary action contemplated under the contract documents to (a) establish during the design phase a Guaranteed Maximum Price (GMP) to construct the project and (b) ensure timely and quality completion of the project at a cost within the GMP. Construction Manager or CM as used in the contract documents means Construction Manager-at-Risk (CM at Risk).

e. A **subcontractor**, as the term is used herein, shall be in the case of a principal trade contractor, a general, mechanical, electrical or plumbing contractor or in the case of a specialty contractor, a trade contractor who is not a principal trade contractor, who has entered into a direct contract with a CM, and includes one who furnishes materials worked to a special design in accordance with plans and specifications covered by the contract, but does not include one who only sells or furnishes materials not requiring work so described or detailed.

f. **Written notice** shall be defined as notice in writing delivered in person to the contractor, or to a partner of the firm in the case of a partnership, or to a member of the contracting organization, or to an officer of the organization in the case of a corporation, or sent to the last known business address of the contracting organization by registered mail.

g. **Work**, as used herein as a noun, is intended to include materials, labor, and workmanship of the appropriate contractor as supervised by the CM.

h. The **project** is the total construction work to be performed under the contract documents.

i. **Construction Management Fee** shall be an all inclusive lump sum management fee which will include all Construction Manager-at-Risk home office, project site and project related costs including all Construction Manager-at-Risk overhead costs and profit.

j. **Change order**, as used herein, shall mean a written order to the CM subsequent to the signing of the contract authorizing a change in the GMP contract. The change order shall be signed by the CM, designer and the Owner, and approved by the State Construction Office, in that order (Article 19).

k. **Field Order,** as used herein, shall mean a written approval for the CM to proceed with the work requested by Owner prior to issuance of a formal Change Order. The field order shall be signed by the CM, designer, Owner, and State Construction Office (SCO).

l. **Field Change,** as used herein shall mean a written approval from the Owner for the CM to proceed with work requested by the Owner to be paid for from the CM Contingency or Owner's Project Reserve within the GMP.

m. **Time of Completion**, as stated in the contract documents, is to be interpreted as consecutive calendar days measured from the date established in the written Notice to Proceed, or such other date as may be established herein (Article 23).

n. **Liquidated damages,** as stated in the contract documents, is an amount reasonably estimated in advance to cover the consequential damages associated with the Owner's economic loss in not being able to use the Project for its intended purposes at the end of the contract's completion date as amended by change order, if any, by reason of failure of the CM to complete the work within the time specified. Liquidated damages does not include the Owner's extended contract administration costs (including but not limited to additional fees for architectural and engineering services, testing services, inspection services, commissioning services, etc.), such other damages directly resulting from delays caused solely by the CM, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the CM (e.g., if a multi-phased project-subsequent phases, delays in start of other projects that are dependent on the completion of this Project, extension of leases and/or maintenance agreements for other facilities).

o. **Surety**, as used herein, shall mean the bonding company or corporate body which is bound with and for the CM, and which engages to be responsible for the CM and his acceptable performance of the work.

p. **Routine written communications between the Designer and the Construction Manager** are any communication other than a "request for information" provided in letter, memo, or transmittal format, sent by mail, courier, electronic mail, or facsimile. Such communications cannot be identified as "request for information".

q. **Clarification or Request for information (RFI)** is a request from the CM seeking an interpretation or clarification by the Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the CM's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.

r. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work**.**

s. **Inspection** shall mean examination or observation of work completed or in progress to determine its compliance with contract documents.

t**.** **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents. Acceptance of equal is subject to approval of the designer and owner.

u. **"Substitution" or "substitute"** shall mean materials, products, equipment, assemblies, or installation methods deviating in at least one characteristic (physical, functional, or aesthetic) from those specified, but which in the opinion of the bidder would improve competition and/or enhance the finished installation. Acceptance of substitution is subject to the approval of the designer and owner.

v. **Provide** shall mean furnish and install complete in place, new, clean, operational, and ready for use.

w. **Indicated and shown** shall mean provide as detailed, or called for, and reasonably implied in the contract documents.

x. **Special inspector** is one who inspects materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with the approved construction documents and referenced standards.

y. **Commissioning** is a quality assurance process that verifies and documents that building components and systems operate in accordance to the owner's project requirements and the project design documents.

z. **Designer Final Inspection** is the inspection performed by the design team to determine the completeness of the project in accordance with approved plans and specifications. This inspection occurs prior to SCO final inspection.

aa. **SCO Final Inspection** is the inspection performed by the State Construction Office to determine the completeness of the project in accordance with NC Building Codes and approved plans and specifications.

bb. **Beneficial Occupancy** is requested by the owner and is occupancy or partial occupancy of the building after all life safety items have been completed as determined by the State Construction Office. Life safety items include but not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.

cc. **Final Acceptance** is the date in which the State Construction Office accepts the construction as totally complete. This includes the SCO Final Inspection and certification by the designer that all punch lists are completed.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

a. The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.

b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.

c. The CM shall execute each copy of the response to RFP, contract, performance bond and payment bond as follows:

1. If the documents are executed by a sole Owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.

2. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.

3. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.

4. If the documents are made by a joint venture, they shall be executed by each member of the joint venture in the above form for sole Owner, partnership or corporation, whichever form is applicable to each particular member.

5. All signatures shall be properly witnessed.

6. If the construction manager's license is held by a person other than an Owner, partner or officer of a firm, then the licensee shall also sign and be a party to the contract. The title "Licensee" shall appear under his/her signature.

7. The bonds shall be executed by an attorney-in-fact. There shall be attached to each copy of the bond a certified copy of power of attorney properly executed and dated.

8. Each copy of the bonds shall be countersigned by an authorized individual agent of the bonding company licensed to do business in North Carolina. The title "Licensed Resident Agent" shall appear after the signature.

9. The seal of the bonding company shall be impressed on each signature page of the bonds.

10. The CM's signature on the performance bond and the payment bond shall correspond with that on the contract.

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer with reasonable promptness by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.

b. The CM and the Designer shall prepare, if deemed necessary, a schedule fixing dates upon which foreseeable clarifications will be required. The schedule will be subject to addition or change in accordance with progress of the work. The Designer shall furnish drawings or clarifications in accordance with that schedule. The CM shall not proceed with the work without such detail drawings and/or written clarifications.

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

The Designer or owner shall furnish free of charge to the CM electronic copies of plans and specifications. If requested by the CM, up to 30 paper copies of plans and specifications will be

provide free of charge,, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the CM shall clearly and legibly record all work-in-place that is at variance with the contract documents. Additional sets shall be furnished at cost, including mailing, to the CM at the request of the CM.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

a. Within fifteen (15) consecutive calendar days of the notice to proceed, a schedule for anticipated submission of all shop drawings, product data, samples, and similar submittals shall be prepared by the CM and provided to the designer. This schedule shall indicate the items, relevant specification sections, other related submittal data, and the date when these items will be furnished to the designer.

b. The CM shall review, approve and submit to the Designer all Shop Drawings, Coordination Drawings, Product Data, Samples, Color Charts, and similar submittal data required or reasonably implied by the Contract Documents. Required Submittals shall bear the CM's stamp of approval, any exceptions to the Contract Documents shall be noted on the submittals, and copies of all submittals shall be of sufficient quantity for the Designer to retain up to three (3) copies of each submittal for his own use plus additional copies as may be required by the CM. Submittals shall be presented to the Designer in accordance with the schedule submitted in paragraph (a). so as to cause no delay in the activities of the Owner.

c. The Designer shall review required submittals promptly, noting desired corrections if any, and retaining three (3) copies (1 for the Designer, 1 for the owner and 1 for SCO) for his use. The remaining copies of each submittal shall be returned to the CM not later than twenty (20) days from the date of receipt by the Designer, for the CM's use or for corrections and resubmittal as noted by the Designer. When resubmittals are required, the submittal procedure shall be the same as for the original submittal***s.***

d. Approval of shop drawings by the designer shall not be construed as relieving the CM from responsibility for compliance with the design or terms of the contract documents nor from responsibility of errors of any sort in the shop drawings, unless such error has been called to the attention of the designer in writing by the CM.

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

a. The CM shall maintain, in readable condition at his job office, one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the Designer or his authorized representative, owner or State Construction Office.

b. The CM shall maintain at the job office, a day-to-day record of work-in-place that is at variance with the contract documents. Such variations shall be fully noted on project drawings by the CM and submitted to the designer upon project completion and no later than thirty (30) days after acceptance of the project.

c. The contractor shall maintain at the job office a record of all required tests that have been performed, clearly indicating the scope of work inspected and the date of approval or rejection.

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

All drawings and specifications are instruments of service and remain the property of the Owner. The use of these instruments on work other than this contract without permission of the Owner is prohibited. All copies of drawings and specifications other than contract copies shall be returned to the Owner upon request after completion of the work.

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

a. The CM shall, unless otherwise specified, supply & pay for all lighting, power, heat, sanitary facilities & water and shall require the Principal Trade and Specialty Contractors to, supply and pay for all labor, transportation, materials, tools, apparatus, scaffolding and incidentals necessary for the completion of his work, and to install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same. The CM shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied there from, all in accordance with the contract documents.

b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.

c. Upon notice, the CM shall furnish evidence from the the Principal Trade and Specialty Contractors as to quality of materials.

d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the CM through the Principal Trade or Specialty Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the CM through the Principal Trade or Specialty Contractor has the option of using any product and manufacturer combination listed. However, the CM through the Principal Trade or Specialty Contractor shall be aware that the cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable. The CM shall be responsible for reviewing all substitution requests from Principal Trade or Specialty Contractors prior to submission to the Project Designer and Owner and shall track & monitor all such requests. Requests for substitution of materials, items, or equipment shall be submitted to the Project Designer for approval or disapproval; such approval or disapproval shall be made by the designer prior to the opening of bids. Alternate materials may be requested after award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and the owner approves.

e. The CM shall obtain written approval from the designer for the use of products, materials, equipment, assemblies or installation methods claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered.

f. The Designer is the judge of equality for proposed substitution of products, materials or equipment.

g. If at any time during the construction and completion of the work covered by these contract documents, the conduct of any workman of the various crafts be adjudged a nuisance to the Owner or Designer, or if any workman be considered detrimental to the work, the CM shall order such parties removed immediately from grounds.

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

It is the intention of the contract documents that the work covered herein will not constitute in any way infringement of any patent whatsoever unless the fact of such patent is clearly evidenced herein. The CM shall protect and save harmless the Owner against suit on account of alleged or actual infringement. The CM shall pay all royalties and/or license fees required on account of patented articles or processes, whether the patent rights are evidenced hereinafter.

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

a. The CM shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. If the CM observes that the drawings and specifications are at variance therewith, he shall promptly notify the Designer in writing. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the CM performs any work or authorizes any work to be performed knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without such notice to the designer, he shall bear all cost arising there from. Additional requirements implemented after bidding will be subject to equitable negotiations.

b. All work under this contract shall conform to the North Carolina State Building Code and other State, local and national codes as are applicable. The cost of all required inspections and permits shall be the responsibility of the CM unless otherwise specified.

c. Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to inspection by any county or municipal authorities and are not subject to county or municipal building codes. The CM shall, however, cooperate with the county or municipal authorities by obtaining building permits. Permits shall be obtained at no cost.

d. Projects involving local funding (Community Colleges) are also subject to county and municipal building codes and inspection by local authorities. The CM shall pay the cost of these permits and inspections unless otherwise specified.

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

a. The CM shall be responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the Owner or designer, and by laws or ordinances governing such conditions. The CM shall be responsible for any damage to the Owner's property or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. The CM shall be responsible for and pay for any damages caused to the Owner. The CM shall have access to the project at all times.

b. The CM shall be responsible to cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the Owner.

c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the Designer.

d. The CM shall ensure that all trees and shrubs designated to remain in the vicinity of the construction operations are protected in accordance with the requirements of the plans and specifications. All walks, roads, etc., shall be barricaded as directed by the designer to keep the public away from the construction. All trenches, excavations or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

e. The CM shall develop and implement a project safety plan that provides all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. *Accident Prevention Manual in Construction*, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. The CM shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. The CM shall insure that protection is provided against damage or injury resulting from falling materials and that all protective devices and signs be maintained throughout the progress of the work.

f. The CM shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974, *Federal Register*), and revisions thereto as adopted by N.C.G.S. 95-126 through 155.

g. The CM shall. designate a responsible person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.

h. In the event of an emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the CM is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage. Any compensation claimed by the CM on account of such action shall be determined as provided for under Article 19(b).

i. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

a. Any land-disturbing activity performed by the CM or any Principal Trade or Specialty Contractor in connection with the project shall comply with all erosion control measures set

forth in the contract documents and any additional measures which may be required in order to ensure that the project is in full compliance with the Sedimentation Pollution Control Act of 1973, as implemented by Title 15, North Carolina Administrative Code, Chapter 4, Sedimentation Control, Subchapters 4A, 4B and 4C, as amended (15 N.C.A.C. 4A, 4B and 4C).

b. Upon receipt of notice that a land-disturbing activity is in violation of said act, the CM shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.

c. The CM shall be responsible for defending any legal actions instituted pursuant to N.C.G.S. 113A-64 against any party or persons described in this article.

d. To the fullest extent permitted by law, the CM shall indemnify and hold harmless the Owner, the designer and the agents, consultants and employees of the Owner and designer, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 - INSPECTION OF THE WORK

a. It is a condition of this contract that the work shall be subject to inspection during normal working hours by the designer, designated official representatives of the Owner, State Construction Office and those persons required by state law to test special work for official approval. The CM shall therefore provide safe access to the work at all times for such inspections.

b. All instructions to the CM will be made only by or through the designer or his designated project representative. Observations made by official representatives of the Owner shall be conveyed to the designer for review and coordination prior to issuance to the CM.

c. The CM shall perform quality control inspections on the work of Principal Trade and Specialty Contractors to guard the Owner against defects and deficiencies in the work and shall coordinate this activity with the on-site duties of the Project Designer. The CM shall advise the Project Designer of any apparent variation and/or deviation from the intent of the Contract Documents and shall take the necessary action to correct such variations and deviations.

d. All work shall be inspected by designer, special inspector and/or State Construction Office prior to being covered by the contractor. The CM shall give a minimum two weeks notice unless otherwise agreed to by all parties. If inspection fails, after the first re-inspection all costs associated with additional re-inspections shall be borne by the CM.

e. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the CM shall give adequate notice to the Project Designer of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the Project Designer. Such special tests or inspections will be made in the presence of the Project Designer, or his authorized representative, and it shall be the CM's responsibility to serve ample notice of such tests.

f. All laboratory tests shall be paid by the Owner unless provided otherwise in the contract documents except the CM shall pay for laboratory tests to establish design mix for concrete and for additional tests to prove compliance with contract documents where materials have tested deficient except when the testing laboratory did not follow the appropriate ASTM testing procedures.

g. Should any work be covered up or concealed prior to inspection and approval by the Project Designer and/or (SCO) such work shall be uncovered or exposed for inspection, if so requested by the Project Designer or SCO in writing. Inspection of the work will be made promptly upon notice from the CM. All cost involved in uncovering, repairing, replacing, recovering and restoring to design condition, the work that has been covered or concealed will be paid by the CM.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

a. On-site representatives of the CM shall manage the work of the Principal Trade and Specialty Contractors and coordinate the work with the activities of the Owner and Project Designer to complete the project with the Owner's objectives of cost, time and quality. Throughout the progress of the work, the CM shall maintain a competent and adequate full-time staff approved by the Owner and Project Designer. It is understood that the designated and approved on-site representative of the CM will remain on the job and in responsible charge as long as those persons remain employed by the CM unless otherwise requested or agreed to by the Owner. The CM shall establish an on-site organization with appropriate lines of authority to act on behalf of the CM. Instructions, directions or notices given to the designated on-site authority shall be as binding as if given to the CM. However, directions, instructions, and notices shall be confirmed in writing.

b. The CM shall examine and study the drawings and specifications and fully understand the project design, and shall provide constant and efficient supervision to the work. Should he discover any discrepancies of any sort in the drawings or specifications, he shall report them to the designer without delay. He will not be held responsible for discrepancies in the drawings and/or specifications, but shall be held responsible to report them should they become known to him.

c. The CM shall call and preside over monthly job site progress conferences. All Principal Trade and Specialty Contractors shall be represented at these job progress conferences by both home office and project personnel. The CM shall require attendance from other subcontractors and material suppliers who can contribute toward maintaining required job progress. It shall be the principal purpose of these meetings, or conferences, to effect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. The CM shall be prepared to assess progress of the work and to recommend remedial measures for correction of progress as may be appropriate. The CM with assistance from the Designer shall be the coordinator of the conferences and shall preside as chairman. The CM shall turn over a copy of his daily reports to the Designer and Owner at the job site progress conference. Owner will determine daily report format.

d. The CM shall employ an engineer or a land surveyor licensed in the State of North Carolina to lay out the work and to establish a bench mark nearby in a location where same will not be disturbed and where direct instruments sights may be taken.

e. Prior to bidding, it shall be the responsibility of the CM to prepare an electronic and paper copy of a preliminary critical path method (CPM) schedule and submit such schedule to the Project Designer for his review and comment in sufficient time to allow revisions prior to inserting said schedule into the Principal Trade and Specialty Contractors' bid packages. After contract award but prior to thirty (30) days from the date of the notice to proceed, the CM shall obtain from the Principal Trade and Specialty Contractors their respective work activities and integrate them into a project construction schedule in CPM form. The resulting CPM schedule shall show all salient features of the work required for construction of the project from start to finish within the time allotted by the contract. The time in days between the CM's early completion date and the contractual completion date is project float time and shall be used as such by the CM unless amended by change order. The CM shall submit to the Project Designer an electronic and paper copy of the final CPM schedule after contracts are executed but within fifteen (15) days prior to the written notice to proceed. The Project Designer after reviewing and commenting on the project CPM schedule shall submit it to the Owner for approval. No application for payment will be processed until the project CPM schedule is approved by the Owner. No monthly application for payment will be processed without the submission of an electronic and paper copy of the CPM schedule attached.

f. The CPM schedule shall be a complete computer generated network analysis showing the complete sequence of construction activities, identifying the work of separate stages and other logically grouped activities, indicating early and late start and early and late finish dates, float duration and a complete logic. Monthly updates will show the estimated completion of each activity.

g. The CM shall distribute to the principal trade and specialty contractors the approved project CPM schedule and shall display same at the job site.

h. The CM shall maintain the project CPM schedule, making monthly adjustments, updates, corrections, etc., which are necessary to finish the project within the time allotted by the contract. In doing so, the CM shall keep the designer as well as all Principal Trade and Specialty Contractors fully informed as to all changes and updates to the schedule. The CM shall submit to the Project Designer a monthly report of the status of all work activities. The monthly status report shall show the actual work completed to date in comparison with the original amount of work scheduled. If the work is behind schedule, the CM must indicate in writing what measures are being taken to bring the work back on schedule and ensure that the contract completion date is not exceeded. If the work is greater than thirty (30) days behind schedule and no legitimate requests for time extensions are in process, then the CM shall prepare and submit to the Project Designer a recovery schedule for review and approval. Failure of the CM to abide by the directives in this paragraph will give the Owner cause to exercise the remedies set forth in Article 29 of the General Conditions and pursue any other legal remedies allowed it by law.

ARTICLE 15 – {NOT USED}

ARTICLE 16 - PRINCIPAL TRADE AND SPECIALTY CONTRACTS AND CONTRACTORS

a. Principal Trade and Specialty Contractors shall be pre-qualified by the CM. The prequalification criteria shall be determined by the Owner and CM to address quality, performance, the time specified in the bids for performance of the contract, the cost of construction oversight, time for completion, capacity to perform, and any other factors deemed appropriate by the Owner and/or CM. Basic qualification information from Principal Trade and Specialty Contractors shall be requested on the standard State of North Carolina

Prequalification Form approved by the State Building Commission. Only pre-qualified contractors are allowed to bid to and contract with the CM on a project.

b. All bids for Principal Trade and Specialty Contracts shall be publically advertised and shall be opened publically in a public venue, and once opened, shall be public records under N.C.G.S. 132. The CM shall award the contract to the lowest responsible, responsive bidder, taking into consideration quality, performance, the time specified in the bids for performance of the contract, the time for completion, compliance with N.C.G.S. 143-128.2, and other factors deemed appropriate by the Owner and advertised as part of the bid solicitation. When contracts are awarded pursuant to this section, the Owner shall provide for a dispute resolution procedure as provided by N.C.G.S. 143-128(f1). Once Principal Trade and Specialty Contractors are in place, the CM shall provide copies of the contracts to the Project Designer and also provide a list of equipment and material suppliers.

c. A CM may perform a portion of the work only if (a) bidding produces no responsible, responsive bidder for that portion of the work, or (b) the lowest responsible, responsive bidder will not execute a contract for the bid portion of the work, or the Principal Trade or Specialty Contractor defaults and a prequalified replacement cannot be obtained in a timely manner, and (c) the Owner approves performance of the work by the CM.

d. The Designer will furnish to any Principal Trade or Specialty Contractor, upon request, evidence regarding amounts of money paid to the CM on account of the work of the Principal Trade or Specialty Contractor.

e. The CM is and remains fully responsible for his own acts or omissions as well as those of any Principal Trade or Specialty Contractor or of any employee of either. The CM agrees that no contractual relationship exists between the Principal Trade and Specialty Contractors and the Owner in regard to the contract, and that the Principal Trade and Specialty Contractors act on this work as an agent or employee of the CM.

ARTICLE 17 - CONSTRUCTION MANAGER AND SUBCONTRACTOR RELATIONSHIPS

The CM agrees that the terms of these contract documents shall apply equally to each Principal Trade and Specialty Contractor as to the CM, and the CM agrees to take such action as may be necessary to bind each Principal Trade and Specialty Contractor to these terms. The CM further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to CM-subcontractor relationships, and that payments to Principal Trade and Specialty Contractors shall be made in accordance with the provisions of N.C.G.S. 143-134.1 titled “Interest on final payments due to prime contractors: payments to subcontractors”.

a. On all public construction contracts which are let by a board or governing body of the state government or any political subdivision thereof, except contracts let by the Department of Transportation pursuant to N.C. G.S. 136-28.1, the balance due the CM shall be paid in full within 45 days after respective prime contracts of the project have been accepted by the Owner, certified by the architect, engineer or designer to be completed in accordance with terms of the plans and specifications, or occupied by the Owner and used for the purpose for which the project was constructed, whichever occurs first. Provided, however, that whenever the architect or consulting engineer in charge of the project determines that delay in completion of the project in accordance with terms of the plans and specifications is the fault of the CM, the project may be occupied and used for the purposes for which it was constructed without payment of any interest on amounts withheld past the 45 day limit. Should final

payment to the CM beyond the date such contracts have been certified to be completed by the Project Designer, accepted by the Owner, or occupied by the Owner and used for the purposes for which the project was constructed, be delayed by more than 45 days, said CM shall be paid interest, beginning on the 46th day, at the rate of one percent (1%) per month or fraction thereof unless a lower rate is agreed upon on such unpaid balance as may be due. In addition to the above final payment provisions, periodic payments due the CM during construction shall be paid in accordance with the payment provisions of the contract documents or said CM shall be paid interest on any such unpaid amount at the rate stipulated above for delayed final payments. Such interest shall begin on the date the payment is due and continue until the date on which payment is made. Such due date may be established by the terms of the contract. Funds for payment of such interest on state-owned projects shall be obtained from the current budget of the owning department, institution or agency. Where a conditional acceptance of a contract exists, and where the Owner is retaining a reasonable sum pending correction of such conditions, interest on such reasonable sum shall not apply.

b. Within seven days of receipt by the CM of each periodic or final payment, the CM shall pay the Principal Trade and Specialty Contractors based on work completed or service provided under their contract with the CM. Should any periodic or final payment to a Principal Trade or Specialty Contractor be delayed by more than seven days after receipt of periodic or final payment by the CM, the CM shall pay the Principal Trade or Specialty Contractor interest, beginning on the eighth day, at the rate of one percent (1%) per month or fraction thereof on such unpaid balance as may be due.

c. The percentage of retainage on payments made by the CM to the Principal Trade and Specialty Contractors shall not exceed the percentage of retainage on payments made by the Owner to the CM. Any percentage of retainage on payments made by the CM to the Principal Trade or Specialty Contractors that exceeds the percentage of retainage on payments made by the Owner to the CM shall be subject to interest to be paid by the CM to the Principal Trade or Specialty Contractor at the rate of one percent (1%) per month or fraction thereof.

d. Nothing in this section shall prevent the CM at the time of application and certification to the Owner from withholding application and certification to the Owner for payment to a Principal Trade or Specialty Contractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of the Principal Trade or Specialty Contractor to make timely payments for labor, equipment and materials; damage to CM or another subcontractor; reasonable evidence that a Principal Trade or Specialty Contract cannot be completed for the unpaid balance of the subcontract sum; or a reasonable amount for retainage not to exceed the initial percentage retained by Owner.

ARTICLE 18 - DESIGNER'S STATUS

a. The Project Designer shall provide liaison and necessary inspection of the work to ensure compliance with plans and specifications. He is the agent of the Owner only for the purpose of constructing this work and to the extent stipulated in the contract documents. He has authority to stop work or to order work removed, or to order corrections of faulty work where such action may be necessary to assure successful completion of the work.

b. The Project Designer is the impartial interpreter of the contract documents, and, as such, he shall exercise his powers under the contract to enforce faithful performance by both the Owner and the CM, taking sides with neither.

c. Should the Project Designer cease to be employed on the work for any reason whatsoever, then the Owner shall employ a competent replacement who shall assume the status of the former Project Designer.

d. The Project Designer will make periodic inspections of the project at intervals appropriate to the stage of construction. He will inspect the progress, the quality and the quantity of the work.

e. The Project Designer and the Owner shall have access to the work whenever it is in preparation and progress during normal working hours. The CM shall provide facilities for such access so the Designer may perform his functions under the contract documents.

f. Based on the Project Designer's inspections and evaluations of the project, the Project Designer shall issue interpretations, directives and decisions as may be necessary to assist the CM in the administration of the project. His decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract. The CM's decisions, however, relating to means and methods, and administration of the contracts the CM holds are final.

ARTICLE 19 - CHANGES IN THE WORK

a. The Owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the CM from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.

b. Except in an emergency endangering life or property, no change shall be made by the contractor except upon receipt of approved change order or written field order from the designer, countersigned by the owner and the state construction office authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed.

A field order, transmitted by fax or hand- delivered, may be used where the change involved impacts the critical path of the work. A formal change order shall be issued as expeditiously as possible.

The CM may be requested to make a change to the work by the Project Designer and Owner where such work is to be funded by the CM Contingency or Project Reserve that is part of the GMP contract. Such a change must be documented in the same manner as a Change Order and must be authorized in writing by the Project Designer and Owner by a Field Change document.

In the event of emergency endangering life or property, the CM may be directed to proceed on a time and material basis whereupon the CM shall proceed and keep accurately on such form as may be required, a correct account of costs together with all proper invoices, payrolls and supporting data. Upon completion of the work the change order will be prepared as outlined under either Method "c(1)" or Method "c(2)" or both.

c. In determining the values of changes, either additive or deductive, the CM and Principal Trade and Specialty Contractors are restricted to the use of the following methods:

1. Where the extra work involved is covered by unit prices quoted in the proposal, the value of the change shall be computed by application of unit prices based on quantities,

estimated or actual as agreed of the items involved, except is such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.

2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.

d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined for a Principal Trade or Specialty Contractor and all multi-tier subcontractors shall not exceed fifteen percent (15%) of **net cost** of the work. No allowance for overhead and profit will be allowed for the CM until the change orders aggregate to a sum in excess of five percent (5%) of the Cost of the Work portion of the GMP. Once this threshold is met the CM may add an overhead & profit allowance not to exceed four percent (4%) of the net cost of the change order. Change orders to the GMP which authorize additional phases of a project without a change in scope of the originally intended project will not be considered in establishing the threshold for additional CM overhead & profit. Under Method "c (1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%*)* profit, but no allowances for overhead.

e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:

1. The actual costs of materials and supplies incorporated or consumed as part of the project;

2. The actual costs of labor expended on the project site;

3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;

4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the project;

5. The actual costs of premiums for bonds, insurance, permit fees and sales or use taxes related to the project.

Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the Owner.

f. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods.

All change orders shall be supported by a breakdown showing method of arriving at net cost as defined above.

g. In all change orders, the procedure will be for the Project Designer to request proposals for the change order work in writing. The CM will require the Principal Trade and Specialty Contractors to provide such proposals and supporting data in suitable format and will review and approve such change orders prior to submission to the designer. The Project Designer shall verify correctness. Within fourteen (14) days after receipt of the CM's proposal**,** the Project Designer shall prepare the change order and forward to the CM for his signature or otherwise respond, in writing, to the CM's proposal. Within seven (7) days after receipt of the change order executed by the CM, the Project Designer shall, certify the change order by his signature, and forward the change order and all supporting data to the Owner for the Owner's signature. The Owner shall execute the change order and forward to the State Construction Office for final approval**,** within seven (7) days of receipt. The State Construction Office shall act on the change order within seven (7) days. Upon approval by the State Construction Office, one copy remains with the State Construction Office, and the remaining copies are sent to the Project Designer for distribution to the Owner(s)**,** CM and the surety. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.

h. At the time of signing a change order, the CM shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."

i. A change order, when issued, shall be full compensation, or credit, for the work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.

j. If, during the progress of the work, the Owner requests a change order and the CM's terms are unacceptable, the Owner**,** with the approval of the State Construction Office, may require the CM to perform such work on a time and material basis in accordance with paragraph "b" above. Without prejudice, nothing in this paragraph shall preclude the Owner from performing or to have performed that portion of the work requested in the change order.

ARTICLE 20 - CLAIMS FOR EXTRA COST

a. Should the CM consider that as a result of any instructions given in any form by the designer, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the designer within seven (7) days without delay. The written notice shall clearly state that a claim for extra cost is being made and shall provide a detailed justification for the extra cost. The CM shall not proceed with the work affected until further advised, except in emergency involving the safety of life or property, which condition is covered in Article 19(b) and Article 11(h). No claims for extra compensation will be considered unless the claim is so made. The Designer shall render a written decision within seven (7) days of receipt of claim.

b. The CM shall not act on instructions received by him from persons other than the Project Designer, and any claims for extra compensation or extension of time on account of such instruction will not be honored. The Project Designer will not be responsible for misunderstandings claimed by the CM of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the

contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.

c. Should a claim for extra compensation that complies with the requirements of (a) above by the CM be denied by the Project Designer or Owner, and cannot be resolved by a representative of the State Construction Office, the CM may request a mediation in connection with N.C.G.S. 143-128(f1) in the dispute resolution rules adopted by the State Building Commission (1 N.C.A.C. 30H .0101 through .1001). If the CM is unable to resolve its claims as a result of mediation, then the CM may pursue his claim in accordance with the provisions of N.C.G.S. 143-135.3, or G.S. 143-135.6 where Community Colleges are the owner, and the following:

1. A CM who has not completed a contract with a state agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the CM claims is due. The Director may deny, allow or compromise the claim, in whole or in part. A claim under this subsection is not a contested case under N.C.G.S. Chapter 150B.

2. (a) A CM who has completed a contract with a State agency or institution for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the Director of the State Construction Office of the Department of Administration for the amount the CM claims is due. The claim shall be submitted within sixty (60) days after the CM receives a final statement of the board's disposition of his claim and shall state the factual basis for the claim.

(b) The Director shall investigate a submitted claim within ninety (90) days of receiving the claim, or within any longer time period upon which the Director and the CM agree. The CM may appear before the Director, either in person or through counsel, to present facts and arguments in support of his claim. The Director may allow, deny or compromise the claim, in whole or in part. The Director shall give the CM a written statement of the Director's decision on the CM's claim.

(c) A CM who is dissatisfied with the Director's decision on a claim submitted under this subsection may commence a contested case on the claim under Chapter 150B of the General Statutes. The contested case shall be commenced within sixty (60) days of receiving the Director's written statement of the decision.

(d) As to any portion of a claim that is denied by the Director, the CM may, in lieu of the procedures set forth in the preceding subsection of this section, within six (6) months of receipt of the Director's final decision, institute a civil action for the sum he claims to be entitled to under the contract by filing a verified complaint and the issuance of a summons in the Superior Court of Wake County or in the superior court of any county where the work under the contract was performed. The procedure shall be the same as in all civil actions except that all issues shall be tried by the judge, without a jury.

ARTICLE 21 - MINOR CHANGES IN THE WORK

The Project Designer will have the authority to order minor changes in the work not involving an adjustment in the contract sum or time for completion, and not inconsistent with the intent of the contract documents. Such changes shall be effected by written order, copied to the State Construction Office, and shall be binding on the Owner and the CM.

ARTICLE 22 - UNCORRECTED FAULTY WORK

Should the correction of faulty or damaged work be considered inadvisable or inexpedient by the Owner and the Project Designer, the Owner shall be reimbursed by the CM. A change order will be issued to reflect a reduction in the contract sum.

ARTICLE 23 - TIME OF COMPLETION, DELAYS, EXTENSION OF TIME

a. The final completion date will be as determined by the Owner, Designer and CM during the pre-construction phase of the project and will be incorporated into the contract for construction services between the Owner and the CM.

b. The CM shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the Project Designer and shall fully complete all work hereunder within the time of completion specified. For each day in excess of the above number of days, the CM shall pay the Owner the sum stated as liquidated damages reasonably estimated in advance to cover the loses to be incurred by the Owner by reason of failure of the CM to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.

c. If the CM is delayed at any time in the progress of his work by any act or negligence of the Owner or the Project Designer, or by any employee of either; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the designer and Owner determine may justify the delay, then the contract time may be extended by change order for the time which the designer and Owner may determine is reasonable.

   Time extensions will not be granted for rain, wind, snow or other natural phenomena of normal intensity for the locality where work is performed. For purpose of determining extent of delay attributable to unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where work is performed and on daily weather logs kept on the job site by the CM reflecting the effect of the weather on progress of the work and initialed by the designer's representative. No weather delays shall be considered after the building is dried in unless work claimed to be delayed is on the critical path of the baseline schedule or approved updated schedule. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any contractor claim for compensable damages for delays is limited to delays caused solely by the owner or its agents. Contractor caused delays shall be accounted for before owner or designer caused delays in the case of concurrent delays.

d. Request for extension of time shall be made in writing to the designer, copies to the owner and SCO, within twenty (20) days following cause of delay. In case of continuing cause for delay, the CM shall notify the designer copies to the owner and SCO, of the delay within twenty (20) days of the beginning of the delay and only one claim is necessary.

e. The CM shall notify his surety in writing of extension of time granted.

f. No claim shall be allowed on account of failure of the Project Designer to furnish drawings or instructions until twenty (20) days after demand for such drawings and/or instructions. See Article 5c. Demand must be in written form clearly stating the potential for delay unless the drawings or instructions are provided. Any delay granted will begin after the twenty (20) day demand period is concluded.

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

a. The Owner may desire to occupy or utilize all or a portion of the project when the work is substantially complete.

b. Should the owner request a utilization of a building or portion thereof, the designer shall perform a designer final inspection of area after being notified by the contractor that the area is ready for such. After the contractor has completed designer final inspection punch list and the designer has verified, then the designer shall schedule a beneficial occupancy inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office. If beneficial occupancy is granted by the State Construction Office, in such areas the following will be established:

   1. The beginning of guarantees and warranties period for the equipment necessary to support. in the area.

   2. The owner assumes all responsibiliites for utility costs for entire building.

   3. Contractor will obtain consent of surety.

   4. Contractor will obtain endorsement from insurance company permitting beneficial occupancy.

c. The Owner shall have the right to exclude the CM from any part of the project which the Project Designer has so certified to be substantially complete, but the Owner will allow the CM reasonable access to complete or correct work to bring it into compliance with the contract.

d. Occupancy by the Owner under this article will in no way relieve the CM from his contractual requirement to complete the project within the specified time. The contractor will not be relieved of liquidated damages because of beneficial occupancy. The designer may prorate liquidated damages based on the percentage of project occupied.

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

a. Upon notification from the CM that the project is complete and ready for inspection, the Project Designer shall make a designer final inspection to verify that the project is complete and ready for SCO final inspection. Prior to SCO final inspection, the CM shall ensure that all items requiring corrective measures noted at the designer final inspection are complete.

The Project Designer shall schedule an SCO final inspection at a time and date acceptable to the Owner, the CM and the State Construction Office.

b. At the SCO final inspection, the designer and his consultants shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the SCO final inspection, the designer and State Construction Office representative shall make the following determinations:

   1. That the project is completed and accepted.

   2. That the project is accepted subject to the correction of the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of SCo final inspection or the Owner may invoke Article 28, Owner's Right to Do Work.

   3. That the project is not complete and another date for a final inspection will be established.

c. Within fourteen (14) days of acceptance per Paragraph c1 or within fourteen (14) days after completion of punch list per Paragraph c2 above, the Project Designer shall certify the work and issue applicable certificate(s) of compliance.

d. Any discrepancies listed or discovered after the date of SCO final inspection and acceptance under Paragraphs c1 or c2 above shall be handled in accordance with Article 42.

e. The date of acceptance will establish the following:

   1. The beginning of guarantees and warranties period.

   2. The date on which the CM's insurance coverage for public liability, property damage and builder's risk may be terminated.

   3. That no liquidated damages (if applicable) shall be assessed after this date.

   4. The termination date of utility cost to the CM (if applicable).

f. **Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide to the owner a complete instructional video (media format acceptable to the owner) on the operation, maintenance, care and adjustment of all equipment and special construction elements.**

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

a. Any work, materials, fabricated items or other parts of the work which have been condemned or declared not in accordance with the contract by the designer shall be promptly removed from the work site by the CM, and shall be immediately replaced by new work in accordance with the contract at no additional cost to the Owner. Work or property of the Owner, damaged or destroyed by virtue of such faulty work, shall be made good at the expense of the CM.

b. Correction of condemned work described above shall commence within twenty-four (24) hours after receipt of notice from the Project Designer, and shall make satisfactory progress until completed.

c. Should the CM fail to proceed with the required corrections, then the Owner may complete the work in accordance with the provisions of Article 28.

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

See Article 35, Performance Bond and Payment Bond, and Article 42, Guarantee**.** Neither the final certificate, final payment, occupancy of the premises by the Owner, nor any provision of the contract, nor any other act or instrument of the Owner, nor the Project Designer, shall relieve the CM from responsibility for negligence, or faulty material or workmanship, or failure to comply with the drawings and specifications. The CM shall correct or make good any defects due thereto and repair any damage resulting therefrom, which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The Owner will report any defects as they may appear to the CM and establish a time limit for completion of corrections by the CM. The Owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the CM fails to prosecute the work properly or to perform any provision of the contract, the Owner, after seven (7) days written notice sent by certified mail, return receipt requested, to the CM from the designer, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the CM, such action and cost of same having been first approved by the Project Designer. Should the cost of such action of the Owner exceed the amount due or to become due the CM, then the CM or his surety, or both, shall be liable for and shall pay to the Owner the amount of said excess.

ARTICLE 29 - ANNULMENT OF CONTRACT

If the CM fails to begin the work under the contract within the time specified or fails to establish a GMP or obtain bids from or enter into contracts with qualified Principal Trade or Specialty Contractors within the GMP, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the CM shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the Owner may give notice in writing, sent by certified mail, return receipt requested, to the CM and his surety of such delay, neglect or default, specifying the same, and if the CM within a period of seven(7) days after such notice shall not proceed in accordance therewith, then the Owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within seven(7) days after being so notified and notify the Owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the Owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said CM, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the Owner, together with the costs of completing the

work under contract, shall be deducted from any monies due or which may become due said CM and surety. In case the expense so incurred by the Owner shall be less than the sum which would have been payable under the contract, if it had been completed by said CM, then the said CM and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the CM and the surety shall be liable and shall pay to the Owner the amount of said excess.

ARTICLE 30 – CONSTRUCTION MANAGER'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

a. Should the work be stopped by order of a court having jurisdiction, or by order of any other public authority for a period of three months, due to cause beyond the fault or control of the CM, or if the Owner should fail or refuse to make payment on account of a certificate issued by the designer within forty-five (45) days after receipt of same, then the CM, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the Owner and the designer, may suspend operations on the work or terminate the contract.

b. The Owner shall be liable to the CM for the cost of all materials delivered and work performed on this contract plus ten (10) percent overhead and profit and shall make such payment. The designer shall be the judge as to the correctness of such payment.

ARTICLE 31 - REQUEST FOR PAYMENT

a. Not later than the fifth day of the month, the CM shall submit to the designer a request for payment for work done during the previous month. The request shall be in the form agreed upon between the CM and the designer, but shall show substantially the value of work done and materials delivered to the site during the period since the last payment, and shall sum up the financial status of the contract with the following information:

    1. Total of contract including change orders.

    2. Value of work completed to date.

    3. Less five percent (5%) retainage, provided however, that after fifty percent (50%) of the CM's work has been satisfactorily completed on schedule, with approval of the owner and the State Construction Office and written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule.

    4. Less previous payments.

    5. Current amount due.

b. Prior to submitting the first payment request, the CM shall prepare a schedule showing a breakdown of the contract price into values of the various parts of the GMP contract. The Cost of the Work breakdown will be arranged so as to facilitate payments to the Principal Trade and Specialty Contractors in accordance with Article 17. The combined CM Construction Management Fee, Bonds & Insurance, CM Contingency, and Project Reserve (if any) will be shown on the Schedule of values as separate lines. The values for the CM Contingency and Project Reserve (if any) will move to appropriate lines within the Cost of the Work as those funds are committed and expended. This schedule of values will be submitted to & approved by the designer and Owner within 30 days of the Notice to Proceed.

The schedule of values shall be prepared in such form and supported by such data to substantiate its accuracy as the designer and Owner may require.

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c. Applications for payment shall be in a form agreed upon by the CM, designer and Owner and shall prepared and supported by such data to substantiate the accuracy of the request as the designer may require.

d. Subject to other provisions of the contract documents, the amount of each progress payment shall be computed as follows:

   1. Take that portion of the GMP properly allocable to completed work as determined by multiplying the percentage completion of each portion Cost of the Work by the share of the GMP allocated to that portion of the work in the schedule of values.

   2. Add that portion of the GMP properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the work or if approved in advance by the Owner, suitably stored off site at a location agreed upon in writing.

   3. Subtract the aggregate of previous payments made by the Owner.

   4. Subtract the amount, in any, by which the CM has been previously overpaid, as evidenced by the Owner's review of the CM's documentation.

   5. Subtract amounts, if any, for which the Project Designer has withheld or nullified a certificate of payment.

   6. Subtract retainage as per paragraph (h) below.

   7. Add the amount due for the CM Construction Management Fee calculated on the basis the percentage completion of the project or on a schedule of payment negotiated with the Owner less fifteen percent (15%) and less previous payments for CM Construction Management Fee.

e. Payment allocated to Principal Trade and Specialty Contractors shall be subject to five percent (5%) retainage, provided, however that after fifty percent (50%) of the Cost of the Work has been satisfactorily completed on schedule, with the approval of the Owner and the State Construction Office and with written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule. The balance of the CM Construction Management Fee shall be held by the Owner until satisfactory completion and close out of the project. Satisfactory completion and close out of the project means that the Owner and Project Designer are satisfied that the project has been completed in accordance with the plans and specifications and within the GMP, all general conditions of the contract pertaining to close out have been satisfied, and all Principal Trade and Specialty Contractors have satisfactorily completed their respective contracts. No retainage will be held for the cost of Bonds and Insurance

f. When payment is made on account of stored materials and equipment, such materials must be stored on the owner's property, and the requests for payments shall be accompanied by invoices or bills of sale or other evidence to establish the owner's title to such materials and equipment. Such payments will be made only for materials that have been customized or fabricated specifically for this project. Raw materials or commodity products including but not limited to piping, conduit, CMU, metal studs and gypsum board may not be submitted. Responsibility for such stored materials and equipment shall remain with the CM regardless

of ownership title. Such stored materials and equipment shall not be removed from the owner's property. Should the space for storage on-site be limited, the CM, at his option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the CM desire to include any such materials or equipment in his application for payment, they must be stored in the name of the owner in an independent, licensed, bonded warehouse approved by the designer, owner and the State Construction Office and located as close to the site as possible. The warehouse selected must be approved by the CM's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer, owner and SCO of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the CM. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer, the owner and the State Construction Office prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State absolute right to possession of the materials at anytime. Bond, security and insurance protection shall continue to be the responsibility of the CM.

g. In the event of beneficial occupancy, retainage of funds due the CM may be reduced with the approval of the State Construction Office to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one-half (2 1/2) times the estimated value of the work to be completed or corrected. Reduction of retainage must be with the consent and approval of the CM's bonding company.

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

a. Within five (5) days from receipt of request for payment from the CM, the designer shall issue and forward to the Owner a certificate for payment. This certificate shall indicate the amount requested or as approved by the designer. If the certificate is not approved by the designer, he shall state in writing to the CM and the Owner his reasons for withholding payment.

b. No certificate issued or payment made shall constitute an acceptance of the work or any part thereof. The making and acceptance of final payment shall constitute a waiver of all claims by the Owner except:

   1. Claims arising from unsettled liens or claims against the CM.

   2. Faulty work or materials appearing after final payment.

   3. Failure of the contractor to perform the work in accordance with drawings and specifications, such failure appearing after payment.

   4. As conditioned in the performance bond and payment bond.

c. The making and acceptance of final payment shall constitute a waiver of all claims by the CM except those claims previously made and remaining unsettled (Article 20(c)).

d. Prior to submitting request for final payment to the designer for approval, the CM shall fully comply with all requirements specified in the“project closeout” section of the specifications. These requirements include but not limited to the following:

   1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval

from agencies having jurisdiction. (The designer must approve the Manuals prior to delivery to the Owner).

2. Transfer of required attic stock material and all keys in an organized manner.

3. Record of Owner's training.

4. Resolution of any final inspection discrepancies.

5. Granting access to Contractor's records, if Owner's internal auditors have made a request for such access pursuant to Article 52.

e. The CM shall forward to the designer, the final application for payment along with the following documents:

1. List of minority business subcontractors and material suppliers showing breakdown of contracts amounts and total actual payments to subcontractors and material suppliers.

2. Affidavit of Release of Liens.

3. Affidavit from CM of payment to material suppliers and subcontractors. (See Article 36).

4. Consent of Surety to Final Payment.

5. Certificates of state agencies required by state law.

f. The designer will not authorize final payment until the work under contract has been certified by Project Designer, certificates of compliance issued, and the CM has complied with the closeout requirements. The designer shall forward the CM's final application for payment to the Owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

a. The designer with the approval of the State Construction Office may withhold payment for the following reasons:

1. Faulty work not corrected.

2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.

3. To provide for sufficient contract balance to cover liquidated damages that will be assessed against the CM.

b. The Secretary of the Department of Administration may authorize the withholding of payment for the following reasons:

1. Claims filed against the CM or evidence that a claim will be filed.

2. Evidence that Principal Trade or Specialty Contractors have not been paid.

c. The Owner may withhold all or a portion of CM's Project Management Fee costs set forth in the approved schedule of values, if CM has failed to comply with: (1) a request to access its records by Owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14.j or provide The Owner; (3) a request to provide an electronic copies of Contractor's baseline schedule, updates with all logic used to create the schedules in the original format of the scheduling software; and (4) Contractor's failure to have its Superintendent on the Project full-time.

d. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the CM without cause will make owner liable for payment of interest to the CM in accordance with G.S. 143-134.1. As provided in G.S.143-134.1(e) the owner shall not be liable for interest on payments withheld by the owner for unsatisfactory job progess, defective construction not remedied, disputed work, or third-party claims filed against the owner or reasonable evidence that a third-party claim will be filed.

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

The work under this contract shall not commence until the CM has verified to the Owner that all required insurance and verifying certificates of insurance have been obtained and approved in writing by the Owner. These certificates shall contain a provision that coverage's afforded under the policies will not be cancelled, reduced in amount or coverage's eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the Owner of such alteration or cancellation.

a. **Worker's Compensation and Employer's Liability**

The CM shall ensure that it and all Principal Trade and Specialty Contractors shall provide and maintain, during the life of the contract, workmen's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of $100,000.

b. **Public Liability and Property Damage**

The CM shall ensure that it and all Principal Trade and Specialty Contractors shall provide and maintain, during the life of the contract, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury:	$500,000 per occurrence
Property Damage:	$100,000 per occurrence / $300,000 aggregate

In lieu of limits listed above, a $500,000 combined single limit shall satisfy both conditions.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

c. **Property Insurance (Builder's Risk/Installation Floater**)

The CM shall ensure that it and all Principal Trade and Specialty Contractors shall purchase and maintain property insurance during the life of this contract, upon the entire work at the

site to the full insurable value thereof. This insurance shall include the interests of the Owner, the CM, and subcontractors in the work and shall insure against the perils of fire, extended coverage, and vandalism and malicious mischief. If the Owner is damaged by failure of the CM to purchase or maintain such insurance, then the CM shall bear all reasonable costs properly attributable thereto; the CM shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions.

d. **Deductible**

Any deductible, if applicable to loss covered by insurance provided, is to be borne by the CM and/or the Principal Trade or Specialty Contractor as applicable.

e. **Other Insurance**

The CM shall ensure that it and all Principal Trade and Specialty Contractors shall obtain such additional insurance as may be required by the Owner or by the General Statutes of North Carolina including motor vehicle insurance, in amounts not less than the statutory limits.

f. **Proof of Carriage**

The CM shall ensure that it and all Principal Trade and Specialty Contractors shall furnish the Owner with satisfactory proof of carriage of the insurance required before written approval is granted by the Owner.

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ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

a. The CM shall furnish a performance bond and payment bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount, which shall be in the amount of the GMP for the entire project. Bonds shall be executed in the form bound with the specifications

b. All bonds shall be countersigned by an authorized agent of the bonding company who is licensed to do business in North Carolina.

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

The final payment of retained amount due the CM on account of the contract shall not become due until the CM has furnished to the Owner through the designer an affidavit signed, sworn and notarized to the effect that all payments for materials, services or subcontracted work to Principal Trade and Specialty Contractors in connection with his contract have been satisfied, and that no claims or liens exist against the CM in connection with this contract. In the event that the CM cannot obtain similar affidavits from the Principal Trade and Specialty Contractors to protect the CM and the Owner from possible liens or claims against the subcontractor, the CM shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the CM's) knowledge, and if any appear afterward, the CM shall save the Owner harmless.

ARTICLE 37 - ASSIGNMENTS

The CM shall not assign any portion of this contract nor subcontract in its entirety. Except as may be required under terms of the performance bond or payment bond, no funds or sums of money due or become due the CM under the contract may be assigned.

ARTICLE 38 - USE OF PREMISES

a. The CM shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the designer and shall not exceed those established limits in his operations.

b. The CM shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

c. The CM shall enforce the designer's and owner's instructions regarding signs, advertisements, fires and smoking.

d. No firearms, any type of alcoholic beverages or drugs (other than those prescribed by a physician) will be permitted at the job site.

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

a. The CM shall ensure that all cutting, fitting or patching that may be required to make the work come together properly and fit it to receive or be received by work of other contractors shown upon or reasonably implied by the drawings and specifications for the completed structure, as the designer may direct.

b. Any cost brought about by defective or ill-timed work shall be borne by the party responsible therefor.

c. No Principal Trade or Specialty Contractor shall endanger any work of another such contractor by cutting, digging or other means, nor shall he cut or alter the work of any other such contractor without the consent of the designer and the affected contractor(s).

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

a. The CM shall provide necessary and adequate facilities for water, electricity, gas, oil, sewer, and other utility services, which may be necessary and required for completion of the project. If the Owner specifies that the CM is to pay all utilities, any permanent meters installed shall be listed in the CM's name until his work is fully accepted by the Owner. As stipulated in the Supplementary General Conditions, the Owner may: (1) pay utilities cost directly, (2) require the CM to pay all utilities cost, (3) or reimburse the CM for the actual cost of utilities. The Owner or CM, as applicable, may recover actual costs of metered utilities from the responsible party should delays occur in project completion. Coordination of the work of the utility companies during construction is the sole responsibility of the CM.

b. If applicable Meters shall be relisted in the Owner's name on the day following completion and acceptance of the CM's work, and the Owner shall pay for services used after that date.

c. Prior to the operation of permanent systems, the CM will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.

d. The CM shall ensure that the permanent building systems are in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed and secured. The HVAC systems shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishes of the building. A building shall be considered enclosed and secured when windows, doorways (exterior, mechanical, and

electrical equipment rooms), and hardware are installed*;* and other openings have protection, which will provide reasonable climatic control. The appropriate time to start the mechanical systems and climatic condition shall be jointly determined by the CM and the designer. Use of the equipment in this manner shall in no way affect the warranty requirements of the CM.

e. The CM shall coordinate the work so that the building's permanent power wiring distribution system shall be in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.

f. The CM shall coordinate the work so that the building's permanent lighting system shall be ready at the time interior painting and finishing begins and shall provide adequate lighting in those areas where interior painting and finishing is being performed.

g. The CM shall be responsible for his permanently fixed service facilities and systems in use during progress of the work. The following procedures shall be strictly adhered to:

    1. Prior to acceptance of work by the State Construction Office, the CM shall coordinate the removal and replacement of any parts of the permanent building systems damaged through use during construction.

    2. Temporary filters as recommended by the equipment manufacturer in orded to keep the equipment and ductwork clean and free of dust and debris shall be installed in each of the heating and air conditioning units and at each return grille during construction. New filters shall be installed in each unit prior to the Owner's acceptance of the work.

    3. Extra effort shall be maintained to keep the building and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.

    4. It shall be understood that any warranty on equipment presented to the Owner shall extend from the day of final acceptance by the Owner. The cost of warranting the equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.

    5. The CM shall ensure that all lamps are in proper working condition at the time of final project acceptance.

h. The CM shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.

i. The CM shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.

j. On multi-story construction projects, the CM shall either provide or ensure that temporary elevators, lifts, or other necessary special equipment is available for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall either be included in the CM Construction Management Fee or specified as part of the work of a Principal Trade or Specialty Contractor and paid for as a part of the Cost of the Work.

k. The CM will erect one sign on the project if required. The sign shall be of sound construction, and shall be neatly lettered with black letters on white background. The sign shall bear the name of the project, and the CM's name, and the name of the designer and consultants. Directional signs may be erected on the Owner's property subject to approval of the Owner with respect to size, style and location of such directional signs. Such signs may bear the name of the contractor and a directional symbol. No other signs will be permitted except by permission of the Owner.

ARTICLE 41 - CLEANING UP

a. The CM shall ensure that the building and surrounding area is reasonably free from rubbish at all times, and shall remove debris from the site on a timely basis or when directed to do so by the designer. The CM shall provide an on-site refuse container(s) for the use of all Principal Trade and Specialty Contractors. The CM shall ensure that each Principal Trade and Specialty Contractor removes their rubbish and debris from the building on a daily basis. The CM shall ensure that the building is broom cleaned as required to minimize dust and dirt accumulation.

b. The CM shall provide and maintain suitable all-weather access to the building.

c. Before final inspection and acceptance of the building, the CM shall ensure that all portions of the work are clean, including glass, hardware, fixtures, masonry, tile and marble (using no acid), clean and wax all floors as specified, and completely prepare the building for use by the Owner, with no cleaning required by the Owner.

ARTICLE 42 - GUARANTEE

a. The CM shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the date of final acceptance of the work or beneficial occupancy and shall replace such defective materials or workmanship without cost to the Owner.

b. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The CM shall replace such defective equipment or materials, without cost to the Owner, within the manufacturer's warranty period.

c. Additionally, the Owner may bring an action for latent defects caused by the negligence of the CM, which is hidden or not readily apparent to the Owner at the time of beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.

d. Guarantees for roof, equipment, materials, and supplies shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

ARTICLE 43 - CODES AND STANDARDS

Wherever reference is given to codes, standard specifications or other data published by regulating agencies including, but not limited to, national electrical codes, North Carolina State Building Codes, federal specifications, ASTM specifications, various institute specifications, etc., it shall be understood that such reference is to the latest edition including addenda published prior to the date of the contract documents.

ARTICLE 44 - INDEMNIFICATION

To the fullest extent permitted by law, the CM shall indemnify and hold harmless the Owner, the designer and the agents, consultants and employees of the Owner and designer, from and against all claims, damages, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance or failure of performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the CM, the CM's subcontractor, or the agents of either the CM or the CM's subcontractor. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this article.

ARTICLE 45 - TAXES

a. Federal excise taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3442(3)).

b. Federal transportation taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3475(b) as amended).

c. North Carolina sales tax and use tax, as required by law, do apply to materials entering into state work and such costs shall be included in the bid proposal and contract sum.

d. Local option sales and use taxes, as required by law, do apply to materials entering into state work as applicable and such costs shall be included in the bid proposal from Principal Trade and specialty Contractors and contract sum.

e. Accounting Procedures for Refund of County Sales & Use Tax

   Amount of county sales and use tax paid per CM's statements:

   CM's performing contracts for state agencies shall ensure that the Principal Trade and Specialty Contractors provide information to allow the CM to give the state agency for whose project the materials, supplies, fixtures and/or equipment was purchased a signed statement containing the information listed in N.C.G.S. 105-164.14(e).

   The Department of Revenue has agreed that in lieu of obtaining copies of sales receipts from contractors, an agency may obtain a certified statement from the contractors setting forth the date, the type of property and the cost of the property purchased from each vendor, the county in which the vendor made the sale and the amount of local sales and use taxes paid thereon. If the property was purchased out-of-state, the county in which the property was delivered should be listed. The contractor should also be notified that the certified statement may be subject to audit.

   In the event the contractors make several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices, the counties, and the county sales and use taxes paid thereon.

   Name of taxing county: The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use.

When property is purchased from out-of-state vendors and the county tax is charged, the county should be identified where delivery is made when reporting the county tax.

Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the CM.

Contractors are not to include any tax paid on supplies, tools and equipment which they use to perform their contracts and should include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure.

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

The non-discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to equal employment opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the Secretary of Labor, are incorporated herein.

ARTICLE 47 - EMPLOYMENT OF INDIVIDUALS WITH DISABILITIES

The CM agrees not to discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant is qualified. The CM agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices.

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The State of North Carolina has attempted to address all asbestos-containing materials that are to be disturbed in the project. However, there may be other asbestos-containing materials in the work areas that are not to be disturbed and do not create an exposure hazard. Construction Managers are reminded of the requirements of instructions under General Conditions of the Contract, titled Examination of Conditions. Statute 130A, Article 19, amended August 3, 1989, established the Asbestos Hazard Management Program that controls asbestos abatement in North Carolina. The latest edition of *Guideline Criteria for Asbestos Abatement* from the State Construction Office is to be incorporated in all asbestos abatement projects for the Capital Improvement Program.

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

N.C.G.S. 143-128.2 establishes a ten percent (10%) goal for participation by minority businesses in total value of work for each State building project and requires documentation of good faith efforts for meeting that goal. The document, *Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts* including Affidavits and Appendix F are hereby incorporated into and made a part of this contract.

The CM shall identify and define contract packages (the value of which shall total to at least ten percent (10%) of the GMP) that remove barriers to participation commonly experienced by Historically Underutilized Businesses and Minority Business Enterprises as those terms are defined in North Carolina General Statute 143-128.2, hereinafter referred to as Reduced Barrier Packages (RBP). Such contract packages will be submitted to the Owner for review. As an example, RBP's may require no performance or payment bond, or may offer the participation of the CM as a guarantor or surety in the financing of material purchases by the Principal Trade and/or Specialty Contractors, provided that the CM may condition such financing participation upon the

issuance of joint checks or other similar arrangements to allow the CM to verify that timely payments are made to suppliers furnishing credit. The CM may propose other and/or additional provisions for reducing barriers to participation.

The Owner shall require the CM to submit a plan for compliance with N.C.G.S.143-128.2 by approval by the Owner prior to soliciting bids for the Principal Trade and Specialty Contracts. The CM and Principal Trade and Specialty Contractors shall make a good faith effort to recruit and select minority businesses for participation in contracts pursuant to N.C.G.S. 143-128.2.

ARTICLE 50 – CONTRACTOR EVALUATION

The CM's overall work performance on the project shall be fairly evaluated in accordance with the State Building Commission policy and procedures, for determining qualifications to compete for future capital improvement projects for institutions and agencies of the State of North Carolina. In addition to final evaluation, interim evaluation may be prepared during the progress of project. The document, Construction Manager Evaluation Procedures, is hereby incorporated and made a part of this contract. The Owner may request the CM's comments to evaluate the designer.

ARTICLE 51 – GIFTS

Pursuant to N.C. Gen. Stat. § 133-32, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, subcontractor, supplier, vendor, etc.), to make gifts or to give favors to any State employee. This prohibition covers those vendors and contractors who: (1) have a contract with a governmental agency; or (2) have performed under such a contract within the past year; or (3) anticipate bidding on such a contract in the future. For additional information regarding the specific requirements and exemptions, vendors and contractors are encouraged to review G.S. Sec. 133-32.

During the construction of the Project, the Contractor is prohibited from making gifts to any of the Owner's employees, Owner's project representatives (architect, engineers, construction manager and their employees), employees of the State Construction Office and/or any other State employee that may have any involvement, influence, responsibilities, oversight, management and/or duties that pertain to and/or relate to the contract administration, financial administration and/or disposition of claims arising from and/or relating to the Contract and/or Project.

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

In accordance with N.C. General Statute 147-64.7, the State Auditor shall have access to Contractor's officers, employees, agents and/or other persons in control of and/or responsible for the Contractor's records that relate to this Contracts for purposes of conducting audits under the referenced statute. The Owner's internal auditors shall also have the right to access and copy the Contractor's records relating to the Contract and Project during the term of the Contract and within two years following the completion of the Project/close-out of the Contract to verify accounts, accuracy, information, calculations and/or data affecting and/or relating to Contractor's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost

escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act ("NCFCA"), N.C Gen. Stat. § 1-605 through 1-618, applies to this Contract. The Contractor should familiarize itself with the entire NCFCA and should seek the assistance of an attorney if it has any questions regarding the NCFCA and its applicability to any requests, demands and/or claims for payment its submits to the State through the contracting state agency, institution, university or community college.

The purpose of the NCFCA "is to deter persons from knowingly causing or assisting in causing the State to pay claims that are false or fraudulent and to provide remedies in the form of treble damages and civil penalties when money is obtained from the State by reason of a false or fraudulent claim." (Section 1-605(b).) A contractor's liability under the NCFCA may arise from, but is not limited to: requests for payment, invoices, billing, claims for extra work, requests for change orders, requests for time extensions, claims for delay damages/extended general conditions costs, claims for loss productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, documentation used to support any of the foregoing requests or claims, and/or any other request for payment from the State through the contracting state agency, institution, university or community college. The parts of the NCFCA that are most likely to be enforced with respect to this type of contract are as follows:

- A "claim" is "[a]ny request or demand, whether under a contract or otherwise, for money or property and whether or not the State has title to the money or property that (i) is presented to an officer, employee, or agent of the State or (ii) is made to a contractor … if the money or property is to be spent or used on the State's behalf or to advance a State program or interest and if the State government: (a) provides or has provided any portion of the money or property that is requested or demanded; or (b) will reimburse such contractor … for any portion of the money or property which is requested or demanded." (Section 1-606(2).)

- "Knowing" and "knowingly." – Whenever a person, with respect to information, does any of the following: (a) Has actual knowledge of the information; (b) Acts in deliberate ignorance of the truth or falsity of the information; and/or (c) Acts in reckless disregard of the truth or falsity of the information. (Section 1-606(4).) Proof of specific intent to defraud is not required. (Section 1-606(4).)

- "Material" means having a natural tendency to influence, or be capable of influencing, the payment or receipt of money or property. (Section 1-606(4).)

- Liability. – "Any person who commits any of the following acts shall be liable to the State for three times the amount of damages that the State sustains because of the act of that person[:] … (1) Knowingly presents or causes to be presented a false or fraudulent claim for payment or

approval. (2) Knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim. (3) Conspires to commit a violation of subdivision (1), (2) …" (Section 1-607(a)(1), (2).)

- The NCFCA shall be interpreted and construed so as to be consistent with the federal False Claims Act, 31 U.S.C. § 3729, et seq., and any subsequent amendments to that act. (Section 1-616(c).)

  Finally, the contracting state agency, institution, university or community college may refer any suspected violation of the NCFCA by the Contractor to the Attorney General's Office for investigation. Under Section 1-608(a), the Attorney General is responsible for investigating any violation of NCFCA, and may bring a civil action against the Contractor under the NCFCA. The Attorney General's investigation and any civil action relating thereto are independent and not subject to any dispute resolution provision set forth in this Contract. (See Section 1-608(a).)

ARTICLE 54 – TERMINATION FOR CONVENIENCE

a. Owner may at any time and for any reason terminate CM's services and work at Owner's convenience. Upon receipt of such notice, CM shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement.

b. Upon such termination, CM shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by CM as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to CM prior to the date of the termination of this Agreement. CM shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

SECTION 000102 – Supplemental General Conditions

000102 UNCW SUPPLEMENTARY GENERAL CONDITIONS (OC-15CM)

The following modify the January 2013, 2nd Edition of the GENERAL CONDITIONS OF THE CONTRACT, STATE OF NORTH CAROLINA FORM OC-15CM and supersedes them only whenever they are in conflict. Unaltered provisions of the General Conditions shall remain in effect. These modifications shall be incorporated into all Contract Forms.

Article 11 – PROTECTION OF WORK, PROPERTY, AND THE PUBLIC

"j": **Add** the following paragraph: "The Contractor and the Owner shall meet on a regular basis as required but not less than weekly to coordinate safety and security issues."

Article 12 – SEDIMENTATION POLLUTION CONTROL ACT OF 1973

"e": **Add** the following new paragraph: "The Contractor shall comply with the following requirements: Equipment utilized during the construction activity on a site must be operated and maintained in a manner as to prevent the potential or actual pollution of the surface or ground waters. Fuels, lubricants, coolants, and hydraulic fluids, or any other petroleum products, shall not be discharged on the ground or into surface waters. Spent fluids shall be disposed of in a manner so as not to enter the waters, surface or ground, and in accordance with applicable state and federal disposal regulations. Any spilled fluids shall be cleaned up to the extent practicable and disposed of in a manner so as not to allow their entry into the waters, surface or ground, storm sewers, or drains on private or public property. Herbicide, pesticide, and fertilizer usage during the construction activity shall be restricted to those Materials approved by EPA and shall be used in accordance with label instructions. All wastes composed of construction materials shall be disposed of in accordance with NC General Statutes, Chapter 130A, Article 9- Solid Waste Management, and rules governing the disposal of solid waste (NC Administrative Code Section l5A NCAC 13B)."

"f": **Add** the following new paragraph: "Minimum Monitoring and Reporting Requirements.

All sedimentation and erosion control of facilities shall be inspected by the Engineer and/or Contractor in accordance with requirements of North Carolina Department of Environmental Quality (NCDEQ) permit issued for the project which Contractor shall have original posted at the site (Yellow Card).

If inspections required by this permit identify a need for maintenance of control measures, modifications or additions to control measures, or corrective actions to control sediment or other pollutants, these actions must be performed as soon as possible and before the next storm event to maintain the effectiveness of the control measures. The Owner reserves the right to deduct the cost of maintenance, modifications, additions or corrective actions from the Contractor's application for payment.

"g": **Add** the following new paragraph: "Maintenance and Inspections

The Contractor shall keep all erosion controls devices and materials in good repair. The Owner reserves the right, within 24 hours prior notice to the Contractor to repair any erosion control

measures or materials as required and deduct the cost of those repairs from the Contractor's application for payment.

The owner's representative may periodically evaluate the project for compliance with these requirements.

The Contractor is to submit a copy of the weekly inspection report to the Owner during weekly site meeting."

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE.

"d" **Add** the following to end of sentence "In such case, the Engineer or land surveyor licensed in the state of North Carolina shall coordinate the project benchmark with known campus benchmarks."

ARTICLE 16 – PRINCIPAL TRADE AND SPECIALTY CONTRACTS AND CONTRACTORS

"f" **Add** the following to end of sentence "A trade bid exceeding the cost of work value in the GMP may be considered not responsive."

"g" **Add** the following new paragraph: "If all trade bids for a package are not responsive due to their exceeding the cost of work value in the GMP, the following shall apply:

1. The CM shall conduct a post bid interview with the bidder that provided the lowest responsible bid and would have otherwise been a responsive bidder but for the total cost.
2. The CM shall identify the cause of any bid overages after the post bid interview. Line-item overages shall be categorized by division by the CM and presented as a written report to the Owner and Designer. The report must include for each line-item overage: the original bid package estimate, the actual bid amount, the difference, and a brief description explaining why the bid exceeded the estimate.
3. The CM, Owner, Designer and State Construction Office will discuss the CM's report and, if deemed necessary by the Owner, collectively agree that one or more of the following measures will be implemented by the CM, Owner, or Designer to offset the bid overages identified in the report:
    a. The CM will negotiate with the lowest responsible bidder and make limited reasonable changes to the plans and specifications without significantly modifying the project scope to bring the bids within the funds available.
    b. The CM will review the bid packages, breakdown larger bid packages, or repackage scopes of work, and rebid packages with minor modifications.
    c. The CM, with Owner approval, will deploy the Owner Market Contingency, if applicable, identified in the GMP.
    d. The CM, with Owner approval, will self-perform work as permitted by Article 16.c.
    e. The CM, with Owner approval, willdeploy CMR Contingency if bid overages pertain to items outlined by RFP Section II General Provisions – Part F.11.b.1

f. The Owner will deploy Owner Reserve Funds.

a. With assistance of the Designer, the plans and specifications will be modified, and the packages readvertised and rebid to bring the cost of the project within the funds available, or
b. Implement other solutions approved by the CM, Owner, Designer and State Construction.

4. All Changes and modifications to the plans and specifications must be reviewed and approved by the Designer and Owner. Approval will not be unreasonably withheld.
5. If all measures to reduce the bid overages to a cost of work within the GMP are unsuccessful, the Owner may identify additional funding and modify the GMP. If additional funding is not available, the Owner my terminate the contract."

ARTICLE 23 - TIME OF COMPLETION. DELAYS. EXTENSION.

"h" **Add** the following new paragraph: "Time. The CM shall commence work to be performed under this agreement on a date to be specified in a written order from the designer and shall fully complete all work within {296} consecutive calendar days from, and including said date."

"i" **Add** the following new paragraph: "Liquidated Damages. For each day in excess of the above number of days, the CM shall pay to the Owner the sum of {$2000/day} as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of said CM to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof."

ARTICLE 38 – USE OF PREMISES.

"d" **Add** the following new sentence: "The CM shall post a sign indicating Firearms are prohibited on the construction site."

END OF SUPPLEMENTARY GENERAL CONDITIONS

GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

In accordance with G.S. 143-128.2 (effective January 1, 2002) these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, and alternative contracting methods, on State construction projects in the amount of $300,000 or more. The legislation provides that the State shall have a verifiable ten percent (10%) goal for participation by minority businesses in the total value of work for each project for which a contract or contracts are awarded. These requirements are published to accomplish that end.

SECTION A: INTENT

It is the intent of these guidelines that the State of North Carolina, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded shall cooperate and in good faith do all things legal, proper and reasonable to achieve the statutory goal of ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to or to make purchases of materials or equipment from minority-business contractors or minority-business subcontractors who do not submit the lowest responsible, responsive bid or bids.

SECTION B: DEFINITIONS

1. Minority - a person who is a citizen or lawful permanent resident of the United States and who is:
   a. Black, that is, a person having origins in any of the black racial groups in Africa;
   b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
   c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, the Pacific Islands;
   d. American Indian, that is, a person having origins in any of the original peoples of North America; or
   e. Female

2. Minority Business - means a business:
   a. In which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and
   b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.

3. Socially and economically disadvantaged individual - means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".

4. Public Entity - means State and all public subdivisions and local governmental units.

5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.

6. Designer – Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.

7. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

8. Contract - A mutually binding legal relationship or any modification thereof obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.

9. Contractor - Any person, firm, partnership, corporation, association, or joint venture which has contracted with the State of North Carolina to perform construction work or repair.

10. Subcontractor - A firm under contract with the prime contractor or construction manager at risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in his subcontract.

SECTION C: RESPONSIBILITIES

1. Office for Historically Underutilized Businesses, Department of Administration (hereinafter referred to as HUB Office).

   The HUB Office has established a program, which allows interested persons or businesses qualifying as a minority business under G.S. 143-128.2, to obtain certification in the State of North Carolina procurement system. The information provided by the minority businesses will be used by the HUB Office to:
   a. Identify those areas of work for which there are minority businesses, as requested.
   b. Make available to interested parties a list of prospective minority business contractors and subcontractors.
   c. Assist in the determination of technical assistance needed by minority business contractors.

   In addition to being responsible for the certification/verification of minority businesses that want to participate in the State construction program, the HUB Office will:
   (1) Maintain a current list of minority businesses. The list shall include the areas of work in which each minority business is interested.
   (2) Inform minority businesses on how to identify and obtain contracting and subcontracting opportunities through the State Construction Office and other public entities.
   (3) Inform minority businesses of the contracting and subcontracting process for public construction building projects.
   (4) Work with the North Carolina trade and professional organizations to improve the ability of minority businesses to compete in the State construction projects.
   (5) The HUB Office also oversees the minority business program by:
      a. Monitoring compliance with the program requirements.
      b. Assisting in the implementation of training and technical assistance programs.
      c. Identifying and implementing outreach efforts to increase the utilization of minority businesses.
      d. Reporting the results of minority business utilization to the Secretary of the Department of Administration, the Governor, and the General Assembly.

2. State Construction Office
   The State Construction Office will be responsible for the following:

   a. Furnish to the HUB Office a minimum of twenty-one days prior to the bid opening the following:
      (1) Project description and location;
      (2) Locations where bidding documents may be reviewed;
      (3) Name of a representative of the owner who can be contacted during the advertising period to advise who the prospective bidders are;
      (4) Date, time and location of the bid opening.
      (5) Date, time and location of prebid conference, if scheduled.

   b. Attending scheduled prebid conference, if necessary, to clarify requirements of the general statutes regarding minority-business participation, including the bidders' responsibilities.

c. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal, that must be complied with, if the bid is to be considered as responsive, prior to award of contracts. The State reserves the right to reject any or all bids and to waive informalities.
d. Reviewing of minority business requirements at Preconstruction conference.
e. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
f. Provide statistical data and required reports to the HUB Office.
g. Resolve any protest and disputes arising after implementation of the plan, in conjunction with the HUB Office.

3. Owner
Before awarding a contract, owner shall do the following:

a. Develop and implement a minority business participation outreach plan to identify minority businesses that can perform public building projects and to implement outreach efforts to encourage minority business participation in these projects to include education, recruitment, and interaction between minority businesses and non-minority businesses.
b. Attend the scheduled prebid conference.
c. At least 10 days prior to the scheduled day of bid opening, notify minority businesses that have requested notices from the public entity for public construction or repair work and minority businesses that otherwise indicated to the Office for Historically Underutilized Businesses an interest in the type of work being bid or the potential contracting opportunities listed in the proposal. The notification shall include the following:
    1. A description of the work for which the bid is being solicited.
    2. The date, time, and location where bids are to be submitted.
    3. The name of the individual within the owner's organization who will be available to answer questions about the project.
    4. Where bid documents may be reviewed.
    5. Any special requirements that may exist.
d. Utilize other media, as appropriate, likely to inform potential minority businesses of the bid being sought.
e. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
f. Review, jointly with the designer, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total dollar value of the bid and affidavit listing good faith efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award to the State Construction Office.
g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to State Construction Office.
h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
i. Make documentation showing evidence of implementation of Owner's responsibilities available for review by State Construction Office and HUB Office, upon request

4. Designer
Under the single-prime bidding, separate prime bidding, construction manager at risk, or alternative contracting method, the designer will:

a. Attend the scheduled prebid conference to explain minority business requirements to the prospective bidders.
b. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential contracting opportunities.
c. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
d. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S.143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with

corresponding total dollar value of the bid and affidavit listing Good Faith Efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award.

e. During construction phase of the project, review "MBE Documentation for Contract Payment" – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the owner and forward copies to the State Construction Office.
f. Make documentation showing evidence of implementation of Designer's responsibilities available for review by State Construction Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, and Its First-Tier Subcontractors
Under the single-prime bidding, the separate-prime biding, construction manager at risk and alternative contracting methods, contractor(s) will:

a. Attend the scheduled prebid conference.
b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
c. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification will include the following:
   (1) A description of the work for which the subbid is being solicited.
   (2) The date, time and location where subbids are to be submitted.
   (3) The name of the individual within the company who will be available to answer questions about the project.
   (4) Where bid documents may be reviewed.
   (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

   If there are more than three (3) minority businesses in the general locality of the project who offer similar contracting or subcontracting services in the specific trade, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.
d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
e. Identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).
f. Make documentation showing evidence of implementation of PM, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), "MBE Documentation for Contract Payment" – (Appendix E), for designer's review.
j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office in writing, of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.

k. If during the construction of a project additional subcontracting opportunities become available, make a good faith effort to solicit subbids from minority businesses.
l. It is the intent of these requirements apply to all contractors performing as prime contractor and first tier subcontractor under construction manager at risk on state projects.

6. Minority Business Responsibilities
While minority businesses are not required to become certified in order to participate in the State construction projects, it is recommended that they become certified and should take advantage of the appropriate technical assistance that is made available. In addition, minority businesses who are contacted by owners or bidders must respond promptly whether or not they wish to submit a bid.

SECTION 4: DISPUTE PROCEDURES
It is the policy of this state that disputes that involves a person's rights, duties or privileges, should be settled through informal procedures. To that end, minority business disputes arising under these guidelines should be resolved as governed under G.S. 143-128(g).

SECTION 5: These guidelines shall apply upon promulgation on state construction projects. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: www.nc-sco.com

SECTION 6: In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing minority business participation in the state construction program.

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: http://www.nc-sco.com

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts **or** affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

OR

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

OR

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

(1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.

(2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.

(3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.

(4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.

(5) Attending any prebid meetings scheduled by the public owner.

(6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.

(7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.

(8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.

(9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.

(10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: _____ Approved/Certified By: _____

Name

_____

Title

_____

Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

(Revised on 3/14/2003)

SECTION 011000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Alderman and King Hall Renovations - King Hall.

B. Owner's Name: UNC Wilmington.

C. Architect's Name: Moseley Architects of Raleigh, NC.

D. Construction Manager at Risk (CMR): Muter Construction.

1.02 CONTRACT DESCRIPTION

A. Contract Type: Single prime, Construction Manager at Risk (CMR) Contract. The Construction Manager will serve as General Contractor; when the Contract Documents refer to "Contractor", they are referring to the CMR.

1.03 PROFESSIONAL SEALS

A. Use of Professional Seals on Bidding, Procurement, and Contract Documents: For the purposes of this paragraph, the term “Regulant” refers to the individual who signs and seals parts of the Contract Documents (e.g. the Drawings and Specifications). Certain information has been excerpted verbatim from a source or sources (e.g., UL Assemblies, SMACNA 2012 Sheet Metal details, 2018 NCBC code text) which was considered or used by Regulant in preparing parts of the Contract Documents, as follows:

1. The excerpted information was neither prepared under the direct control nor personal supervision nor created by the Regulant, as it was prepared by the source and owner of the excerpted information.
2. For purposes of bidding, procuring, and performance of the Work, and in any event of conflicts or ambiguities between the excerpted information in the Contract Documents and the requirements of applicable codes and standards, provide the better quality or greater quantity of Work which, at a minimum, complies with the requirements of the applicable codes and standards.
3. Advise Architect immediately upon becoming aware of requirements of the Work which are not consistent with the requirements of the excerpted information.
4. Attribution is acknowledged for information obtained and included herein verbatim from other source or sources.
5. Regulant has taken into consideration and used certain excerpted information from other sources which are applicable to the Contract Documents, and the Regulant indicates by its seal that it is assuming responsibility for its services in use and application of the excerpted information to the requirements of Work, but not for the excerpted information itself which was prepared by others. Regulant does not indicate by its seal that it is responsible for use or application of other information in such source or sources which was not included herein.

1.04 OWNER OCCUPANCY

A. The existing building shall be unoccupied for the duration of construction.

B. Owner intends to occupy the Project upon Owner's Final Acceptance.

C. Cooperate with Owner to minimize conflict with Owner's operations in adjacent facilities.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

C. Existing building spaces may not be used for storage.

D. Existing building shall be maintained weathertight. Do not modify elements of the existing building except as indicated on the Construction Documents. Repair damage to the existing building due to construction activity.

E. Time Restrictions:
   1. Comply with local regulations for hours of work, noise ordinances, and similar requirements.

F. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

G. Controlled Substances: The use of alcohol and drugs is not permitted on the Project site. Provide a designated outdoor smoking area for construction personnel that is at least 30 feet away from the building.

1.06 SPECIFICATION SECTIONS APPLICABLE TO ALL WORK

A. The provisions of the Owner/Contractor agreement, General Conditions of the Contract, Supplementary Conditions (if any), and all Division 01 sections shall apply to all sections of the Project Manual.

1.07 SECURITY PROVISIONS

A. Background Check: The Owner requires that a background check be performed on all personnel working on the site. Comply with Owner's requirements for screening service to be used. Maintain a list of all accredited persons, submit a copy to Owner on request.

B. Identification Badges: Provide identification badges to each person authorized to enter premises. Badge shall include personal photograph, name, employer, expiration date, and an assigned number. Have personnel return badges to Contractor after completion of their portion of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 011000

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, unless otherwise agreed to by Owner in writing.

B. Forms filled out by hand will not be accepted.

C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

D. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.
   1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Balance to Finish.
   9. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
   1. When a Change Order includes multiple PCOs, break down the total Change Order to include each PCO as an individual line item.

I. Submit one electronic and three hard-copies of each Application for Payment.

J. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 013000.
   2. Construction progress schedule, revised and current as specified in Section 013000.
   3. Partial release of liens from major subcontractors and vendors.
   4. Affidavits attesting to off-site stored products.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor on AIA Document G710 "Architect's Supplemental Instructions."

B. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days, unless otherwise indicated in Proposal Request.

C. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation.

D. For other required changes, Architect will issue a Construction Change Directive, on AIA Document G714, signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. Provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. Support each claim for additional costs with additional information:
      a. Origin and date of claim.
      b. Dates and times work was performed, and by whom.
      c. Time records and wage rates paid.
      d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

G. Execution of Change Orders: Architect will issue Change Orders on AIA Document G701 for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures have been completed in accordance with Section 017000.
   2. All closeout submittals have been completed in accordance with Section 017800.

C. Provide evidence and supporting data for the following, as attachments to the Application for Final Payment:
   1. AIA G706, "Contractor's Affidavit of Payment of Debts and Claims."
   2. AIA G707, "Consent of Surety to Final Payment."
   3. Settlement of all debts and claims, including liquidated damages, taxes, and fees.
   4. Utility meter readings, fuel levels, and similar measurements, as of the date of turn over to the Owner.
   5. Certificates for insured products.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012000

SECTION 012100
ALLOWANCES

PART 1 GENERAL

1.01 SUBMITTALS

A. Allowance Proposal: Submit initial proposal for purchase of products and materials, on Change Order form.

B. Supporting Documentation:

1. Products and Material: Provide invoices and other documents as required, for products and materials indicating quantities, prices, taxes, delivery fees, and other costs.
2. Labor and Installation: Provide time sheets and other documents as required, indicating all on-site Subcontractor costs, including hours worked, quantity or amount of product/material installed, hourly wages, and Subcontractor overhead and profit.

1.02 QUANTITY ALLOWANCES

A. Costs Included in Quantity Allowances: All Subcontractor's costs: Cost of products and materials, taxes, freight, delivery, receiving and handling, labor and installation, Subcontractor overhead and profit.

B. Costs Not Included in Quantity Allowances: All General Contractor's costs: General coordination, GC's overhead and profit.

C. Contractor Responsibilities:

1. Assist Architect in selection of products.
2. Obtain proposals from suppliers and installers and offer recommendations.
3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.

D. Differences in costs will be adjusted by Change Order.

1.03 ALLOWANCES SCHEDULE

A. Allowance No. 1: Quantity Allowance: Include 200 linear feet (L.F.) of Cat 6 ethernet cable. Coordinate with Division 1 "Unit Prices" for unit price requirements that will be used to determine allowance adjustments.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012100

SECTION 012200
UNIT PRICES

PART 1 GENERAL

1.01 COSTS INCLUDED

A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.02 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.03 MEASUREMENT OF QUANTITIES

A. Measurement methods delineated on the Drawings or in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the Drawings or individual specification section govern.

B. Take all measurements and compute quantities. Measurements and quantities will be verified via mutual agreement, and by personnel authorized by Owner, if required.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

D. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

E. Contractor's Engineer Responsibilities: Sign surveyor's field notes or keep duplicate field notes , calculate and certify quantities for payment purposes.

1.04 PAYMENT

A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.

B. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

1.05 SCHEDULE OF UNIT PRICES

A. Unit Price 1: Category 6 Ethernet Cable.

1. Unit price shall cover furnish and installation of cat 6 ethernet cabling. Unit price shall be measured in linear feet (l.f.). Refer to Section 271500 - Communications Horizontal Cabling for additional info.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012200

SECTION 012300
ALTERNATES

PART 1 GENERAL

1.01 ACCEPTANCE OF ALTERNATES

A. Alternates pricing will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.02 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Replace existing windows and window shades.
   1. Base Bid: Existing windows and window shades shall remain.
   2. Alternate: Provide new windows and window shades at locations indicated on Drawings.

B. Alternate No. 2: Recoat the flat portion of the roof.
   1. Base Bid: Provide only repair, patching, and penetration work as required and as indicated on Drawings; field of roof shall remain as is.
   2. Alternate: Provide a protective fluid-applied top coat over the entire flat roof surface.

C. Alternate No. 3: Carpet, paint, and base in first floor offices.
   1. Base Bid: Do not provide carpet, paint, and base in first floor offices.
   2. Alternate: Provide carpet, paint, and base in first floor offices as indicated on Drawings.

D. Alternate No. 3A: Carpet, paint, and base in Classroom 104.
   1. Base Bid: Do not provide carpet, paint, and base in indicated classroom space.
   2. Alternate: Provide carpet, paint, and base in classroom as indicated on Drawings.

E. Alternate No. 4: Install 2 new windows and window shades in exterior wall.
   1. Base Bid: Do not provide Work required for new windows.
   2. Alternate: Provide all work required for two window locations indicated, including selective demolition of existing wall, masonry infill and patching, lintels, flashing, and windows and window shades.

F. Alternate No. 5: Scrape and paint exterior wood trim.
   1. Base Bid: Do not provide exterior trim work.
   2. Alternate: Provide preparation and refinishing of exterior wood trim around the complete perimeter of the building as indicated on Drawings.

G. Alternate No. 6: Replace door frames with new rated frames with rated glass transom and sidelites to match existing at four stairway double doors.
   1. Base Bid: Do not provide replacement frame assemblies; replace doors and hardware in existing frame only.
   2. Alternate: Remove and replace door frames with new rated frames and glazing in addition to door/hardware replacement.

H. Alternate No. 7: Wayfinding signage.
   1. Base Bid: Do not provide wayfinding graphic signage.
   2. Alternate: Provide custom vinyl wallcovering with digital graphic pattern at location indicated on Drawings; coordinate custom graphics to provide in accordance with UNCW signage standards.

I. Alternate No. 8: Remodel and reconfigure first floor men's toilet room.
   1. Base Bid: Do not provide any Work in indicated men's toilet room.
   2. Alternate: Provide all work including selective demolition, wall and partition work, toilet partitions, fixture replacement, toilet accessories, finishes, and utility work as indicated on Drawings for indicated men's toilet room.

J. Alternate No. 9: Heat pump water heater.
   1. Base Bid: Provide electric resistance water heater.
   2. Alternate: Provide heat pump water heater and all accessories as indicated on Drawings.

1.03 SCHEDULE OF OWNER PREFERRED ALTERNATES

A. Alternate No. 10: Door Hardware:
   1. Base Bid: Provide indicated door hardware products by any of the listed manufacturers meeting the performance requirements in Section 087100.
   2. Alternate: Provide the following Owner preferred alternates for Door Hardware:
      a. Exit Device: Von Duprin Wide Stile Push Pad 98/99 Series.
      b. Keying System (Cylinders & Cores): Schlage Everest 29SL 7-pin SFIC.
      c. Locks, Latches, and Bolts: Schlage, Series L9000, Grade 1.
      d. ADA Operators: LCN 4630/4640 Series.
      e. Closers: LCN 4010/4111 EDA Series.
      f. Power Supplies: Von Duprin PS914 900-4RL.

B. Alternate No. 11: Building Automation Controller and Flow Meters:
   1. Base Bid: Provide system network controller and flow meter by manufacturer complying with performance specification requirements in Section 230900.
   2. Alternate: Provide system network controller by Tridium Niagara N4 platform and Onicon F-3500 flow meters.

C. Alternate No. 12: Communications Horizontal Cabling System:
   1. Base Bid: Provide communications horizontal cabling system by manufacturer complying with performance specification requirements in Section 271500.
   2. Alternate: Provide communications horizontal cabling system by Commscope SYSTIMAX.

D. Alternate No. 13: Two-Way Communication System:
   1. Base Bid: Provide two-way communication system by manufacturer complying with performance specification requirements in Section 275227.
   2. Alternate: Provide two-way communication system by Rath AORA including 1-116 call box.

E. Alternate No. 14: Fire Alarm System:
   1. Base Bid: Provide fire alarm system by manufacturer complying with performance specification requirements in Section 283111.
   2. Alternate: Provide fire alarm system complete by Notifier (unless noted otherwise below) with FACP model 3030 and monitor module FMM-1. Provide system sensor smoke detectors and notification appliances.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 012300

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control, such as unavailability, regulatory changes, or unobtainable warranty terms.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. A copy of the Substitution Request Form that shall be used is included at the end of this Section for informational purposes. Request a Word or editable PDF version of the form from the Architect and complete the form digitally; do not complete the form by hand.
   2. Contractor's Substitution Request documentation must include the following:
      a. Substitution Request Information:
         1) Indication of whether the substitution is for cause or convenience.
         2) Issue date.
         3) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
         4) Description of Substitution.
         5) Reason why the specified item cannot be provided.

6) Description of how proposed substitution affects other parts of work.

b. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
   1) Physical characteristics.
   2) In-service performance.
   3) Expected durability.
   4) Visual effect.
   5) Sustainable design features.
   6) Warranties.
   7) Other salient features and requirements.
   8) Include, as appropriate or requested, the following types of documentation:
      (a) Product Data:
      (b) Samples.
      (c) Certificates, test, reports or similar qualification data.
      (d) Drawings, when required to show impact on adjacent construction elements.

c. Impact of Substitution: Provide data indicating cost savings to Owner and change in Contract Time due to accepting substitution.

D. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Architect will consider requests for substitutions for convenience only within 30 days after date of Agreement.
   1. Substitutions for convenience submitted after this time period may or may not be considered, at the Architect's discretion.

B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
   2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
   3. Bear the costs engendered by proposed substitution of:
      a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
      b. Other unanticipated project considerations.

D. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.

3.03 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.

3.04 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION 012500

MOSELEYARCHITECTS

Substitution Request Form – Prior to Receipt of Bids

General Information				
Project Name	UNCW - Alderman and King Hall Renovations - King Hall			
A/E Project Number	620589 / SCO # 22-24639-01A			
Specified Product/Item Information				
Specification Title				
Section				
Page				
Article / Paragraph				
Description				
Proposed Substitution Information				
Proposed Substitution				
Reason for not providing specified product/item				
Comparative Data	Attach a point-by-point comparative data list. Include all differences between the proposed substitution and the specified product/item. If not provided, this Request will be rejected.			
Manufacturer				
Manufacturer Address				
Manufacturer Phone				
Manufacturer Representative Email address				
Trade / Model Name				
Model Number				
Installer (if known)				
Installer Address				
Installer Phone				
History	☐ New product	☐ 2-5 years	☐ 5-10 yrs	☐ 10 yrs or longer
Proposed substitution affects other parts of the Work	☐ Yes		☐ No	
If yes, explain				
Proposed Substitution Similar Installation				
Have you used this product/item on any other projects	☐ Yes		☐ No	
Project				
Project Address				
Architect/Engineer				
A/E Phone				

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Owner	
Owner Phone	
Date installed	

Attached Supporting Data

☐ Drawings	☐ Product Data/Specs	☐ Samples	☐ Tests	☐ Reports	☐

Entity submitting this Substitution Request certifies all of the following:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein.
- Proposed substitution's function, appearance, and quality are equal or superior in all respects to the specified product, except as may otherwise be specifically and clearly indicated herein.
- Same or superior warranty and/or guarantees shall be furnished for proposed substitution as is required for the specified product/item.
- Same maintenance service and source replacement parts, as applicable, are available; including local availability.
- Proposed substitution shall have no adverse effect on other trades.
- Proposed substitution shall not affect dimensions and functional clearances.
- Coordination, installation, and changes to the Work as necessary for the accepted proposed substitution shall be complete in all respects.

Entity's Information

Submitted by	
Signed By	
Date	
Email address of Signee above	
Company Name	
Address	
Phone	

Architect / Engineer Review and Action

If this Substitution request is acceptable, it shall be included in an Addendum. If the proposed substitution is not included in an Addendum, then the proposed substitution was rejected; was not submitted in accordance with the Bidding/Procurement Documents; and/or this Form was not complete. This Form shall be completely filled in to be considered for acceptance.

Acceptance of this Substitution request is an acceptance of the manufacturer and product/item only for general conformance with the design concept reflected in the Bidding/Procurement Documents. The A/E has made no attempt to verify specific performance data, or to check details of the proposed substitution as to special features, capacities, physical dimensions, or code and/or regulatory compliance – all of which remain the responsibility of the submitting entity and the Contractor (if not the submitting entity).

END OF SUBSTITUTION REQUEST FORM

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: General product requirements.

1.02 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 017000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Electronic File Distribution: Upon request, Contractor may be provided electronic files for use in coordination of the Work and preparation of submittals. Contractor shall submit a signed Request Form for Electronic Files, provided by the Architect.

1. Electronic files do not contain all of the information of the Bid Documents or Contract Documents for construction of the Project, and the Architect shall not be responsible for differences between electronic files, Bid Documents, and Contract Documents.

1.03 SUBMITTALS

A. General Contractor Personnel: Within 15 days after award of Contract, provide a summary of General Contractor's on site personnel. Identify each individual, beginning with project superintendent. List project responsibilities, cell phone number, and email address.

B. Subcontractors: Within 15 days after award of Contract, provide a summary of all companies and individuals engaged as subcontractors for any part of the Project. Include a contact name, company address, phone number, and email address, and identify what part of the Work shall be completed by each subcontractor.

C. Coordination Drawings: Submit completed Coordination Drawings for Architect's information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.

1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
2. It is Contractor's responsibility to submit documents in allowable format.
3. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
4. Paper document transmittals will not be reviewed unless previously approved; emailed electronic documents will not be reviewed.

5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: Coordinate method for exchanging files no later than the Preconstruction Meeting. The Architect's "Newforma InfoExchange" website and procedures can be used at no charge. If the Contractor chooses to use a different platform and methodology:
   1. The Architect may reject the methodology or platform proposed and:
      a. use the Architect's Newforma InfoExchange website, or
      b. the project team will revert to traditional hard-copy exchange;
   2. or the Contractor shall bear the cost of software, licensing, training, etc., for the project team to participate.

C. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive/record copies of files for Owner. If the Project Team uses an alternate platform preferred by the Contractor, the Contractor shall be responsible for distributing archive/record copies of files to Owner and Architect.

3.02 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.
   4. Owner's Commissioning Agent.
   5. Major subcontractors, consultants, and others as necessary and appropriate.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract and Architect.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.
   8. Site mobilization and utilization.
   9. Other project-specific items on pre-distributed agenda.

D. Architect shall record minutes and distribute digital copies to Owner, Contractor, and other attendees. Contractor shall be responsible for distribution to subcontractors and other personnel affected by decisions made.

3.03 INDOOR AIR QUALITY (IAQ) MANAGEMENT PLAN DEVELOPMENT SESSION

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Owner's Environmental Health & Safety (EH&S) representative.
   3. Owner's Commissioning Agent.
   4. Architect.

5. Mechanical engineer.
6. Contractor.
7. HVAC subcontractor.
8. Other major subcontractors, consultants, and others as necessary and appropriate.

C. Agenda:
1. Protection of Materials: Discussion of how and where materials that could impact IAQ will be stored, including but not limited to, the following:
   a. Insulation.
   b. Gypsum board.
   c. Flooring materials.
   d. Ceiling panels.
   e. Furnishings.
   f. Odorous chemicals.
2. Protection of HVAC: Discussion of how HVAC equipment will be stored installed, and operated during construction.
3. Pathway Interruption: Discussion of how airflow between construction zones will be limited to prevent the spreading of pollutants from one part of the building to another.
4. Housekeeping: Discussion of how the building will be kept clean and dry.
5. Materials Installation Scheduling: Discussion of what wet (odor emitting) materials will be used on the project, in order to schedule their installation before fuzzy (odor absorbing) materials.

3.04 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section. Do not allow installation of affected work to proceed until preinstallation meeting can be held.
1. Include all preinstallation meetings on the Project Schedule.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect and Owner in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of examination, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.05 PROGRESS MEETINGS

A. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor's superintendent.
4. Other subcontractors or consultants as required for the specific parts of the Work to be discussed.

C. Agenda:
1. Review minutes of previous meetings.

2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to the work.

D. Architect shall record minutes and distribute copies to the Owner, Contractor, and other consultants, Owner's representatives, or other third party attendees. The Contractor shall be responsible for distributing to any affected subcontractors and other personnel.

3.06 CLOSEOUT MEETING

A. Schedule and administer closeout meeting no later than 30 days before the scheduled Date of Owner's Final Acceptance.

B. Make arrangements for the meeting, prepare agenda with copies for participants, and preside at the meeting.

C. Attendance Required:
1. Owner.
2. Architect.
3. Contractor's superintendent.
4. Major subcontractors.
5. Other subcontractors or consultants as required.

D. Agenda:
1. Review closeout requirements and procedures in Division 1 Section "Execution and Closeout Requirements."
2. Review startup, testing, and adjusting of all systems, including testing/adjusting/balancing and Commissioning,
3. Coordination of inspections by local authorities having jurisdiction and third party Special Inspectors as required to obtain Certificate of Occupancy.
4. Coordination of Owner's occupancy and changeover of utilities, insurance, and building keying/lock system.
5. Procedures for Contractor's Correction Punch List, Architect's Initial Completion inspection, and Final Correction Punch List.
6. Delivery, turnover, and storage of maintenance materials, attic stock, special tools, and other non-installed materials.
7. Coordination of closeout documentation, including demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
8. Removal of temporary facilities, construction equipment, and tools.
9. Final cleaning, touchup, restoration, and preventive maintenance.
10. Coordination of final Applications for Payment.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.07 DAILY CONSTRUCTION REPORTS

A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.

B. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Approximate count of personnel at Project site.
   5. Major equipment at Project site.
   6. Material deliveries.
   7. Safety, environmental, or industrial relations incidents.
   8. Meetings and significant decisions.
   9. Unusual events (submit a separate special report).
   10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   11. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
   12. Testing and/or inspections performed.
   13. Signature of Contractor's authorized representative.

3.08 COORDINATION DRAWINGS AND COORDINATION CONFERENCE

A. Coordination Drawings: The Contractor shall prepare coordination drawings of all spaces where utilities, systems, and other components converge or intersect and efficient installation is required to accommodate all components.
   1. Prepare coordination drawings of the following spaces, at minimum. Supplement with additional spaces as required by project-specific conditions.
      a. Above ceilings.
      b. Vertical chases, shafts, and wall cavities.
      c. Mechanical and electrical rooms, fire pump room, and other major utility spaces.
   2. Provide accurate overall dimensions of components (for example, outside diameters of pipe and conduit, or overall ductwork dimensions including insulation and enclosure thickness).
   3. Include accessory components of systems that could cause potential conflicts, such as bracing, slotted channel framing, hangers, and other supports, valve handles, flanges, fittings, cable/wire management trays, and other similar components.
   4. Include sequence of installation of all components, materials, and systems.
   5. Include means of access to each component, material, or system, for maintenance and repairs.
   6. Provide additional coordination drawings as required by individual specification sections.
   7. Prepare Coordination Drawings using project-specific information. Do not use photocopies or reproductions of Contract Documents, and do not use standard details or data from manufacturers, suppliers, or other outside parties.

8. Drawing Files: The Contractor may develop coordination drawings using 2D CAD software or with 3D BIM software with clash-detection functionality.
    a. The Architect will furnish original 3D BIM model or 2D DWG files for Contractor's use upon receipt of Architect's "Request Form for Electronic Files". A copy of this form shall be provided to the Contractor upon request.
        1) The Architect makes no guarantee to the accuracy of components in electronic files. The Contractor shall coordinate electronic data with the Contract Documents in order to provide final Coordination Drawings.
        2) If using 2D files, the Contractor shall prepare drawings in multiple views (for example, RCP and section) to fully represent 3D space, for example plenum heights, wall assembly thicknesses, etc.
9. Submittal: Submit Coordination Drawings as a "Submittal for Information." Architect will not approve Coordination Drawings, but will keep on file for use in subsequent coordination and conflict resolution.

B. Coordination Conference: Schedule and conduct a Coordination Conference prior to beginning construction or rough-in of affected work. Require attendance by all affected trades and installers.
    1. Identify the Coordination Conference as a "milestone" date on the Construction Progress Schedule.
    2. Advise the Architect of all potential conflicts identified in the Coordination Drawings and at the Coordination Conference.
    3. Do not proceed with construction or installation of components, materials, or systems until potential conflicts have been resolved and affected parties have agreed to a remedy.
    4. Remedies to address conflicts not identified in the Coordination Drawings, at the Coordination Conference, or otherwise addressed prior to construction or installation of affected components, materials, and systems, or discovery of a non-workable situation not identified or addressed, will not be considered as a basis for delay, time extension, or additional cost to the Contract.

3.09 REQUESTS FOR INFORMATION (RFI)

A. Definition: A request seeking one of the following:
    1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
    2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
    1. Prepare a separate RFI for each specific item.
        a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
        b. Do not forward requests which solely require internal coordination between subcontractors.
    2. Prepare in a format and with content acceptable to Owner.
    3. Prepare using software provided by the Electronic Document Submittal Service.
    4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 016000 - Product Requirements)
      c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
      d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response.
   4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response.
      a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.

D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date and requested reply date.
   5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
   7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
   1. Indicate current status of every RFI. Update log promptly and on a regular basis.
   2. Note dates of when each request is made, and when a response is received.

G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement.

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. When the Architect provides a response to an RFI, that RFI shall be closed. If there is additional information required, or a question about the response itself, then another RFI with a new number shall be generated by the Contractor. At no time shall an RFI be "re-opened" or remain open after the Architect has formally responded.
   2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
   3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
   4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
      b. Account for a reasonable duration of time to allow for final color selections, approvals, and preparation of final finish schedules (one finish schedule for interior color selections, and one for exterior color selections). This period shall begin upon receipt of all submittals requiring color selection.

3.11 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Design data.
   3. Shop drawings.
   4. Samples for selection.
   5. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. Color Selection: In individual specification sections, specific items are identified which require color/finish selections to be made by the Architect from color chart or sample submittals. The Submittal Schedule, prepared according to “Submittal Schedule” paragraph above, shall identify these required color/finish submittals.

1. Submittals requiring color selection must be submitted by Contractor and approved by Architect for conformance with Contract Documents prior to the start of the color selection process. When the submittals have been approved for conformance with Contract Documents, the process for color selection, presentation of color concepts, Owner approval, and Color Schedule preparation will begin.
2. Interior Color Selections: The Architect will make coordinated selections of colors/finishes for the building interior, present the resulting color concepts to the Owner for approval, and prepare the actual Interior Color Schedule for the Work.
3. Exterior Color Selections: The Architect will make coordinated selections of colors/finishes for the building exterior and prepare Exterior Color Schedule.

E. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below.

3.12 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
1. Certificates.
2. Test reports.
3. Inspection reports.
4. Manufacturer's instructions.
5. Manufacturer's field reports.
6. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.13 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Architect's Initial Completion.

B. Submit Final Correction Punch List for Owner's Final Acceptance.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

3.14 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Selection Samples: Submit one set of manufacturer's charts indicating full range of available colors, textures, patterns, and other aesthetic qualities.

C. Verification Samples: Submit three sets of physical samples. Two sets will be retained by Architect, the third will be returned to the Contractor. Maintain approved sample at the Project site for use in comparing to installed Work.
1. Where a full-size assembly of multiple components is required as a sample (for example, railing section or full-size cabinet), only one sample is required for those items.

3.15 SUBMITTAL PROCEDURES

A. General Requirements:

1. Use a single transmittal for all submittals required by each individual specification section, unless otherwise indicated.
    a. Verification samples and large shop drawing submittals may be submitted under separate cover when approved by Architect.
2. Transmit using AIA G810 or other approved form.
3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
5. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
    a. Upload submittals in electronic form to Electronic Document Submittal Service website.
7. Schedule submittals to expedite the Project, and coordinate submission of related items.
    a. Allow sufficient time for administrative processing, Architect's initial review, and potential resubmittals.
        1) Large submittals may require longer review durations. Large or multi-part submittals (such as structural steel or aluminum storefront and curtainwall) may be submitted by building area, building level, or otherwise subdivided "packages" with the approval of the Architect. Subdivided "packages" will be reviewed one at a time in the order received. If large submittals are submitted in their entirety as a single package, the Architect may elect to review and return portions of the submittal individually, and will coordinate the schedule for return of these partial reviews with the Contractor for sequencing in the Work.
    b. Allow additional time for submittals requiring sequential reviews involving Architect's consultants, Owner, or another affected party.
    c. Allow additional time for submittals requiring sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval.
    d. No extensions to the project schedule shall be granted due to delays that can be attributed to submittal processing or failure to allow for sequential reviews or resubmittals.
8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
11. Incomplete submittals may not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
12. Submittals not requested will be recognized, and will be returned "Not Reviewed".

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.

4. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Do not reproduce Contract Documents to create shop drawings.
   3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
   1. Transmit related items together as single package.
   2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
   3. Selection Samples: Provide color charts that accurately relay color, pattern, and texture information. Photographs or photocopies of color charts are unacceptable and subject to rejection.
   4. Verification Samples: Provide physical samples of each color selected by Architect from Selection Samples. Verification samples shall be manufactured and prepared identically to the material that shall be used in the installed Work. Label each sample clearly with manufacturer, product name, and color, texture, and/or pattern name as applicable. Photographs of physical samples are unacceptable and subject to rejection.

3.16 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt, but will take no other action.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
   1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's actions on items submitted for review:
   1. Authorizing purchasing, fabrication, delivery, and installation:
      a. "Approved as Noted":
         1) Where review notations indicate revisions are necessary, submit corrected item, with review notations acknowledged and incorporated.
   2. Not Authorizing fabrication, delivery, and installation:
      a. "Revise and Resubmit":
         1) Resubmit revised item, with review notations acknowledged and incorporated.
      b. "Rejected/Resubmit":
         1) New submittal required, with item complying with requirements of Contract Documents.
      c. "Color Selection Required":
         1) Color selections for the entire project, or portion thereof, will be provided after receipt of all color charts and samples required for the Project.
      d. "Not Submitted":
         1) Additional submittal items are required that were not provided in the original submittal.

E. Architect's actions on items submitted for information:
   1. Items for which no action was taken:

a. "Not Reviewed": To notify the Contractor that the submittal has been received for record only.

END OF SECTION 013000

SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

F. Submit in PDF format.

1.02 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.03 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify work of separate phases and other logically grouped activities.

C. Identify all major milestone dates, including, but not limited to, Notice to Proceed and Architect's Initial Completion, and Owner's Final Acceptance dates.

D. Identify duration of each activity, in maximum 15 day intervals.

E. Incorporate work restrictions indicated in Section 011000 - Summary, if any.

F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.

H. Indicate procurement duration and delivery dates for long-lead time items.

I. Coordinate submittal approval process with procurement and delivery requirements. Submittals requiring resubmission or revision for approval will not be allowed as a basis for schedule impacts.

J. Indicate delivery dates for owner-furnished products and products identified under Allowances.

K. Indicate the time period for color selection activity and approval by Owner and Architect, as required per Section 013000 - Administrative Requirements.

L. Indicate date of changeover from temporary to permanent utilities.

M. Indicate time periods for Commissioning activities, equipment startup, and testing and balancing.

N. Provide a reasonable time period prior to the date of Owner's Final Acceptance for administrative activities and procedures.

O. Provide legend for symbols and abbreviations used.

3.03 NETWORK ANALYSIS (CPM)

A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.

B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.

C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity, in maximum 15 day intervals.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Latest start date.
   9. Latest finish date.
   10. Total and free float; float time shall accrue to Owner and to Owner's benefit.
   11. Percentage of activity completed.
   12. Responsibility.

D. Analysis Program: Capable of accepting revised completion dates, and recomputation of all dates and float.

E. Required Reports: List activities in sorts or groups:
   1. By preceding work item or event number from lowest to highest.
   2. By amount of float, then in order of early start.
   3. In order of latest allowable finish dates.
   4. Listing of activities on the critical path.

3.04 REVIEW AND EVALUATION OF SCHEDULE

A. Participate in joint review and evaluation of schedule with Architect at each submittal.

B. Evaluate project status to determine work behind schedule and work ahead of schedule.

C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Owner's Final Acceptance.

F. Schedule revisions shall not modify any Contract Dates or the Contract Sum, unless specifically approved and documented via Change Order.

G. Submit reports required to support recommended changes.

H. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

I. Recovery Schedule: If the Contractor is 14 or more days behind schedule, in the opinion of the Owner, the Contractor shall prepare a Recovery Schedule, incorporating a reasonable, mutually agreed upon length of time to return the Work to the approved Schedule. The Recovery Schedule shall be prepared to the same level of detail as the original construction progress schedule. Submit the recovery schedule for Owner review; do not proceed until the Owner has approved.
    1. At the end of the recovery period, Owner shall reevaluate construction progress and determine if the Recovery Schedule has been successfully completed. If completed, Owner shall direct the Contractor to proceed with the latest approved Construction Schedule.
        a. If the Contractor is still behind schedule at the end of the recovery period, the Owner shall direct the Contractor to provide additional schedule revisions to complete the recovery, or may at its option pursue other means of resolution as provided for by the Contract Documents.
    2. Need for and preparation of a Recovery Plan shall not be the basis of additional cost to the Owner or extension of Project Schedule, unless the Contractor can demonstrate that the reason for being behind schedule is no fault of their own.

3.06 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 013216

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 014200 - Definitions and Reference Standards.

1.02 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services/Delegated Design: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Design Services Types Required:
      a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
      b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.03 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary scaffolding.
   3. Temporary bracing.
   4. Temporary falsework for support of spanning or arched structures.
   5. Temporary foundation underpinning.
   6. Temporary stairs or steps required for construction access only.
   7. Temporary hoist(s) and rigging.
   8. Investigation of soil conditions and design of temporary foundations to support construction equipment.
   9. Additional temporary controls as required.

1.04 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.
   1. Submit a Request for Information to Architect if the criteria indicated are not sufficient to perform required design services.

C. Scope of Design Services/Delegated Design: As required by individual specification sections.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
   1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
      a. Full name.
      b. Professional licensure information.
      c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.

C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
   4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

D. Test Reports: After each test/inspection, require testing agency to promptly distribute digital copy of report to Architect, Owner, Contractor, and others as required.
   1. Include:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in the Project.
      g. Type of test/inspection.
      h. Date of test/inspection.
      i. Results of test/inspection.
      j. Compliance with Contract Documents.
      k. When requested by Architect, provide interpretation of results.

E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
   2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

G. Manufacturer's Field Reports:
   1. Submit report promptly to Architect for information.
   2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
   2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
   3. Qualification Statement: Provide documentation showing testing laboratory is accredited under OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).

B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

C. Contractor's Quality Control (CQC) Plan:
   1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
      a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
         1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
      b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
         1) Management and control of documents and records relating to quality.
         2) Communications.
         3) Coordination procedures.
         4) Resource management.
         5) Process control.
         6) Inspection and testing procedures and scheduling, including inspections by authorities having jurisdiction and special inspections.
         7) Control of noncomplying work.
         8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
         9) Control of testing and measuring equipment.
         10) Project materials certification.
         11) Managerial continuity and flexibility.
      c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.

1.07 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until date of Owner's Final Acceptance.

E. Should specified reference standards conflict with Contract Documents, comply with the higher quality or quantity, and provide documentation of the conflict to the Architect.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.08 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform Special Inspections and other specified testing indicated in individual specification sections.

B. Where indicated in individual specification sections, Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency: Testing agency shall comply with requirements of ASTM E 329, and shall be certified through OSHA's Nationally Recognized Testing Laboratory (NRTL) program or through the National Institute of Standards and Technology's (NIST's) National Voluntary Laboratory Accreditation Program (NVLAP).

1. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

D. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

E. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties for Contractor-employed Testing and Inspection Agencies:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   6. Perform additional tests and inspections required by Architect.
   7. Attend preconstruction meetings and progress meetings.
   8. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the Work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
3. Provide incidental labor and facilities:
a. To provide access to Work to be tested/inspected.
b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
c. To facilitate tests/inspections.
d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
7. Coordinate repairs where testing and inspection has damaged the Work.

E. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be performed by the same agency. Do not proceed with construction activities that would conceal or cover work needing re-testing or re-inspection.

F. Re-testing and/or re-inspections required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, and field quality control requirements as applicable, and to initiate instructions when necessary.

B. Provide a written report of observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions or Contract Documents. Obtain Owner's approval prior to proceeding with any modifications.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. Contractor may request to restore defective Work or portions of the Work to comply with specified requirements in lieu of replacement. Obtain Owner's approval prior to proceeding with restoration.

C. If, in the opinion of Owner, it is not practical to restore or remove and replace the work, Owner will direct an appropriate remedy or adjust payment.

END OF SECTION 014000

SECTION 014200
DEFINITIONS AND REFERENCE STANDARDS

PART 1 GENERAL

1.01 SUMMARY

A. The definitions include in this section supplement, but do not replace, the definitions contained in the General Conditions. In the event of duplication, the General Conditions shall govern.

B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

A. Furnish: To supply, deliver, unload, and inspect for damage.

B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

D. Provide: To furnish and install.

E. Supply: Same as Furnish.

F. Installer: A Contractor or other entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that specified requirements apply exclusively to tradespeople of the corresponding generic name.

G. Experienced: When used with the term "Installer," this term means having successfully completed previous work similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with the requirements of local authorities having jurisdiction.

H. Replace: Provide an acceptable like product or material in place of a missing or unacceptable (rejected) product or material. To "replace" an unacceptable product or material includes its removal and disposal.

I. Punch List: A written list of unfinished Work and defective Work resulting from inspection and testing to determine whether the Work has been accomplished. The unfinished Work and defective Work must be finished and corrected to obtain Owner's Final Acceptance, in accordance with the General Conditions.

J. Written or Printed: When used in conjunction with manufacturer's product data or installation requirements, either of these terms may be used to require compliance with manufacturer's current printed and published information.

1.03 REFERENCE STANDARDS

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified, or are required by applicable codes or local authorities having jurisdiction.

B. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 014200

SECTION 014520 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
    a. Constant-volume air systems.
    b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
    a. Variable-flow hydronic systems.
    b. Primary-secondary hydronic systems.
3. Balancing steam systems.
4. Testing, Adjusting, and Balancing Equipment:
    a. Motors.
    b. Condensing units.
    c. Heat-transfer coils.
5. Testing, adjusting, and balancing existing systems and equipment.
6. Additional Tests.
    a. Duct Leakage Testing.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation system.

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 or Architect, 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' 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 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB agent and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 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: Within 14 days of completion of balancing work, submit testing and balancing report.

G. Sample report forms.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC or NEBB. TAB provider shall be an independent company from the contractors performing the work.

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/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

D. The following information shall be submitted as part of the Quality Assurance Submittal:

1. Provide evidence of satisfactory completion of at least two projects of similar size and scope. Submit the following for each project:

a. Completed testing and balancing reports for each project.
b. If not included in the testing and balancing report, provide equipment startup checklists for each project.
c. Owner contact for each project.
d. Design engineer contact for each project.
e. Architect contact for each project.

2. The Architect shall determine whether the agent is qualified and the decision shall be final. Re-submittals on behalf of the same company shall not be considered.

E. TAB Conference: After approval of the TAB submittals, the TAB specialist shall arrange a meeting with the Owner's and the Architect's representatives to develop a mutual understanding of the details and review the TAB strategies and procedures plan. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installer, and other support personnel. Provide 14 days' notice of scheduled meeting time and location.

1. Minimum Agenda:

a. Submittal distribution requirements.
b. Contract documents examination report.
c. TAB strategies and procedures plan.
d. Work schedule and project site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.
g. Systems readiness checklists.

F. TAB Reports: Use standard forms from AABC's "National Standards for TAB" or NEBB's "Procedural Standards for TAB of Environmental Systems."

G. Instrumentation Type, Quantity, and Accuracy: As described in the "AABC National Standards for Total System Balance" or NEBB's "Procedural Standards for TAB of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

H. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.7 COORDINATION

A. Coordinate the efforts of work performed under other sections for operation of systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days' notice to the Contractor and Architect for each test. Include scheduled test dates and times.

C. Perform TAB after any required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. General Warranty: The national project performance guarantee indicated in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Guarantee: Provide a guarantee on NEBB or AABC forms stating that NEBB or AABC will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine 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.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. 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.

2. Hydronics:

    a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
    b. Piping is complete with terminals installed.
    c. Water treatment is complete.
    d. Systems are flushed, filled, and air purged.
    e. Strainers are pulled and cleaned.
    f. Control valves are functioning per the sequence of operation.
    g. Shutoff and balance valves have been verified to be 100 percent open.
    h. Pumps are started and proper rotation is verified.
    i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    j. Variable-frequency controllers' startup is complete and safeties are verified.
    k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance," ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" 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 230700 "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 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."

3.5 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 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.

3.6 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.

3.7 PROCEDURES FOR MULTIZONE SYSTEMS

A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.

B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.

C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

   a. Measure static pressure directly at the fan outlet or through the flexible connection.
   b. Measure static pressure directly at the fan inlet or through the flexible connection.
   c. Measure static pressure across each component that makes up the air-handling system.
   d. Report artificial loading of filters at the time static pressures are measured.

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 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.

E. 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.

F. 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.

G. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.

4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.
3. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

    c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

a. Measure differential pressure, and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
c. Mark final settings.

13. Verify that memory stops have been set.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first.

B. Balance the secondary circuits after the primary circuits are complete.

C. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

a. Position valves for full flow through coils.
b. Measure flow by main flow meter, if installed.
c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
c. Convert pressure to head and correct for differences in gage heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

D. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

E. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

F. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

G. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

H. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

I. Verify that memory stops have been set.

3.11 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.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.

2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.14 DUCT LEAKAGE TESTS

A. Witness the duct pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified tolerances.

C. Report deficiencies observed.

3.15 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: 0 to plus 10 percent.
2. Air Outlets: Plus or minus 10 percent.
3. Return Inlets: Plus or minus 10 percent.
4. Exhaust Inlets: 0 to plus 10 percent.
5. Heating-Water Flow Rate: Plus or minus 10 percent.
6. Cooling-Water Flow Rate: Plus or minus 10 percent.
7. Unless indicated otherwise: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.16 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 monthly 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.

3.17 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. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB 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. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

    a. Total 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.
    j. Return airflow in cfm.
    k. Outdoor-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch.
    f. Make and model number.
    g. Face area in square feet.
    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. 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.

H. 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 square feet.
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.

I. 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 square feet.

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.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.

e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

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.

3.18 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of commissioning authority.

B. Commissioning authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.19 ADDITIONAL TESTS

A. When requested, provide up to 40 hours by the technician that provided services under this Section to support commissioning.

END OF SECTION 014520

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 DEWATERING

A. Provide temporary means and methods for dewatering all temporary facilities and controls, in compliance with local authority having jurisdiction.

B. Maintain temporary facilities in operable condition.

1.02 TEMPORARY UTILITIES

A. Owner will provide the following unmetered connections:
   1. Electrical power, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

B. New permanent facilities may be used, with prior Owner authorization.
   1. Use of permanent facilities shall not impact specified warranties. Equipment shall be maintained during temporary usage.

C. Temporary Lighting: Provide temporary lighting of type and producing lighting levels necessary for proper installation of the Work.

D. Temporary Heating, Cooling, and Ventilation: Provide temporary measures and equipment as required for curing, drying, and humidity control. Comply with manufacturer's installation instructions for specific product requirements.
   1. Provide measures and equipment to meet warranty requirements of interior woodwork specified in Division 6 and/or Division 12 sections.
   2. Use of Permanent HVAC Facilities and Equipment: Use of HVAC equipment shall be subject to Owner approval.
      a. Protect new and existing HVAC equipment from intrusion of dust, silica, dirt and debris during construction operations.
      b. Cover all openings in new and existing inactive ductwork during construction operation with minimum 6 mil polyethylene sheet.
      c. Where use of existing HVAC equipment is approved by Owner, provide temporary filters with a minimum MERV of 8. Change the filters every two weeks while construction is ongoing. Provide new filters at Date of Owner's Final Inspection; do not change out temporary filter until approved by Architect.
      d. Do not perform testing and balancing of HVAC equipment until dust, silica, dirt and debris producing activities are complete.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Telephone Service: Contractor shall ensure that all of its forces, including on-site managers/supervisors of each Subcontractor, have mobile devices and adequate voice and data coverage for on-site operations

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
   1. Provide all required disposable supplies.

2. Provide handwash stations and hand sanitizer at each toilet unit.
3. Provide regular servicing of portable facilities by professional servicing company; including draining, cleaning, and disinfecting.

B. New permanent facilities may be used during construction operations.

C. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building, and for emergency egress.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

A. Barrier Mesh Fence: Provide minimum 6-foot height open-mesh polypropylene barrier fabric mounted on lumber or galvanized steel posts to isolate and define construction area and prevent accidental public access.

B. Construction: Commercial grade chain link fence.
1. Contractor may provide either fixed or portable fencing to suit conditions. For portable fencing, provide concrete or galvanized steel bases for supporting posts. Bases for portable fencing shall not obstruct sidewalks or other pathways used by pedestrians.

C. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

D. Unless otherwise indicated, provide barrier mesh fencing to enclose the approximate extent of the entire construction site. Chain link fencing shall be used to enclose Contractor's field office and laydown/storage areas, areas of the site actively in construction, and as deemed necessary by Contractor.

1.07 EXTERIOR ENCLOSURES

A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

A. Provide temporary partitions to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
1. Contractor shall repair damage to existing facilities caused by Construction operations.

B. Coordinate with Owner's security program.

C. Environmental Protection: Comply with EPA, OSHA and other regulatory requirements to prevent contamination of site, air, and public sewer/runoff.
   1. Provide additional work restrictions and protective measures as indicated on Civil/Site Drawings and as specified in Section 011000 - Summary.

1.10 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Designated existing on-site roads may be used for construction traffic.

F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.11 WASTE REMOVAL

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site periodically.

D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.
   1. Obtain and pay for any permits required for temporary signage by local authority having jurisdiction.

B. Erect on site at location(s) established by Architect.

C. Provide temporary directional signage as directed to facilitate site access for visitors and other construction personnel.

D. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

A. Field Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture and drawing display table.
   1. Provide space for Project meetings, with table and chairs to accommodate 10 persons.
   2. Provide drinking water/water cooler and a private bathroom.
   3. Maintain the following materials in the field office, available to Architect and Owner's representative at all times:
      a. A complete, up-to-date set of all Contract Documents, including FCs, RFIs, PCOs, and COs.

b. A complete, up-to-date set of all reviewed final shop drawings.
c. The most recent, up-to-date version of Contractor's Progress Schedule.

B. Locate offices a minimum distance of 30 feet from other structures.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Owner's Final Acceptance inspection.

B. Remove temporary underground installations.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rough Carpentry: 2x lumber, in length and depth required for floor to ceiling partitions. Partitions shall not be fastened to existing ceilings or flooring to remain. Provide additional bracing and concealed attachments to building structure.

B. Gypsum Board: 1/2-inch gypsum wallboard; ASTM C 1396.

C. Insulation: Mineral-wool fiber blankets; with maximum flame-spread and smoke-developed ratings of 25 and 50 when tested per ASTM E 84.

D. Polyethylene Sheet: Minimum 10 mil reinforced sheeting; achieving a passing rating when tested per NFPA 701, and a maximum flame-spread rating of 15 when tested per ASTM E 84.

E. Walk-Off Mats: Dust-, dirt- and silica-control walk-off mats at each entrance into the enclosed construction area and each entrance through temporary partitions.

F. Hardware: Provide temporary hinges, latch, and lock at doors in temporary partitions. Where doors in temporary partitions are also indicated to serve as egress, provide ADA-compliant exit device and closer.

2.02 EQUIPMENT

A. Fire Extinguishers: Provide portable UL rated extinguishers. Provide extinguisher types rated for potential classes of fire expected for construction work indicated.

PART 3 EXECUTION

3.01 ELEVATOR AND STAIR USAGE

A. Use of existing elevator(s) is not permitted.

B. Use of existing stairs is permitted. Cover existing finishes and maintain stairs without damage. Clean and restore stairs to Owner's approval by the Date of Owner's Final Acceptance inspection.

C. Use of new stairs is permitted. To prevent wear on finishes, do not install finishes on stairs until construction foot traffic can be minimized. Clean and prepare stair substrate thoroughly prior to installation of finishes. Cover finishes after installation, and clean and restore to Owner's approval at Date of Owner's Final Acceptance inspection.
1. Provide temporary stairs until new stairs are available.

3.02 PEST CONTROL

A. Provide pest-control services at regular intervals, performed in compliance with regulations of state regulations, and by a pest-control firm licensed in the state where the project is located. Any chemicals and pesticides used shall be approved by EPA and local authority having jurisdiction. Contractor's pest control plan shall ensure the facility is free of termites, roaches, rodents, and other pests at time of Owner's Final Acceptance inspection.
   1. Coordinate with Owner's Integrated Pest Management (IPM) plan where applicable.
   2. Provide Owner with a minimum 72 hours pre-notification for pest-control treatments.

3.03 TEMPORARY FIRE PROTECTION

A. Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
   1. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations" for additional provisions and conditions that are not covered by Chapter 33 of the International Fire Code.

B. Provide a fire-prevention program, review with all personnel on site, and post fire-prevention information in clearly visible area. Coordinate fire-prevention program with local fire department.

C. Provide clearly labeled portable fire extinguishers.

D. Provide fire watch in compliance with OSHA requirements during and after use of all potential ignition sources, including but not limited to, welders, grinders, cutting torches, heating and electrical equipment, and lighting.

E. Do not allow smoking in areas under construction.

3.04 MOISTURE CONTROL

A. Prevent the absorption of moisture and humidity by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Prior to building dry-in, store porous materials in a separate enclosed storage building. Keep all surfaces clear of standing water, and cover or otherwise protect all materials from water infiltration and damage. Do not enclose interior spaces until dry-in is complete and ventilation can remove excess moisture.

C. After building dry-in, provide temporary mechanical ventilation for humidity and moisture control until the building HVAC system is operational. Do not store or install material in the building until ambient temperature and humidity is within manufacturer's acceptable range. Do not install wet materials, and ensure that substrates are fully dry prior to installing other materials over them.

D. Provide continuous monitoring of installed materials. Remove gypsum board, wood products, and other mold-supporting products, if they become and remain wet for 48 hours. Remove and replace any materials showing visible signs of mold or mildew.

3.05 TEMPORARY FACILITY USAGE AND REMOVAL

A. Maintenance and Usage: Keep temporary facilities clean and in well-maintained condition for the duration of the Project. Prevent misuse of or damage to facilities by construction personnel. Make repairs to temporary facilities or replace facilities as required to keep them in good operating condition and in compliance with applicable OSHA, local permitting, and other applicable regulations.

B. Changeover: Coordinate changeover from temporary facilities to permanent facilities at Date of Owner's Final Acceptance inspection, unless an alternate arrangement for changeover has been agreed upon in writing by Owner.
   1. Contractor shall be responsible for repair, restoration, and cleaning of permanent facilities that are used for construction purposes after changeover.

C. Removal: Unless otherwise indicated, temporary facilities and controls are the property of the Contractor, and shall be removed upon Architect's approval when Contractor can demonstrate that they are no longer needed.
   1. Comply with construction waste management and recycling requirements for temporary facilities and materials that are not able to be reused.
   2. After removal of temporary facilities and controls, complete all permanent construction that was not accessible due to the presence of temporary facilities.
   3. Remove materials that have become soiled or contaminated due to construction vehicle traffic, parking, temporary field offices, oil or other chemical spillage, and other temporary usage, and replace with clean material. Complete grading, landscaping, paving, and other site improvements, and repair or restore all damage to existing or previously completed site improvements.

END OF SECTION 015000

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 011000 - Summary: Identification of Owner-supplied products.

B. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

C. Section 014000 - Quality Requirements: Product quality monitoring.

D. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.02 DEFINITIONS

A. Comparable Product: An unnamed product that is similar in quality and performance to named product(s).

B. Basis-of-Design Product: A specific product selected by the Architect for use in the design process; based on certain performance characteristics, physical qualities or details, a specialized finish type, pattern, or color, or other indicated characteristics.

1.03 WARRANTIES

A. Product warranties shall be provided in addition to and run concurrently to Contractor's general warranty/guarantee.

1. Unless otherwise indicated, all warranty terms shall start on the date of Owner's Final Acceptance.

B. Manufacturer's Warranty: A standard warranty issued by the product manufacturer, covering production and material defects.

C. Special Warranties: Warranties in addition to standard manufacturer's warranty, covering fabrication, installation, or specific performance items such as weathertightness

D. Warranty Form: Warranty shall be provided on either manufacturer's standard form or on specified form. When a sample warranty form is not included in the Project Manual, the warranty shall be on mutually agreed form.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 014000 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:
   1. Made using or containing CFC's or HCFC's.
   2. Containing lead, cadmium, or asbestos.

2.03 PRODUCT OPTIONS

A. Products Specified with a Single Named Product: Where required by Owner due to facility standards, provide the named product; no options or substitutions allowed.

B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

C. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

D. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

E. Products Specified by Naming One or More Manufacturers with a Provision for Comparable Products: Unnamed comparable product may be submitted after award of Contract. Comply with requirements in "Comparable Products" article below.

2.04 BASIS-OF-DESIGN PRODUCTS

A. Where a product is specified by naming a Basis-of-Design, comply with the following:
   1. Where a list of additional manufacturers is provided, provide the Basis-of-Design product or a comparable product by one of the listed manufacturers, in compliance with "Comparable Products" article below.
   2. Basis-of-Design characteristics shall include requirements in the Specifications and on the Drawings.
   3. Where the Basis-of-Design lists a specific finish, manufacturers wishing to submit as a Comparable Product or as a substitution shall certify that they are able to provide an exact match to the specified finish, or that they will provide a custom finish to match.

2.05 COMPARABLE PRODUCTS

A. Where a product is specified with a provision for comparable products, Contractors submitting a Comparable Product shall comply with the following:
   1. The submitted product shall not require changes to the Work, unless specifically approved by Architect. If changes are required, the Contractor shall resubmit the product as a substitution request, and the Contractor shall bear the cost of the changes, coordinate with other impacted contractors, and provide appropriate notations on record documents.
   2. Contractor shall provide, with the submittal, a detailed breakdown comparing the submitted product to at least one of the other listed products; list specified performance qualities, test results, dimensions, finish, and other critical properties.
   3. Contractor shall provide warranty data indicating that submitted Comparable Product complies with indicated warranty term(s).

B. Comparable product submittals are subject to Architect's final approval. If a proposed product is found to be unacceptable, Contractor shall revert to one of the named products.

2.06 COLOR/FINISH OPTIONS

A. Preselected Color/Finish: Where a specific manufacturer's premium or custom finish or color is indicated as the basis-of-design, other listed manufacturers shall certify that they can provide an exact match, or that they will provide pricing under the assumption that a custom finish or color will be required.

B. Color/Finish Selection: Unless specifically indicated to either be a custom color or to be selected from manufacturer's standard range, color and finish selections shall be made from manufacturer's full range of options, including premiums, metallics, wood grains, etc.

2.07 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to location designated by Owner; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 012500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. See Section 011000 - Summary for identification of Owner-supplied products.

B. Owner's Responsibilities:

1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
2. Arrange and pay for product delivery to site.
3. On delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:

1. Review Owner reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.

1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

G. For exterior storage of fabricated products, place on sloped supports above ground.

H. Provide off-site storage and protection when site does not permit on-site storage or protection.

I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

J. Comply with manufacturer's warranty conditions, if any.

K. Do not store products directly on the ground.

L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

M. Prevent contact with material that may cause corrosion, discoloration, or staining.

N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

O. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 016000

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.

C. Project Record Documents: Accurately record actual locations of capped and active utilities.

D. Hazardous Materials Disclosure Inventory Statement: Provide inventory of materials that may be considered hazardous, formatted in accordance with Table 307.1 of the North Carolina Building Code (materials include but not limited to generator fuel, batteries for UPS systems, aerosols, etc) for permanently installed construction.Materials shall be identified as solid, liquid, or gas, and shall be identified in pounds, gallons, or cubic feet. Provide breakdown of amounts used and if they are used in an open or closed system. Identify Control area for each material.

1.02 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.03 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Perform dewatering activities, as required, for the duration of the project.

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

F. Dust and Silica Control: Execute work by methods to minimize raising dust and silica from construction operations. Provide positive means to prevent air-borne dust and silica from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust and silica that is generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.

3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

K. Hazardous Materials: Do not use materials or products that contain hazardous substances, for permanently installed products and materials, installation materials, or for cleaning or other construction use.
1. Where it is unavoidable to install materials that may be considered hazardous, per Table 307.1 of the North Carolina Building Code, maintain an inventory of such materials that will be present in the finished work, and submit for Owner's recordkeeping.

1.04 COORDINATION

A. See Section 011000 for occupancy-related requirements.

B. 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.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new 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.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated 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.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Contractor shall locate and protect survey control and reference points.

D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

G. Utilize recognized engineering survey practices.

H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
2. Grid or axis for structures.
3. Building foundation, column locations, ground floor elevations.

J. Periodically verify layouts by same means.

K. Maintain a complete and accurate log of control and survey work as it progresses.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Fire Safety: Comply with provisions of 2018 International Fire Code, Chapter 33; "Fire Safety During Construction and Demolition" for preventing damage to structures under construction.
   1. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.

B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 CUTTING AND PATCHING

A. Perform cutting and patching to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.

C. Employ skilled and experienced installer to perform cutting and patching.

D. Restore work with new products in accordance with requirements of Contract Documents.

E. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to maintain existing fire ratings, to full thickness of the penetrated element.

G. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

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

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust and silica.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from landscaped areas.

I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP AND ADJUSTING

A. Coordinate with requirements of Division 01 Section "General Commissioning Requirements."

B. Coordinate schedule for start-up of various equipment and systems.

C. Notify Architect and Owner seven days prior to start-up of each item.

D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

F. Verify that wiring and support components for equipment are complete and tested.

G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

I. Adjust operating products and equipment to ensure smooth and unhindered operation.

J. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. See Section 017900 - Demonstration and Training.

3.10 FINAL CLEANING

A. Execute final cleaning prior to Owner's Final Acceptance inspection.

1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Replace filters of operating equipment.

G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.

H. Clean site; sweep paved areas, rake clean landscaped surfaces.

I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.11 CLOSEOUT PROCEDURES

A. Closeout Schedule: Verify tentative closeout schedule with Owner and Architect at Preconstruction Meeting and confirm and coordinate closeout schedule and procedures at Closeout Meeting. Refer to Division 01 Section "Administrative Requirements."
   1. Coordinate all closeout procedures with Article 25 of the North Carolina State Construction Office (SCO) General Conditions.
   2. Verify anticipated date of Owner's Final Acceptance established by the Contract Documents, and date upon which liquidated damages begin to accumulate.
   3. The Contractor shall allow for at least two weeks lead time for Owner's (SCO's) Final Acceptance Inspection from the date that the request is made to the SCO by the Architect.
   4. The Contractor and Architect shall coordinate date of Architect's Final Inspection, however, the Contractor shall be fully responsible for ensuring there is enough time between Architect's Final Inspection and Owner's Final Acceptance inspection for completion of all required closeout items, including inspection lead time.

B. Prior to Architect's Final inspection, complete the following:
   1. Provide startup, testing, and adjusting of all systems and equipment.
      a. Demonstrate that air and water systems are balanced and that automatic temperature control system is in control of all equipment. This may require separate demonstrations if controls cannot be tested for applicable seasons of the year.
      b. Submit written certification that testing/adjusting/balancing operations have been completed, and that systems are operation and under control in conformance with applicable specification section(s).
      c. Submit written certification that all Building Commissioning has been completed.
      d. Complete testing of the electronic security systems and equipment, demonstrating security control.
   2. Provide all inspections required by local authorities having jurisdiction to obtain Certificate of Occupancy, and provide written certification of completion of Special Inspections.
   3. Provide preventive maintenance services for all equipment used prior to Owner's Final Acceptance inspection, and provide initial maintenance servicing for all products and equipment that will be subject to ongoing maintenance/service contracts.
   4. Provide final cleaning of all products, materials, and equipment, and provide touch up and restoration of exposed materials and finishes.
   5. Provide fresh batteries in all battery-powered products and equipment.

6. Provide demonstration and training for Owner's personnel on all required systems and equipment.
7. Coordinate a walkthrough with the Owner and the local fire department and other emergency services.
8. To the maximum extent possible, remove temporary facilities and controls, construction equipment and tools, and similar items that are not part of the finished Work.
9. Coordinate changeover with the Owner of permanent utilities, insurance requirements, and building's permanent keying and lock system.

C. Notify Architect when work is considered ready for Architect's Final inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Final Completion inspection.

E. Conduct Architect's Final Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Notify Architect when work is considered finally complete and ready for Owner's Final Acceptance inspection.

G. Prior to Owner's Final Acceptance inspection, complete the following:
1. Complete items of work determined by Architect, as listed in Final Correction Punch List.
2. Remove any remaining construction equipment, tools, and materials; perform additional cleaning required due to construction activities following Architect's Final inspection, and leave the site prepared for Owner occupancy.

H. The Owner shall occupy the building after the Owner's Final Acceptance inspection.

I. Prior to final payment and project closeout, complete the following:
1. Provide final pest and rodent control treatments and inspections.
2. Submit final demonstration and training materials and videos, as built/record documents, operation and maintenance binders, and warranty binders.
3. Submit final application for payment.

3.12 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.
1. Contractor's maintenance responsibility shall be through Owner's Final Acceptance, unless a longer term is required by individual specification section.

B. Maintenance service shall not be assigned or transferred to any agent or third party without prior written consent of the Owner.

END OF SECTION 017000

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

E. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.

F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.
   1. Fire Safety: Comply with International Fire Code, Chapter 33 "Fire Safety During Construction and Demolition" and with NFPA 241 for provisions relating to accumulation and removal of combustible debris and waste.

1.02 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.

1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
2. Submit Report on a form acceptable to Owner.
3. Landfill Disposal: Include the following information:
    a. Identification of material.
    b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
    c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
    d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
4. Incinerator Disposal: Include the following information:
    a. Identification of material.
    b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
    c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
    d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
    a. Identification of material, including those retrieved by installer for use on other projects.
    b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
    a. Identification of material and how it was used in the project.

b. Amount, in tons or cubic yards.
c. Include weight tickets as evidence of quantity.

7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to Contractor's site superintendent, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
1. Prebid meeting.
2. Preconstruction meeting.
3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
1. Provide containers as required.
2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION 017419

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Submittal procedures, shop drawings, product data, and samples.

B. Individual Product Sections: Specific requirements for operation and maintenance data.

C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect within 15 days after the date of Owner's Final Acceptance.

B. Operation and Maintenance Data:

1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within 15 days after acceptance.
2. Submit one PDF draft copy of completed documents within 15 days after the Closeout Conference. This copy will be reviewed and returned, with Architect comments. Revise content of all document sets as required prior to final submission.
3. After revisions are complete, submit one bound hard copy and PDF electronic file of revised final documents in final form within 15 days after Date of Owner's Final Acceptance.

C. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 15 days after acceptance.
2. Make other submittals within 15 days after Date of Owner's Final Acceptance, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Owner's Final Acceptance, submit within 15 days after acceptance.
4. All warranties shall list the date of Owner's Final Acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Addenda.
3. Change Orders and other modifications to the Contract.

4. Miscellaneous record submittals.

B. Ensure entries are complete and accurate, enabling future reference by Owner.
   1. Include revised Drawings reissued during Bidding and Construction.

C. Store record documents separate from documents used for construction.
   1. Keep record documents in a location accessible to Architect for periodic review and reference.
   2. Maintain in legible condition. If record document set becomes damaged or excessively dirty, transfer comments to clean set prior to submittal to Architect.

D. Record information concurrent with construction progress.

E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

F. Miscellaneous Record Submittals: Where other specification sections require completion certifications, or closeout or record submittals, submit in a single binder organized by specification section.

3.02 ASSEMBLY OF RECORD DOCUMENTS

A. Submittal for Architect's Review:
   1. Submit PDF scanned copy of marked up prints.
   2. Architect shall review and provide comment on completeness

B. Submittal for Distribution to Owner:
   1. After Architect has approved for content and completeness, submit PDF scanned copy of final marked up prints, and submit hard copy originals.
   2. Submit full set of Drawings, regardless of whether any modification or markings are on each sheet.

3.03 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.04 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and

recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

3.06 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder on front and spine with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties and bonds.

3.07 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 15 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Final Completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Retain warranties and bonds until time specified for submittal.

D. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.

E. Cover: Identify each binder on front and spine with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

F. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

G. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible

principal.

H. Provide photocopy of each warranty in operation and maintenance manuals; locate each warranty with applicable O&M data for product or equipment.

END OF SECTION 017800

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products, systems, equipment, and other items where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance of products, systems, equipment, and as otherwise indicated in specific specification sections.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures; except:

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit not less than four weeks prior to start of training.
   2. Revise and resubmit until acceptable.
   3. Provide an overall schedule showing all training sessions.
   4. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such as slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Training Reports:
   1. Identification of each training session, date, time, and duration.
   2. Sign-in sheet showing names and job titles of attendees.
   3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.
   2. Label each disc and container with session identification and date.
   3. Where available, provide manufacturer's pre-produced training videos in conjunction with live demonstration and training video.

1.03 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Instructor shall be certified by the manufacturer or fabricator of system.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable, and if acceptable to Owner.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Complete demonstrations within two weeks after the date of Owner's Final Acceptance.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Complete demonstrations within two weeks after the date of Owner's Final Acceptance.

3.02 TRAINING - GENERAL

A. Conduct training on-site, utilizing installed products and equipment, unless otherwise indicated.

B. Provide training in minimum two hour segments.

C. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

D. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   2. Typical uses of the O&M manuals.

E. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.

4. Discuss cleaning products and procedures, including recommended cleaning products and products that are detrimental to equipment operation or finishes.
5. Provide hands-on training on all operational modes possible and preventive maintenance.
6. Emphasize safe and proper operating requirements; discuss relevant health and safety issues, warning or error indications, and emergency procedures and shutdown.
7. Discuss common troubleshooting problems and solutions. Include minor adjustments for resolving noise, vibration, and improving system efficiency.
8. Discuss any peculiarities of equipment installation or operation.
9. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage. Include discussion of continuing maintenance agreements and procedures.
10. Review recommended tools and spare parts inventory suggestions of manufacturers.
11. Review spare parts and tools required to be furnished by Contractor.
12. Review spare parts suppliers and sources and procurement procedures.

F. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 017900

SECTION 018119
INDOOR AIR QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Provide Indoor Air Quality (IAQ) Management Plan to remain in force during the construction period.

B. Chapter 3 of the Sheet Metal and Air Conditioning National Contractors' Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2nd Edition 2007, available from SMACNA (703-803-2980 or www.smacna.org).

1.02 SUBMITTAL

A. Construction Indoor Air Quality Management Plan (CIAQM Plan).

PART 2 OBJECTIVES DURING CONSTRUCTION

2.01 PROTECTION

A. Store all materials and equipment in a protected area (inside warehouse or storage trailer). Protect materials and equipment that are too large or heavy to store in a trailer from water and dirt/dust/debris.
   1. OPTION: When stored outside, provide two layers of minimum 8-mil poly on the ground and elevate equipment or material a minimum of 4 inches to allow water to run off. Secure top and sides with two layers of 8-mil poly to prevent water penetration and dust/dirt accumulation.

B. Protect HVAC equipment from dust and odors. Do not store equipment in areas near painting, pressure washing, or excavation. Do not operate equipment during cutting or grinding of masonry or concrete.
   1. Refer to Division 23 for construction filter requirements for protection of mechanical duct systems during construction.
   2. Clean ductwork when installed. Cap ends with poly during construction to prevent contamination.
   3. Do not operate HVAC system until the exterior walls, roof, glass, doors and building filters are properly installed.
   4. If air handlers must be used during construction, provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 at each air-handling unit. Provide specified prefilters and final filters for operation during construction or install temporary 4-inch MERV 8 filters at each return air grille for operation during construction.
   5. Replace all filtration media immediately prior to Owner's Final Acceptance inspection.
      a. Filtration media installed in air-handling units shall have a Minimum Efficiency Reporting Value (MERV) of 8.
   6. Do not perform Testing and Balancing until dust or odor generating activities are completed.

2.02 SOURCE CONTROL

A. Minimize IAQ contaminants introduced by construction materials.

B. Store waste construction materials a minimum of 30 feet away from the building.

C. Do not smoke within 30 feet of the exterior building perimeter.

2.03 PATHWAY INTERRUPTION

A. Provide barriers to contain construction areas to allow a portion of the building to be cleaned and then operate the HVAC system in that cleaned area. Acceptable barriers include dust curtains and temporary walls.
   1. Protect areas of the building in which HVAC is operational by physical barriers from areas of the building not acceptable for operation of the HVAC system.

B. Maintain areas within 30 feet of outdoor air intakes free of dust, dirt, debris, and volatile materials while the HVAC system is in operation.

2.04 HOUSEKEEPING

A. As dust accumulates at the Site, it can become airborne when disturbed by nearby activity. Similarly, spills or excess applications of products containing solvents will increase odors at the Site. Leaving the Site wet or damp for more than a day could result in the growth of mold and bacteria. Therefore, Site cleanup and maintenance is important to maintaining good IAQ during construction.

B. Perform the following to control contaminants at the Site:
   1. Suppress dust with wetting agents or sweeping compounds
   2. Provide an efficient dust collection method (e.g. a damp rag, wet mop, or vacuum equipped with a high efficiency particulate arrester (HEPA) filter or wet scrubber).
   3. Remove spills or excess applications of solvent-containing products immediately. Provide low-VOC emitting spot removers and cleaning agents near occupied areas.
   4. Remove accumulated water and keep work areas as dry as possible, including the use of dehumidification, if necessary.
   5. Once building is enclosed, vacuum with HEPA filtered vacuum cleaners to prevent settled dust from becoming airborne again.
   6. Protect porous materials from exposure to moisture. Replace items that remain damp for more than four hours.

END OF SECTION 018119

SECTION 019113 – COMMISSIONING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 220800 – Commissioning of Plumbing Systems

C. Section 230800 – Commissioning of HVAC Systems

D. Section 260800 – Commissioning of Electrical Systems

E. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.

B. The purpose of the construction phase commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design intent. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team in cooperation with the Owner, Design Professionals, Construction Manager or General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

1.3 DEFINITIONS

A. Commissioning Agent: The Commissioning Agent is a third-party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).

B. Commissioning Team: The Commissioning Team is the group of individuals selected by each company to represent that company for direct involvement in the commissioning activities during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to, Commissioning Agent, Owner, Architect, System Design Professionals, Construction Manager or General Contractor, and all Sub-Contracting Companies.

C. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or venders who are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 01650 Section 1.5 - Systems to be Included in Commissioning. Contracting parties outside of the scope of the systems being commissioned are not included.

D. Functional Performance Test (FPT): Functional Performance Tests are system verification tests written by the Commissioning Agent and performed by the Contractor(s). The FPT's are an integral part of Commissioning and must be completed prior to System Acceptance.

E. Pre-Functional Checklist (PFC): Pre-Functional Checklists are installation checklists prepared by the Commissioning Agent and filled out (completed) by the Contractor(s). The PFC's are an integral part of Commissioning and must be completed prior to beginning Functional Performance Testing.

F. Pre-Verification Testing (PVT): Pre-Verification Testing is the process of pre-testing systems by the installing Contractors to ensure they operate completely. Functional Performance Tests are made available for the installing Contractors to use in performing PVT's. PVT's and FPT's follow the same test protocols and parameters.

G. Subcontractor(s): The term Subcontractors utilized herein refers to the any and all subcontracting companies or venders who are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 01650 Section 1.5 - Systems to be Included in Commissioning. Subcontracting parties outside of the scope of the systems being commissioned are not included.

H. System Design Professional(s): The System Design Professional(s) are the designers and design firm representatives for the systems being commissioned. There is a representative for each discipline including but not limited to: mechanical, electrical, plumbing, telecommunications, security, and building envelope.

1.4 ROLES AND RESPONSIBILITIES

A. Owner

1. The commissioning roles and responsibilities of the Owner are outlined within the Commissioning Plan. The Owner is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.

2. The Owner shall reserve the right to review, approve or reject Commissioning Forms and their completion by the various Contractors. It is in the Owner's best interest to verify that the forms being utilized are appropriate and being utilized effectively for their own benefit.

B. Commissioning Agent

1. The commissioning roles and responsibilities of the Commissioning Agent are outlined within the Commissioning Plan. The Commissioning Agent is not contractually obligated to complete any tasks defined within the Commissioning Specifications. Rather, the Specifications identify the Commissioning Agent's roles for informational purposes only.

2. Host the Commissioning Kick-Off Meeting. The Commissioning Agent will prepare the agenda for this meeting. The meeting will generally review the Draft Commissioning Plan and these specifications. The intent of the meeting is to clarify the specific Commissioning Process to be applied to this project. Furthermore, the Cx Kick-Off Meeting shall serve to establish project specific protocols such as the submittal review process and submittal routing.

3. Prepare the Commissioning Plan. The Commissioning Agent will prepare a Draft Commissioning Plan and present it to the Commissioning Team. After team reviews, the Commissioning Plan will be finalized and re-issued.

4. Coordinate the integration of Commissioning Activities into the Construction Schedule.

5. Review submittals associated with systems to be commissioned (e.g., equipment, ductwork, piping, automatic controls, and TAB procedures, etc.) for their effect on the commissioning process and the final performance of the HVAC system.

6. The Commissioning Agent shall receive a copy of all controls submittals from the Contractor(s). The Commissioning Agent shall perform an explicit review of these submittals to verify their compliance with the design sequence of events and Owner's Project Requirements.

7. The Commissioning Agent shall provide installation checklists entitled Pre-Functional Checklists (PFC's) for use and completion by the installing Contractor(s). The Commissioning Agent will develop the PFC's in an online database driven web application called Facility Grid.

   [The Commissioning Agent shall host Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning Activities increase. Meetings often begin when the Systems Being Commissioned begin to be installed. Meetings are often held monthly until these systems are prepared for Functional Performance Testing.

8. Attend select Coordination Meetings, aside from Commissioning Meetings, held between the Owner, System Design Professional(s), and Contractor(s).

9. The Commissioning Agent shall conduct periodic inspections of work in progress. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

10. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing duct leakage test procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

11. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing pipe pressure test procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

12. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing pipe cleaning and flushing procedures. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

13. The Commissioning Agent shall perform select site visits for the explicit purpose of witnessing equipment start-up. The Commissioning Agent shall generate and distribute a Site Visit Report documenting their observations. All issues and discrepancies found during these visits shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.

14. The Commissioning Agent shall provide detailed system verification test protocols entitled Functional Performance Tests (FPT's). These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent. The test protocols may include test criteria not specifically identified in the system design or sequence but are inherently required for correct operation. The Commissioning Agent will develop the FPT's in an online database driven web application called Facility Grid.

15. Upon receipt of notification from the System Design Professional(s) that the mechanical systems are complete and the Final TAB Report is approved, the Commissioning Agent shall proceed to witness verification of the approved Final TAB Report for compliance with the TAB Specifications. The Commissioning Agent shall recommend acceptance of the Final Test, Adjustment and Balance Report.

16. The Commissioning Agent shall review the Pre-Functional Checklists (PFC's) for completion and accuracy. The PFC's must be reviewed and approved for a select system prior to the Commissioning Agent witnessing that system FPT. PFC's are maintained and managed in an online data-base driven software package called Facility Grid.

17. The Commissioning Agent shall oversee Functional Performance Testing which shall be performed by the installing Contractors. The witnessing of Functional Testing by the Commissioning Agent is system verification and intended to confirm all Functional Checklist Items pass. The Commissioning Agent is not required to witness initial testing or troubleshooting of the system to identify the Functional Checklist Items that will not pass. Initial testing is to be conducted by the installing Contractors and is referred to as Pre-Verification Testing (PVT.) The Commissioning Agent is not scoped to witness any Functional Testing a second time if the test should not pass the initial attempt. Rather, the test shall be documented as failed. The Commissioning Agent may witness repeated, failed Functional Testing at their discretion, the cost of which shall not be borne by the Owner but shall be billed to the responsible Contractor.

    All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent. The Commissioning Issues Log is maintained in a database driven software package called Facility Grid.

18. Recommend to the Owner acceptance or non-acceptance of the individual Systems to be Commissioned upon completion of project commissioning.

19. The Commissioning Agent shall oversee Seasonal Testing which shall be performed by the installing Contractors. Seasonal Testing shall follow the same protocols and procedures as Functional Performance Tests (FPT) and shall be documented in the same manner.

20. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

C. System Design Professional(s)

1. The commissioning roles and responsibilities of the System Design Professional(s) are outlined within the Commissioning Plan. The System Design Professional(s) is not contractually obligated to complete any tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are highly recommended for the successful completion of Commissioning.

2. The commissioning roles and responsibilities outlined within the Commissioning Plan do not supersede any contractual requirements between the Owner and the Systems Design Professional(s), nor do they relieve the Systems Design Professional(s) of any Designer or Construction Administrator responsibilities.

D. Construction Manager / General Contractor

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.

2. Include commissioning requirements in the mechanical, electrical, plumbing, telecommunications, security and building envelope subcontracts, and all other subcontracts relating to the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems to be Included in Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.

3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.

4. Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section 2.1 – Project Schedule. Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.

5. Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section 2.3 – Submittals. Coordinate submittal review procedures with System Design Professionals and Commissioning Agent.

6. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.

7. Provide all Commissioning Team Member contact information to the Commissioning Agent. All Commissioning Team Members shall require access to RMF's online Commissioning Database Facility Grid.

8. Provide a representative to regularly attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.

9. Coordinate all scheduled commissioning activities with the Commissioning Agent. Maintain an updated schedule listing all Commissioning Activities. Notify the Commissioning Team a minimum of two (2) weeks for any and all upcoming Commissioning Activities. These activities include but are not limited to: Duct Leakage Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, System Start-up, Equipment Start-up, Completion of Pre-Functional Checklists, Hydronic Test and Balance, Air Test and Balance, Readiness for Functional Performance Testing and System Completion. Lack of adequate notification may result in repetition of any Commissioning Activity required to be witnessed by any specific member of the Commissioning Team.

10. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.

11. Manage completion of all PFC's. Verify all PFC's and PVT's are completed by the installing Contractors. Check and Sign all completed PFC's through Facility Grid and notify the Commissioning Agent of their completion. The CM shall be responsible to verify all sub-contractors complete each checklist item for which they are responsible. The CM may complete any outstanding checklist items which have not been completed by the sub-contractors, understanding that by checking and initialing any blank item, the CM accepts responsibility for the truthful state of that installation item.

12. Confirm all associated Quality Control and Start-Up Documentation is complete and uploaded to Facility Grid as required by the Contract Documents and as identified by the associated PFC.

13. Manage completion of Pre-Verification Testing (PVT) by the installing Contractors. Notify the Commissioning Agent that systems have been pre-tested and are ready for final witnessing of Functional Performance Tests.

14. Manage and coordinate all Functional Performance Testing with the Commissioning Team. Notify the team of system readiness. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs. Ensure their participation. Absence of the required participants necessary for system demonstration during Functional Testing may be adequate reason for declaring test failures due to lack of ability to test.

15. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

E. Subcontractors

1. This section applies to all installing Contractors, Subcontractors, Vendors, Start-Up Representatives, 3rd Party Test Agencies or any other party contracted to perform tasks associated with the Systems being Commissioned.

2. In addition to these requirements and responsibilities, some Subcontractor responsibilities are outlined within respective Commissioning Specification Sections:

   a. Plumbing Subcontractor responsibilities are outlined in Section 220800 – Commissioning of Plumbing Systems.

   b. Mechanical Subcontractor responsibilities are outlined in Section 230800 – Commissioning of HVAC Systems.

   c. Electrical Subcontractor responsibilities are outlined in Section 260800 – Commissioning of Electrical Systems.

3. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents.

4. Provide all Commissioning Team Member contact information to the Commissioning Agent. All Commissioning Team Members shall require access to RMF's online Commissioning Database Facility Grid.

5. Provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.

6. Provide schedule updates to the Commissioning Team with regard to all Commissioning Tasks and Activities. Notify the Commissioning Team a minimum of two (2) weeks for any and all upcoming Commissioning Activities. These activities include but are not limited to: Duct Leakage Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, System Start-up, Equipment Start-up, Completion of Pre-Functional Checklists, Hydronic Test and Balance, Air Test and Balance, Readiness for Functional Performance Testing and System Completion.

7. Complete and check-off all responsible checklist items on the Pre-Functional Checklists (PFC). Verify completion of all responsible checklist items through the online Commissioning Software Facility Grid. Each Contractor is responsible for completing and checking-off all Pre-Functional Checklist items for which their sub-contractors, vendors, start-up technicians or any other 3rd party test agencies are responsible. It is at the discretion of each Contractor to have their sub-contractor check-off items for which their sub-contractor is responsible, or to check it themselves.

8. Confirm all associated Quality Control and Start-Up Documentation is complete and uploaded to Facility Grid as required by the Contract Documents and as identified by the associated PFC.

9. Complete and check-off all responsible checklist items on the Pre-Verification Tests (PVT) via Facility Grid. Verify correct operation of all responsible systems via PVTs which match the Functional Test scripts in preparation of the Functional Performance Testing to be witnessed by the Commissioning Agent. The Contractors and Sub-Contractors are responsible for ensuring system readiness and correct operation prior to CxA Verification.

10. Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics and Functional Performance Test results.

11. Schedule and conduct all Functional Performance Testing with the Commissioning Team. Notify the team of system readiness. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs. Ensure their participation. Absence of the required participants necessary for system demonstration during Functional Testing may be adequate reason for declaring test failures due to lack of ability to test.

12. Schedule and conduct Seasonal Testing as outlined in the Functional Performance Tests. Manage all Contractors and Subcontractors responsible for demonstrating system FPTs and ensure their participation similar to initial Functional Performance Testing.

13. The Commissioning Agent shall not have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by any Contractor(s) without such written approval shall be the responsibility of that Contractor(s).

1.5 SYSTEMS TO BE INCLUDED IN COMMISSIONING

A. For the systems listed, all requirements specified within the Commissioning Specifications Sections 019113, 220800, 230800, 260800 shall apply including but not limited to:

1. All system related documentation shall be tracked within forms provided by the Commissioning Agent.

2. All required equipment and component submittals shall be copied to the Commissioning Agent per Specification 019113 Section 2.3 – Submittals.

3. All system related documentation shall be copied by the Contractor and provided to the Commissioning Agent for inclusion into the Commissioning Record Documents. Facility Grid is to be utilized for Document Uploads.

4. All systems shall be inspected by the Commissioning Agent while under construction and all issues discovered by the Commissioning Agent shall be corrected or otherwise addressed by the contractors.

5. All systems shall have Pre-Functional Checklists and Functional Performance Tests provided by the Commissioning Agent and completed by the Contractor(s) as per Specification 091113 Sections 2.4 – Pre-Functional Checklists and 2.6 – Functional Performance Tests.

B. The following systems shall be commissioned. System No. is for Commissioning Reference Only and does NOT link or tie to a specific specification number.

System No.	System	Associated Equipment & Description
Plumbing Systems		
221119	Domestic Water Piping Specialities	BFP, RPZ, Pressure Regulators, Associated Controls
221319	Sanitary Waste Piping Specialties	Drains, Piping, etc.
223300	Electric Water Heaters	Electric Heaters, Controls
Refrigeration		
232123	Hydronic Pumps	Secondary Circulation Pumps, Piping, VFD's, Associated Controls
Exhaust Systems		
233423	HVAC Power Ventilators	Exhaust Fans, Ductwork, VFD's, Associated Controls
Terminal Equipment		

System No.	System	Associated Equipment & Description
233600	Air Terminal Units	Terminal Units used to support Central AHU's, and Exhaust Systems, Reheat Coils, Ductwork, & Associated Controls
238126	Ductless Mini-Split Air Conditioning Units	AC units used to support local climate conditions, Associated Controls
238219	Fan Coil Units	Fan Coils Units, Associated Controls
Central Station AHU's		
237313	Modular Central Station Air Handling Units	Modular AHU's, Supply & Return Fans, VFD's, Ductwork, & Associated Controls
Packaged Air Conditioning Systems		
238126	Ductless Mini-Split Air Conditioning Units	Split A/C Systems, Variable Refrigerant Systems, Ductwork, Piping & Associated Controls, etc.
Process Systems		
232113	Hydronic Piping	Pumps, Piping, Associated Controls
Instrumentation & Controls		
230900	Building Automation System	Overall Control System Test to verify the interconnected systems are integrated together properly and proper graphics are displayed, Verify Sequences, GUI, Etc.
Electrical Systems		
261219, 262416	Pad mounted, liquid-filled, medium voltage transformers, Panelboards	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, etc.
262726	Wiring Devices	Transformers, Switchboards, Switchgear, MCC's, Circuit Breakers, Panel Boards, Conductors, Termination Devices, Load Break Elbows, Splice Kits, Power Generators, Paralleling Switchgear, ATS, etc.
Lighting Controls		
260923	Lighting Control Devices	Switches, Light Sensors, Occupancy Sensors
265119	LED Interior Lighting	Fixtures

1.6 COORDINATION

A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager and/or General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.

B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.

C. Task required to be coordinated with the Commissioning Team include but are not limited to:

1. Submittal Review
2. Quality Control Tests
3. System and Equipment Start-Up
4. Pre-Functional Checklist Completion
5. Functional Performance Testing
6. Training and Orientation
7. Close-Out Document Review (O&M's, As-Builts, Warranties)

D. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include: System Start-up, Duct Pressure Tests, Pipe Pressure Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.

E. The Commissioning Authorities primary responsibility is to the Owner, and as such, shall regularly apprise the Contractor and the Owner of progress, pending problems and/or disputes, and shall provide regular status updates on progress with each system.

1.7 SCHEDULE

A. Construction Manager and/or General Contractor is ultimately responsible for the Project Schedule. Commissioning Tasks are to be identified within the Project Schedule. The following Commissioning Tasks are to be identified within the Master Project Schedule for each individual System to be Commissioned as listed in section 019113-1.5:

1. Submittal Review
2. Quality Control Tests

3. System and Equipment Start-Up

4. Test, Adjustment and Balance (TAB)

5. Pre-Functional Checklist Completion

6. Functional Performance Testing

7. Training and Orientation

B. Schedule activities must also include overall construction milestones that effect the Systems being Commissioned but are not defined by them including Architectural Milestones such as Building Dry-In and Ceiling Closures.

C. All Commissioning Tasks are to be conducted or completed by Contractors or their Sub-Contractors and witnessed by the Owner, System Design Professional or Commissioning Agent. Therefore, it is up to the Contractors to schedule and maintain schedule of these activities. The Commissioning Agent shall assist by providing commissioning scheduling information and background to the Construction Manager or General Contractor for incorporation into the Overall Master Schedule.

D. All Commissioning activities which require the presence of the Commissioning Agent shall be scheduled such that the Commissioning Agent is made aware of the required site visit with a minimum of two weeks (14 calendar days) notice.

E. Commissioning Issues shall not be a cause for delay or project schedule extension.

F. Pre-Functional Checklists and Quality Control Tests are a pre-requisite for beginning Functional Performance Tests. These must be complete and submitted to the Commissioning Agent for review prior to any witnessing of FPTs. All pre-requisites are required to be provided with a standard review period (typically 14 calendar days) by the Commissioning Agent prior to Functional Performance Testing.

G. Functional Performance Testing is a pre-requisite to Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 PROJECT SCHEDULE

A. Contractor(s) shall submit two copies of a complete project schedule to the Commissioning Agent within 60 days of the Contractor's Notice to Proceed.

B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule per section 019113-1.7 - Schedule

C. The Contractor(s) must submit updated schedules on a monthly basis to indicate tasks, milestones and final completion have not moved unless the contractual end date has been formally changed.

2.2 SCHEDULE OF VALUES

A. The Contractor(s) shall include within the Schedule of Values, specific line items to reflect Commissioning progress. For each system to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, a line item shall be listed in the Schedule of Values for the following:

1. Pre-Functional Checklist

2. System Start-Up

3. Functional Performance Test

4. Equipment/System Training

B. The Contractor(s) shall submit two copies of the Schedule of Values to the Commissioning Agent for review. The Commissioning Agent shall review and comment on line items relevant to commissioning and systems to be commissioned. Any comments by the Commissioning Agent will be forwarded to the System Design Professional(s) for review and inclusion.

2.3 PRODUCT SUBMITTALS

A. Contractor(s) shall submit two copies of all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within specification section 019113-1.5. Any comments by the Commissioning Agent will be forwarded to the Commissioning Team for review and inclusion. Exact submittal and review comment routing to be determined by the Commissioning Team and documented in the Commissioning Plan.

B. Manufacturer's Product Data: The Contractor(s) shall provide to the Commissioning Agent all product data as required within each individual specification section.

2.4 COORDINATION DRAWINGS

A. Coordination Drawings: The Contractor(s) shall provide to the Commissioning Agent all Coordination Drawings as required within each individual specification section.

2.5 INSTALLATION INSTRUCTIONS

A. Manufacturer's Installation Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of installation instructions for every piece of equipment and accessory included as part of a commissioned system.

2.6 CALIBRATION INSTRUCTIONS

A. Manufacturer's Controls Calibration Instructions: The Contractor(s) shall provide to the Commissioning Agent a minimum of one copy of calibration instructions for each type of control device to be installed. Submit only control device calibration instructions for devices which have been approved by the System Design Professional(s).

2.7 PRE-FUNCTIONAL CHECKLISTS

A. Pre-Functional Checklists (PFC) shall be issued by the Commissioning Agent to the Commissioning Team via electronic website database called Facility Grid. PFC's shall be provided for every piece of equipment and system component included within the systems outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.

B. It is the contractor's responsibility to estimate the extent and depth of the PFC requirements, based upon the level of involvement required to install each individual piece of equipment or system component.

C. The number of checklist items for each piece of equipment or system component shall range anywhere from 30 checklist items up to 100 checklist items depending upon the level of involvement and the way the equipment is broken down. For example, a strainer may have 10 checklist items associated with it, but several strainers may be grouped onto a single PFC for a whole system, such that that PFC has up to 200 checklist items. A single piece of equipment that has more installation requirements such as a VAV Terminal Unit with Hydronic Reheat may have numerous components whose checklist items total 100. PFC's should be anticipated to have an average of 65 checklist items to be completed by the installing contractors for every piece of equipment.

D. PFC content is as follows:

1. Equipment PFC's shall list for comparison the manufacturer's data of the equipment as per the design, approved submittal and the installed equipment. These items are initially blank on the forms provided to the contractors by the Commissioning Agent. The Contractors are responsible for obtaining this information and filling in these blanks.

    a. Design: The manufacturer's data shall be filled in by the contractor according to the design criteria outlined within the design specifications or equipment schedules.

    b. Submitted: The manufacturer's data shall be filled in by the contractor according to the product submittal, submitted by the contractor and approved of by the design representative

    c. Installed: The manufacturer's data shall be filled in by the contractor according to the actual piece of equipment installed in the field nameplate data.

2. PFC's include checklist items requiring submittals to be completed. Submittals that are not product submittals provided to the System Design Professionals for review and approval are to be attached to the PFC. Documents can be attached to the PFC's via upload to Facility Grid.

3. The majority of each PFC's is the installation checklist items required to be verified by the installing contractor. Final checks include verification that start-up, testing and balancing has been properly performed.

4. Some PFC's for operating equipment include a handful of start-up readings to ensure start-up has been conducted. These readings do not require a second or redundant effort but can be transposed from a start-up report or TAB report.

E. PFC's shall not require an extension of the project schedule but shall be integrated into the original overall Master Project Schedule. PFC's require no additional installation work above and beyond the scope of the contract documents. PFC checklist items shall be checked-off as equipment is being installed according to the project schedule. PFC's shall be completed in conjunction with the completion of equipment installations.

F. PFC's may be reviewed and commented on by the Commissioning Team. Comments must be received within 14 calendar days of the PFC being generated on Facility Grid. Once PFC's have begun to be filled out be the installing contractors, the PFC's will not be further revised. The only exception is to accommodate construction document changes.

G. PFC's are multi-discipline and therefore must be partially completed by multiple contractors. The division of each PFC is the contractor's responsibility. Division of project work is determined by the Construction Manager or General Contractor and Subcontractors and is not within the jurisdiction of the Commissioning Agent. Therefore, the division of work outlined within each PFC is generalized and has not taken into account the true scope of each individual sub-contracting company. Each contractor must review every PFC to determine their own obligation to the installation checklist items described therein.

H. PFC's shall include full calibration documentation of all field calibrated devices as required by the specifications of equipment or controls. Calibration may be recorded on the PFC form if fields are available. Alternatively, calibration records can be submitted as an attachment to the PFC. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device.

2.8 CALIBRATION RECORDS

A. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device. Calibration documentation may be recorded on the associated PFC form if fields are available. Alternatively, calibration records can be submitted as an attachment to the PFC.

2.9 START-UP AND TEST REPORTS

A. Contractor(s) shall submit copies of all start-up reports for systems to be commissioned, test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall be submitted with the appropriate Pre-Functional Checklists. Reports shall include but are not limited to:

1. Equipment Start-Up
2. Leakage Tests
3. Pressure/Vacuum Tests
4. Flushing and Cleaning
5. Chemical Treatment

6. Equipment Repair

7. Electrical Tests (Megger, Ground, Resistance, Continuity, Hi-Pot, Etc.)

2.10 PRE-VERIFICATION TESTS

A. Pre-Verification Tests (PVT's) shall be issued by the Commissioning Agent to the Commissioning Team. PVT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.

B. PVT's are virtually identical copies of the Functional Performance Tests. PVT's are FPT versions created for the Contractor's use in pre-testing the various Commissioning Systems. Where FPT's include sections for spot-checking system components, PVT's will include full test sections for 100% component testing. On Facility Grid, Contractors will have access to complete the PVT's but will not have access to complete the FPT's.

C. See Functional Performance Tests for more PVT content description.

2.11 FUNCTIONAL PERFORMANCE TESTS

A. Functional Performance Tests (FPT's) shall be issued by the Commissioning Agent to the Commissioning Team. FPT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.

B. A Functional Performance Test must be completed for each of the systems to be commissioned as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning unless otherwise specifically noted by the Owner or Commissioning Agent.

C. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth. Functional Performance Tests content shall include:

1. Control devices, sensors, meters and gauges shall be individually tested for correct operation and calibration. Devices include control valves, control dampers and variable frequency drives (VFD's). Testing of redundant components may follow a sampling strategy based upon the testing results.

2. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. Operation shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch.

3. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.

4. Step-by-step procedures intended to prove the sequence of operations has been properly met according to the construction documents. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.

5. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.

6. System failures and alarms shall be fully tested. Some case scenarios may require simulation of failed equipment to trigger alarms and failure sequence. Some case scenarios may require control overrides or device manipulation to trigger alarms and failure sequence. Tasting shall not include any destructive tests.

2.12 TAB VERIFICATION

A. The Test, Adjustment and Balance Contractor shall submit deficiency logs to the Commissioning Team to disseminate construction issues that can potentially impact completion of the TAB process.

B. The Test, Adjustment and Balance Contractor shall submit a Final TAB Report as required by the TAB specifications. The TAB Report shall ultimately be verified by the Commissioning Agent as demonstrated by the TAB contractor.

C. The Test, Adjustment and Balance Contractor may submit Draft TAB Report sections on a system-by-system basis if certain systems are prepared prior than others and the Commissioning Team agrees Commissioning of that system may proceed to the next phase (functional testing.) In order to proceed, the Draft TAB Reports must include all content necessary to perform functional testing. In order to be acceptable, Draft TAB Reports must contain data that is ultimately reflected in the Final TAB Report. If Draft TAB Reports are utilized for TAB Verification and the same data is not reflected in the Final TAB Report, the TAB Verification performed becomes null and void.

2.13 TEST EQUIPMENT

A. All industry standard test equipment required for performing the specified tests shall be provided by the Contractors. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer at no additional cost.

B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control vendor at no additional cost.

C. Instrumentation provided by the Contractors, Manufacturer and/or Vendors shall meet the following standards:

1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.

2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument

3. Be maintained in good repair and operating condition throughout the duration of use on this project.

4. Be immediately replaced if dropped and/or damaged in any way during use on this project.

2.14 COMMISSIONING ISSUES LOG

A. The Commissioning Agent will document any issues, discrepancies, variances, delays or other Commissioning Related Issues on the Commissioning Issues Log. The Cx Issues Log will be updated and distributed regularly, typically prior to every Commissioning Meeting for discussion of critical issues. The intent of the Commissioning Issues Log is to track issues that have an impact on the overall project with regard to schedule, cost or systems operation.

B. Commissioning Issues may arise from Submittal Review, Site Observations, Commissioning Meetings, Commissioning Correspondence, Pre-Verification Testing or Functional Performance Testing.

C. Commissioning Issues Log lists items with a Subject Line, a detailed description of the issue, when the issue was found and the responsible contractor, from the perspective of the Commissioning Agent. The actual contractor responsible for any corrective actions is at the discretion of the primary contracting party, typically the Construction Manager or General Contractor.

2.15 TRAINING RECORDS

A. Each Training Session Record must include:

1. Trainer by name, company and contact information

2. Agenda of Topics and Durations and Depth of Training

3. O&M's and other Material Covered in the Training Session

4. List of Training Attendees and Attendance Log (Signatures)

5. Trainee Review of Training Adequacy or Trainee Comprehension Test

PART 3 - EXECUTION

3.1 COMMISSIONING KICK OFF

A. Schedule the Construction Phase Commissioning Kick-Off meeting within 90 days of the award of the contract, at some convenient location and at a time suitable to the Contractor and System Design Professional(s). This meeting shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for Commissioning Activities. The meeting shall review Commissioning Protocols and flush out any specifics not already defined, such as submittal routing, review and comment return durations.

B. The Construction Manager or General Contractor shall be required to ensure a representative is present for every Contractor involved in the Commissioning process including such 3rd party testing agencies such as the Test, Adjustment and Balance Contractor. Coordinate exact participant requirements with the Commissioning Agent.

3.2 SUBMITTALS

A. The Commissioning Agent shall review all submittals for approval in conjunction with the Design Review Professionals. Commissioning submittal review shall be coordinated with the System Design Professional(s) review to avoid comment redundancy.

B. Routing of submittals to accommodate both Owner, Design Professional and Commissioning Agent review is to be established at the Commissioning Kick-Off Meeting and followed for the duration of the project.

C. Submittal approval by the Commissioning Agent shall not supersede any submittal comments or rejection by the System Design Professional(s) and vice versa.

3.3 COMMISSIONING SCHEDULE

A. The Contractor(s) shall submit to the Commissioning Agent a copy of the overall Master Project Schedule. The Contractor(s) shall be responsible for submitting updated copies of this schedule to the Commissioning Agent on a Monthly Basis throughout Construction.

B. The Construction Manager or General Contractor, in coordination with the Commissioning Team, will develop a general commissioning schedule with the ideal time frame for implementation of the various commissioning tasks. The Commissioning Schedule will be reviewed with the Owner, the System Design Professional(s) and Commissioning Agent for integration into the overall project construction schedule. All commissioning tasks as well as critical milestone dates will be tracked on the master project schedule.

C. The Construction Manager/General Contractor and Contractor(s) shall be responsible for providing periodic updates to the commissioning tasks within the master schedule, identifying areas where commissioning and/or related milestones are falling behind schedule. This shall prompt discussions for schedule recovery at the Commissioning Meetings.

3.4 COMMISSIONING PLAN

A. The Commissioning Plan shall describe the Commissioning Process to be followed for the duration of the Project. Specific protocols shall be drafted in the Draft Cx Plan, discussed and verified at the Kick-Off Meeting and documented for record in the Final Cx Plan.

B. The Cx Team is to be drafted in the Draft Cx Plan with names and contact information. The Cx Team is to be discussed and verified at the Kick-Off Meeting and documented for record in the Final Cx Plan.

3.5 CONSTRUCTION OBSERVATION

A. The System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner.

B. The Commissioning Agent will perform site observations throughout construction to document construction progress as well as identify any variance from the construction documents. The Commissioning Agent will provide Site Visit Reports for each site observation visit. The Commissioning Agent shall document any potential construction issues sited during a site observation on the Commissioning Issues Log.

3.6 TEST AND BALANCE

A. See Specification 230800 Section 1.5 – Roles and Responsibilities for the requirements of the Test, Adjustment and Balance Contractor as related to Commissioning.

B. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent, often referred to as TAB Verification. This requires final balance to be complete and final measurements recorded. The TAB Contractor shall be required to repeat measurements selected at random by the Commissioning Agent to confirm the accuracy of the submitted report.

C. TAB Verification Scope:

1. TAB Verification shall include repeating every reading and measurement for each piece of equipment recorded in the TAB Report.

2. TAB Verification shall include 20% repeated testing of Redundant Equipment. Redundant Equipment is defined within 019113 Section 1.5 – Systems to be Commissioned.

3. TAB Verification shall include 100% repeated testing of Major Equipment. Major Equipment is considered to be every type of equipment that is not specifically identified as Redundant within 019113 Section 1.5 – Systems to be Commissioned.

D. TAB Verification and related readings to be witnessed by the Commissioning Agent shall be specifically identified within portions of the various system Functional Performance Tests. Equipment to be spot-checked shall not be specifically, listed, only the measurements and data for that equipment type will be identified on the FPT.

3.7 PRE-FUNCTIONAL CHECKLIST PROCEDURES

A. Draft Pre-Functional Checklists may be provided early in the construction phase. However, Final Pre-Functional Checklists are provided by the Commissioning Agent after equipment submittals are approved. PFCs require some portion of equipment specific items that cannot be included until the actual equipment is selected.

B. The contractors shall use only PFC forms provided by the Commissioning Agent.

C. The PFC's are to be completed as equipment and systems are being started-up, balanced and tuned. As start-up, balancing and tuning is completed, the PFC's must also be completed. These are the final steps leading up to the beginning of functional testing.

D. PFC's are required to be completed by the Contractor(s) and approved by the Commissioning Agent prior to Functional Performance Testing. Prior to proceeding with any particular system Functional Performance Test, all PFC's associated with equipment or system components which fall under the scope of that particular system, shall be 100% complete and accepted. If the Commissioning Team agrees to move the Commissioning Process forward prior to completion of any Commissioning Predecessor including QA/QC Documentation, Start-Up Documentation, Pre-Functional Checklist, etc., that Predecessor must be logged on the Commissioning Issues Log in detail describing exactly what is incomplete.

E. In the event, the Commissioning Agent has omitted a piece of equipment or system component from its applicable PFC which is included within the systems to be commissioned. The sub-contractor shall remain responsible for completing a PFC for that particular piece of equipment or system component. The Contractor (or any member of the Cx Team) shall bring the omitted item to the attention of the Commissioning Team or Commissioning Agent. The Commissioning Agent will provide an additional form for the omitted item.

F. If Printed Paper PFC's are to be utilized:

1. The CM shall be responsible for maintaining a master PFC for each PFC provided by the Commissioning Agent. The master PFC shall be completed in black fine-point ink unless kept electronically via PDF. All marks must be permanent and legible. Each PFC checklist item shall be verified by the responsible contractor and checked-off on the master copy of the respective PFC. Sub-contractors may utilize their personal copies of each PFC's in the field to verify installations and then transfer all checks, notes an initials to the master PFC. Otherwise, sub-contractors my check-off items directly on the master PFC, while in the field. Contractors shall not assemble pages from multiple copies of a PFC, which have been completed by multiple sub-contractors, to create a single PFC representing the master PFC.

2. Each PFC checklist item shall be checked by the responsible contractor. The specific individual person who checks off any single item on a PFC shall legibly scribe their personal three-letter initials in the space provided adjacent to the item checkbox. Upon completion of any contractor's portion of checklist items, the responsible manager or field superintendent for that company shall sign their full signature in all required places indicated on the PFC. The day's date shall be scribed next to the signature. Typically, the only signature space shall be on the title page of each PFC.

3. The Commissioning Agent shall require the following for the acceptance of each Pre-Functional Checklist: Each checklist item shall be checked or noted otherwise. Each checklist item shall bear a three-letter initial next to it if an initial space is provided. Each piece of manufacturer's data shall be complete and accurate. Each device calibration checklist shall be complete. Every space on each PFC which requires a signature shall bear the appropriate signature. All marks shall be black and legible according to the Owner or Commissioning Agent.

3.8 PRE-FUNCTIONAL CHECKLIST - VERIFICATION

A. The pre-functional test forms shall be completed by the installing contractor, manufacturer's, and all others with related involvement with the commissioned equipment. The test forms shall be signed verifying completion by the Construction Manager or General Contractor and all related contractors and sub-contractors.

B. The Commissioning Agent shall review PFC forms along with the actual installations to verify completion and accuracy. If the review reveals discrepancies, the PFC forms will be rejected and the contractors will be required to redo the forms. The Commissioning Agent's scope does not include re-review of PFC forms due to failed or rejected PFC's. If the CxA is required to re-review PFC forms there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of $110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install equipment and components, verify the installation and certify via PFC that the installation conforms to the contract requirements prior to inviting the Commissioning Agent to review these PFC's and installations.

3.9 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. Draft Functional Performance Tests may be provided early in the construction phase. However, Final Functional Performance Tests are provided by the Commissioning Agent after equipment submittals are approved. FPT's require some portion of equipment specific items that cannot be included until the actual equipment is selected. FPT's require confirmation of the final sequences as submitted and approved by the System Design Professionals.

B. The Contractors shall use only FPT forms provided by the Commissioning Agent.

C. The Contractors shall have the opportunity to review the Functional Performance Tests and provide Comments to the Commissioning Team. Comment incorporation into the FPT's is at the discretion of the Owner, System Design Professionals and Commissioning Agent. Upon receipt of each Functional Performance Test, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team and Commissioning Agent of any and all changes within the project which may have an effect on the sequence of operations of any system as it is tested by Functional Performance Test. It is important that the Final Functional Performance Tests, performed in the field and witnessed by the Commissioning Agent are in-fact finalized drafts which encompass all changes made to the systems. The Commissioning Team shall have a minimum of two weeks (14 calendar days) to review the Draft FPT's prior to the forms being finalized.

D. Functional performance testing shall be performed by the installing Contractors. The Commissioning Agent shall direct and witness functional testing.

E. The contractor must account for performing each Functional Performance Test two (2) times:

1. The Contractors shall have FPT forms available to be completed by themselves prior to inviting the Commissioning Agent to witness functional testing. FPT's intended for use by the Contractors are referred to as Pre-Verification Tests (PVT's.) The Contractor(s) shall utilize the PVT's to perform the tests provided by the CxA, debug the systems, and verify compliance prior to requesting the final FPT to be witnessed by the Commissioning Agent. The contractor shall be responsible for performing all steps within a Pre-Verification Test prior to issuing a formal request for the Commissioning Agent to witness Functional Performance Testing. Upon successful completion of each PVT, the contractor may request the presence of the Commissioning Agent to witness the test.

2. The final Functional Performance Tests shall be conducted by the Contractors and witnessed by the Commissioning Agent to verify operation.

F. Redundant Equipment: A Functional Performance Test shall be provided to test every piece of redundant equipment. The contractor shall be responsible for testing every unit to verify correct operation utilizing the FPT's in the form of Pre-Verification Tests. All redundant equipment shall not necessarily be retested and witnessed by the Commissioning Agent as part of the Functional Testing. The Commissioning Agent will select a certain percentage of redundant equipment to be tested. These units shall be chosen at random by the Commissioning Agent, during functional testing and typically follow the TAB Verification Testing Random Sampling Rate.

3.10 FUNCTIONAL PERFORMANCE TEST - VERIFICATION

A. The Functional Performance Testing shall be conducted by the installing contractors, manufacturers, testing agencies and any other necessary parties required to accomplish the tests as prescribed in the Functional Performance Tests forms. The Commissioning Agent will witness and document the test results as they are being conducted.

B. The Commissioning Agent's scope does not include re-witnessing of FPTs due to lack of participant coordination or test failures. If the CxA is required to re-witness any part of the FPT there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of $110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install, test, debug and verify system operation conforms to the contract requirements prior to inviting the Commissioning Agent to witness the FPT's.

C. Functional Tests must be completed comprehensively and to the extent necessary to enable the Commissioning Agent to assure the Owner and System Design Professional(s) that the systems do perform per the design intent.

D. Redundant Equipment: A failure of a certain percentage (typically 10%) or greater of the redundant equipment tested shall indicate improper operation and performance of the entire group of redundant equipment and shall result in system failure.

3.11 COMMISSIONING ISSUES LOG

A. Upon the discovery of Commissioning Issues, the Contractor(s) shall be notified via distribution of an updated Commissioning Issues Log.

B. Additional visits to the site for re-inspection or re-testing shall be scheduled as required. Prior to these additional visits, related deficiencies shall be rectified by the responsible party. The Contractor(s) shall be responsible for ensuring that all required corrective actions are performed in a timely manner to maintain the project schedule.

C. Site visits for re-inspections or re-testing shall be coordinated with the Commissioning Team such that additional visits are used efficiently. The Commissioning Agent is not to be scheduled for a site visit to re-inspect or re-witness a single small or quick item from the Commissioning Issues Log unless that particular item is of a critical nature. This would be deemed inefficient use of the Commissioning Team's time. Issues are to be coordinated and grouped to effectively use half-days or full days for re-inspections and re-testing.

D. Re-inspections and re-witness repeated conducting of Functional Performance Tests is not included within the scope of the Commissioning Agent. Such visits shall be performed at no additional cost to the Owner. If the CxA is required to re-inspect or re-witness testing, there will be additional costs incurred. The CxA will invoice the responsible Contractor at an hourly rate of $110/hour including any required travel time, plus expenses. These costs may be routed through the Owner and Construction Manager in the form of a Contract Deduction or Back-Charge. It is the contractor's responsibility to properly install, test, debug and verify system operation and completeness in conformance with the contract requirements prior to inviting the Commissioning Agent to perform inspections or witness testing.

3.12 EXCLUSIONS

A. Responsibility for construction means and methods: The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.

B. Hands-on work by the Commissioning Agent: The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

3.13 PREREQUISITES TO BENEFICIAL OCCUPANCY

A. All commissioning of the Systems to be Commissioning as listed in 019113 Section 1.5 must be complete prior to Beneficial Occupancy. Exceptions to this are the planned control system training performed after occupancy and any required seasonal or approved deferred testing. Prerequisites for all systems include but are not limited to:

1. Completed and signed Start-Up Reports
2. Completed and signed Pre-Functional Checklists
3. Submission and Approval of Final TAB Report
4. Completion of all Functional Performance Tests
5. Completion of all Training and Owner Orientation
6. Submission and Approval of Final O&M Manuals
7. Commissioning deficiencies as identified on the Cx Issues Log are either all completed, corrected and closed or have otherwise been individually reviewed and approved by the Owner to be completed after Final Acceptance.

B. The Owner's Project Manager will determine the date of Functional Completion after reviewing the Commissioning Agent's recommendation for Final Acceptance.

C. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

END OF SECTION 019113

ABATEMENT AND DEMOLITION BID FORM (REVISED)

for

UNCW King Hall
Asbestos Abatement
Wilmington, North Carolina

The undersigned, as bidder, proposes and agrees if this proposal is accepted to contract with ECS for the furnishing of all materials, equipment, and labor necessary to complete abatement of the work described in the Technical Specifications for Asbestos Abatement (and any subsequent Addendums) in full and complete accordance with plans, specifications, and contract documents, and to the full and entire satisfaction of ECS for the lump sum fee of:

BASE BID (ABATEMENT):

_____

_____**Dollars**

$_____

ADD/ALTERNATE PRICES AND UNIT RATES (if necessary)

In the event that additional asbestos is identified or the scope of work is expanded, the contractor is to include unit rates for removal of the following materials. These unit rates are to be based on performing asbestos removal during the project without the contractor having to remobilize to the site:

Remobilization (if necessary):	$_____	per mobilization
Residual Flooring Mastic:	$_____	per square foot
VCT and Associated Mastic:	$_____	per square foot
Vibration Dampener:	$_____	per unit
Mudded Elbows:	$_____	per elbow
Black Mastic on Pipes	$_____	per linear foot
Black Tar on HVAC Wrap	$_____	per linear foot
Drywall/Joint Compound:	$_____	per square foot
ACM Textured Wall:	$_____	per square foot
Window Removal:	$_____	per window

Respectively submitted this _____ day of_____2023

_____
(Name of firm or corporation making bid)

Federal ID#:_____

Witness: By:_____

_____ Title:_____
(Proprietorship or Partnership) (Owner, Partner, Pres. or VP)

Attest: Address: _____
_____

By:_____
(Corporate Seal)
Title:_____
(Corp.Sec./Ass't Sec.)

Phone Number _____

ACCEPTED: ECS

BY:_____ TITLE:_____

DATE:_____2023

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.01 DEFINITIONS

A. "Remove": Carefully detach or dismantle items from existing construction and properly dispose of or recycle off site, unless items are indicated to be salvaged or reinstalled.

B. "Salvage" or "Remove and Salvage": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition. If indicated to be reinstalled, store in a secure area until ready for reinstallation.

C. "Reinstall" or "Remove and Reinstall": Carefully detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.

D. "Existing", "Existing to Remain" or "ETR": Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1. Not all existing construction to remain shall be noted with one of these terms on the Drawings; the intent is to assist the Contractor in areas where it may be difficult to determine. Existing construction shall be assumed to remain unless specifically noted to be removed - either when noted with "remove", "salvage", or "reinstall" terminology per above, or when indicated graphically in accordance with the Demolition Legend on the Demolition Drawings.

1.02 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2022, with Errata (2021).

1.03 SUBMITTALS

A. Photographic Documentation: Submit photographic record of the existing conditions, either as still photographs or as a video-recorded walkthrough. Contractor shall perform walkthrough of existing conditions with Owner's representative prior to site mobilization.

1. Photographic documentation shall clearly show existing damage and wear on existing surfaces that may be interpreted as being caused by subsequent demolition and construction operations.
2. For still photographs, submit marked-up plan(s) indicating locations where photographs were taken and direction photograph is facing. Include a written narrative to describe existing damage and other conditions as deemed necessary.
3. For video recordings, include a spoken narrative to describe locations and existing conditions, or provide a supplementary written narrative.
4. Submit all photographic documentation as digital photo / video files, and supplementary narratives and plans as PDF files. Submit as part of the initial submittal package required prior to release of the first request for payment.

B. Site Plan: Indicate:

1. Areas for temporary construction and field offices.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. All demolition work shall be considered unclassified. Barring discovery of hazardous materials or undocumented structural components, where elements are indicated to be demolished, the bid price shall be for complete demolition of the element, regardless of the individual component makeup of that element.

B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Fire Safety: Comply with applicable requirements of the International Fire Code; Chapter 33, and with NFPA 241.
      a. Use of explosives is not permitted.
      b. Hot Work: Remove all combustibles from areas where hot work is required, including use of cutting torches, welding, or heating equipment. Maintain fire watch for entire duration of hot work and for a minimum 30 minutes after completion of hot work.
         1) Keep portable fire extinguishers within 30 feet of locations where hot work is being performed for entire duration.
      c. Maintain egress routes and emergency access routes at all times; do not allow demolished materials to accumulate and block routes.
      d. Remove combustible demolished materials from the building by the end of each work day. Temporarily store combustible materials in noncombustible containers with self-closing lids until they can be removed from the building.
      e. Do not burn demolished material on site.
   3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   4. Provide, erect, and maintain temporary barriers and security devices.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
   7. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
   8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.

C. Do not begin removal until receipt of notification to proceed from Owner.

D. Do not begin removal until built elements to be salvaged, relocated, or reinstalled have been removed.

E. Protect existing structures and other elements to remain in place and not removed.
   1. Provide bracing and shoring.
   2. Prevent movement or settlement of adjacent structures.
   3. Stop work immediately if adjacent structures appear to be in danger.

F. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. Hazardous Materials:
   1. Hazardous materials are present in the existing facility. A report on the locations and types of hazardous materials is on file for Contractor's reference. Coordinate with CM's abatement Contractor to ensure abatement Work is complete prior to beginning demolition activities.
   2. If hazardous materials other than those in the report are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.

H. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Dismantle existing construction and separate materials.
   2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.02 EXISTING UTILITIES

A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.03 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
   1. Verify construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from areas that remain occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.

D. Remove existing work as indicated and required to accomplish new work.
   1. Remove items indicated on drawings.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Floor Finishes: After removal of existing floor finishes including backings, underlayments, and thick set mortar beds, remove all residual adhesives and glue. Provide grinding, sanding, or shot-blasting of existing concrete floor slab to achieve the proper surface to receive new indicated floor finish. Coordinate slab surface preparations required for each new indicated floor finish with appropriate subcontractor.

G. Concrete: Cut neatly in straight lines with power-driven saw with diamond-tooth blade or other type specifically intended for concrete and masonry. Break up and remove carefully, avoiding damage to adjacent flooring that will remain exposed in the finished work.

H. Masonry: Remove masonry in whole units at exposed surfaces, new openings, and unless otherwise indicated, to allow for toothing-in of new masonry.
   1. Carefully remove brick and clean of mortar for later reinstallation. Coordinate with Division 4 Unit Masonry.
   2. Solid masonry may be cut with power saw where masonry edges will be concealed by the finished work. Do not cut hollow masonry.

I. Existing Surfaces to Receive Finishes: Remove miscellaneous hangers, exposed nails not serving as fasteners, and similar protrusions; remove adhesive residue and tape; fill anchorage holes; and otherwise patch and restore surface to be a uniform substrate suitable for applied finishes.

J. Protect existing work to remain.
   1. Prevent movement of structure. Provide shoring and bracing as required.
   2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch to match new work.

3.04 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 024100

APPENDIX A – HAZARDOUS MATERIALS REPORT & SPECIFICATION

The following hazardous materials information was prepared by ECS Southeast, LLP, for UNC Wilmington – King Hall, under a third party contract with UNCW:

Asbestos and Lead Paint Survey; Dated November 1, 2022.

Technical Specifications for Asbestos Abatement; Dated March 23, 2023.

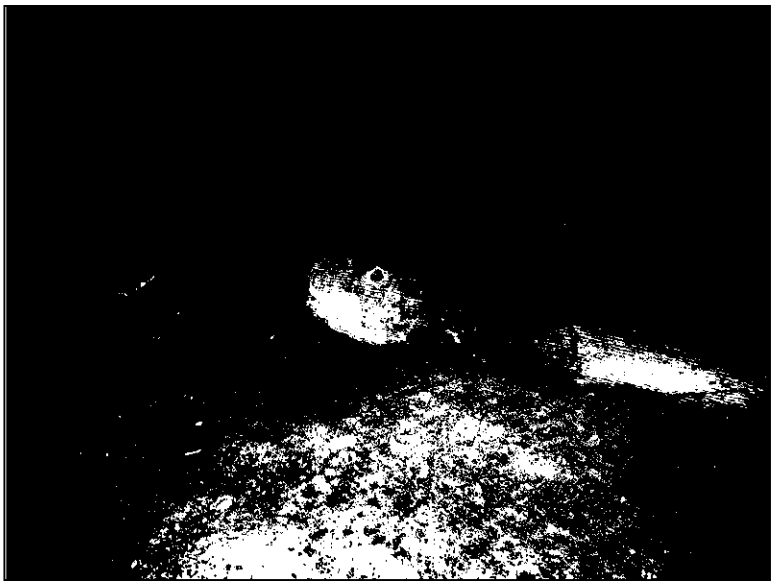
The opinions expressed in the survey report are those of the Hazardous Materials Engineer and represent their interpretation of the existing conditions, tests and the results of analyses which they have conducted.

The accuracy or completeness of the data is not warranted or guaranteed by the Architect. The Architect expressly disclaims any responsibility for the data as being representative of the conditions and materials which may be encountered.

The data and quantities included in the Hazardous Materials Report and procedures and requirements in the Technical Specifications shall be used for bidding/pricing purposes to determine abatement costs. Any questions arising from review of these documents shall be directed to the Owner for review by third party Hazardous Materials Engineer.

The Asbestos Abatement Subcontractor shall be responsible for a final inspection of existing conditions to verify location of hazardous materials prior to commencement of demolition.

Refer to the following pages.



UNC-WILMINGTON - KING HALL

601 HAMILTON DRIVE
WILMINGTON, NORTH CAROLINA 28403

ECS PROJECT NO. 49:18273

FOR: UNC-WILMINGTON

NOVEMBER 1, 2022

November 1, 2022

Mr. David Holsinger
UNC-Wilmington
601 South College Road
Wilmington, North Carolina 28403

ECS Project No. 49:18273

Reference: Asbestos and Lead Paint Survey, UNC-Wilmington - King Hall, 601 Hamilton Drive, Wilmington, North Carolina

Dear Mr. Holsinger:

ECS Southeast, LLP (ECS) is pleased to provide UNC-Wilmington with the results of the Asbestos and Lead Paint Survey performed at the UNC-Wilmington - King Hall. This report summarizes our observations, analytical results, findings, and recommendations related to the work performed. The work described in this report was performed by ECS in general accordance with the Scope of Services described in ECS Proposal Number 49:31775P and the terms and conditions of the agreement authorizing those services.

ECS appreciates this opportunity to provide UNC-Wilmington with our services. If we can be of further assistance to you, please do not hesitate to contact us.

Sincerely,

ECS Southeast, LLP

Tina M. Stewart, REM
Environmental Principal
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336-314-4691

Amy DeSaix, REM, CIEC
Environmental Principal
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EXECUTIVE SUMMARY

The subject property consists of a two-story educational building located on the UNC Wilmington (UNCW) campus at 601 Hamilton Drive in Wilmington, New Hanover County, North Carolina. Based on the information available, the building is referred to as King Hall, contains 22,288 square feet of space, and was reportedly constructed in 1968. UNCW provided prior reports from 2002 and a spreadsheet with identified asbestos-containing materials (ACMs) including samples collected from 2018. The building consist of concrete masonry unit (CMU) block and plaster gypsum board wall finishes with floor tiles, and a drop down ceiling.

The purpose of this Asbestos and Lead Paint Survey is to evaluate if ACMs or lead-containing paint (LCP) may be present within portions of the buildings to be renovated which may require special handling and/or disposal if removed during construction activities. Reportedly, the proposed renovations include new carpet, paint, restrooms, ADA upgrades, window replacement, suite alterations including moving walls. Therefore, the survey was performed on accessible areas of the interior and exterior windows and excludes the remainder of the exterior of the building and roofing system(s).

Based on the laboratory analysis of the bulk samples collected during the survey, asbestos was identified to be in the building materials sampled. The ACMs identified included the following:

- Vibration Dampener;
- Black tar on white HVAC wrap;
- Various floor tiles and mastics;
- Black mastic on 6" pipes;
- White wall texture;
- Black residual mastic; and,
- Sink coating.

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous sampling areas including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory.

ECS was provided previous asbestos survey reports that included the identification of ACMs in the following materials:

- Cloth vibration dampener in mechanical closets;
- Mudded insulation on the steam and hot water pipes throughout the building;
- Insulation located inside the boiler flue;
- Silver/black roof flashing;
- 12"x12" white with gray and black specs floor tile;
- Black mastic beneath carpet;
- 12"x12" cream with white and gray flecks floor tile;
- 12"x12" off-white with gray streak floor tile;
- 12"x12" cream with tan and gray streak floor tile;
- 12"x12" gray/black floor tile; and,
- 12"x12" white with black dots floor tile.

Based on the laboratory analysis of the paint chip samples collected during the survey, lead was identified in several of the paint samples that included white, black, and gray paint.

Recommendations regarding the removal and disposal of the ACMs, and LCPs identified by ECS can be found in Section 5.0 of this report.

This Executive Summary is an integral part of the report. ECS recommends that the report be read in its entirety.

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TABLE OF APPENDICES

1.0 SITE DESCRIPTION

The subject property consists of a two-story educational building located on the UNC Wilmington (UNCW) campus at 601 Hamilton Drive in Wilmington, New Hanover County, North Carolina. Based on the information available, the building is referred to as King Hall, contains 22,288 square feet of space, and was reportedly constructed in 1968. UNCW provided prior reports from 2002 and a spreadsheet with identified asbestos-containing materials (ACMs) including samples collected from 2018. The building consist of concrete masonry unit (CMU) block and plaster gypsum board wall finishes with floor tiles, and a drop down ceiling.

2.0 PURPOSE

The purpose of this Asbestos and Lead Paint Survey is to evaluate if ACMs or lead-containing paint (LCP) may be present within portions of the buildings to be renovated which may require special handling and/or disposal if removed during construction activities. Reportedly, the proposed renovations include new carpet, paint, restrooms, ADA upgrades, window replacement, suite alterations including moving walls. Therefore, the survey was performed on accessible areas of the interior and exterior windows and excludes the remainder of the exterior of the building and roofing system(s).

The identification of ACMs may require trained labor, regulated work practices, and special disposal. The identification of LCP or other lead hazards may require disclosure to contractors and monitoring of lead exposure.

3.0 METHODOLOGY

ECS performed the authorized Scope of Services in general accordance with our proposal, standard industry practice(s) and methods specified by regulation(s) for the identification and confirmation of ACMs and LCPs. Prior reports indicated the following materials contained asbestos:

- Cloth Vibration Dampener in mechanical closets;
- Mudded Insulation on the steam and hot water pipes throughout the building;
- Insulation located inside the Boiler Flue;
- Silver/Black Roof Flashing;
- 12"x12" White with Gray and Black Specs Floor Tile;
- Black Mastic beneath carpet;
- 12"x12" Cream with White and Gray Flecks Floor Tile;
- 12"x12" Off-white with Gary Streak Floor Tile;
- 12"x12" Cream with Tan and Gray Streak Floor Tile;
- 12"x12" Grayish/Black Floor Tile; and,
- 12"x12" White with Black Dots Floor Tile.

Additionally the reports found the following lead-containing paints (LCPs):

- Interior Window Sills; and,
- Interior and Exterior Window Mullions.

It should be noted that ECS was unable to access the auditorium; however, prior reports indicate ACM tile and mastic within the auditorium.

3.1 Asbestos-Containing Materials

The minorly destructive asbestos survey was performed on August 29 and September 15, 2022 by Jennifer Turner and Amy DeSaix (NC License #12107), asbestos inspectors who have received EPA accredited training and is licensed by North Carolina. Samples of suspect ACMs were collected utilizing hand tools and placed into individual, labeled plastic bags. Unique bulk suspect ACM samples were submitted to Eurofins, CEI in Cary, North Carolina for analysis via Polarized Light Microscopy (PLM) in accordance with current EPA-600 methodology. Materials consisting of additional layers were analyzed separately. Eurofins, CEI is listed as an accredited laboratory by the National Voluntary Laboratory Accreditation Plan (NVLAP) managed by the National Institute of Standards and Technology (NIST) for bulk sample analysis by currently approved EPA methodology by PLM.

During the survey, ECS attempted to identify suspect ACMs in readily accessible areas. However, due to the destructive means required to identify some materials, certain areas were deemed inaccessible (i.e. behind walls or sub grade materials) and were not surveyed for suspect ACMs. Unidentified suspect ACMs may be located in these and/or other inaccessible areas.

Samples were collected in general accordance with EPA Standard 40 CFR 763 Subpart E, Asbestos Hazard Emergency Response Act (AHERA) and OSHA Standard 29 CFR 1926.1101 Inspection Protocol. Multiple samples of each unique material were submitted. Samples were analyzed using "Positive Stop" methodology. If one sample of a homogeneous material is reported to contain asbestos, the remaining samples of that material are not analyzed. EPA regulations stipulate that if one sample contains asbestos the entire quantity of that material contains asbestos, regardless of additional analysis.

3.2 Lead in Paint and Surface Coatings

The lead paint survey was performed by a North Carolina licensed Lead Inspector using a X-Ray Fluorescence (XRF) Spectrometer and paint chip sampling to identify lead concentrations in painted and glazed surfaces. Paint chip samples were collected utilizing hand tools and placed into individual, labeled plastic bags. Unique sample identifications were given to each sample and samples were submitted to Eurofins, CEI in Cary, North Carolina for analysis via Flame Atomic Absorption Spectrophotometry..

The survey was conducted utilizing the U.S. EPA definition of lead-based paint (LBP). Under this definition, painted surfaces which contain lead in concentrations equal to or greater than 1.0 milligrams per square centimeter ($\geq$ 1.0 mg/cm^2) using an XRF or 0.5% concentration by weight are classified as coated with LBP. Paints with detectable concentrations of lead are considered LCPs. Additionally, fixtures or components that are manufactured with a factory applied glazing (i.e., sinks, toilets, ceramic tiles, etc.) are tested as these factory-applied finishes often contain lead. Activities which disturb LCPs and glazing (while not LBPs by the U.S. EPA definition) are regulated by OSHA (29 CFR 1926.62).

Because the current or proposed use of the property is not residential or child-occupied, the scope of the survey was not conducted in accordance with HUD Chapter 7 requirements. This representative survey included walls, windows, doors, and miscellaneous components.

4.0 RESULTS

The following is a summary of laboratory results, findings and observations.

4.1 Asbestos-Containing Materials

In total, 94 bulk samples from 49 homogeneous areas were submitted to the laboratory of which 70 layers were analyzed. An ACM is defined as any material containing more than one percent (>1%) asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763, Section 1, PLM. Materials are categorized by the U.S. EPA in the following categories:

- Friable ACMs are defined as any ACM that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure. Non-friable ACMs are defined as any ACM that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
- Category I non-friable ACM are listed as following: packings, gaskets, resilient floor coverings, and asphalt roofing products containing more than one percent (>1%) asbestos.
- Category II non-friable ACM are listed as any material, excluding Category I non-friable ACM, containing more than one percent (>1%) asbestos.

Regulated ACMs (RACMs) are friable ACMs or non-friable ACMs that will be or has been subjected to sanding, grinding, cutting, or abrading or has crumbled, been pulverized, or reduced to powder in the course of renovation and/or demolition operations.

Eurofins, CEI submitted a signed final laboratory report to ECS on September 7 and 22, 2022. Seventeen of the bulk samples submitted for analysis were reported to contain asbestos in detectable concentrations. These materials are summarized below. A complete list of the sampled materials submitted for analysis and sample locations are located in the Appendix of this report. Additional details regarding the overall locations of the materials identified as asbestos-containing are provided further in the report. Photographs of collected samples are also located in the Appendix of this report.

Summary of Asbestos-Containing Materials Identified

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
12-1	Mechanical Room 102, 103, and 201 and Crawlspace	White Vibration Dampener	35% Chrysotile	Friable	7 Vibration Dampeners, one of which is 20 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
13-1,2	Observed in Mechanical Room 103; Possibly located in other mechanical rooms	White HVAC sealant with Black Tar on HVAC Equipment	5% Chrysotile	Category II Non-Friable	20 square feet
18-1,2	Room 106-H	Cream Gray Floor Tile and associated Black Mastic	Floor Tile (FT): 2% Chrysotile Mastic: 3% Chrysotile	Category I Non-Friable	130 square feet
26-1,2	First Floor Ceiling into 2nd Floor Mech. Room	Black Mastic on 6" Pipes	5% Chrysotile	Category II Non-Friable	Unknown
27-1,2	Janitorial Room H200	White Wall Texture	2% Chrysotile	Friable	90 square feet
31-1,2	Room 211, Observed in Rooms 211A, 210, C200A, 208, 207, and 206	White Floor Tile	FT: 2% Chrysotile Mastic: None Detected (ND)	Category I Non-Friable	2,850 square feet
34-1	Room 209	Black Residual Mastic	3% Chrysotile	Category I Non-Friable	334 square feet
35-1,2	Room 208	Tan Floor Tile and associated Black Mastic	FT: 2% Chrysotile Mastic- 3% Chrysotile	Category I Non-Friable	450 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
36-1	Room 203, 203A, 203B, and in Second Floor Hallway by Room 203 Door and Elevator	Yellow/Black Mastic associated with Light Gray Floor Tile with Gray Streaks	FT: ND Mastic: 5% Chrysotile	Category I Non-Friable	1,250 square feet
37-1	Second Floor Hallway and Room 201A	Gray Floor Tile with Black Streaks and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	750 square feet
40-1	Room 201E	White Floor Tile under Gray Carpet and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	160 square feet
41-1	Room 201	White Sink Undercoating	3% Chrysotile	Category II Non-Friable	10 square feet
42-1	First Floor Hallway	Cream Floor Tile with Tan Streaks	FT: 2% Chrysotile	Category I Non-Friable	2,500 square feet
43-1	Room 104	White Floor Tile with Gray Streaks	FT (Tan): 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	270 square feet
44-1	Room 104	Olive Floor Tile and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	270 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
48-1,2	Room 104A	Yellow/Black Mastic associated with White Floor Tile with Multi-color Specs	FT: ND Mastic: 3% Chrysotile	Category I Non-Friable	160 square feet
49-1,2,3,4,5,6,7	Interior Hallway and Room H200	White/ Off-white Wall Texture	2% Chrysotile	Friable	2,500 square feet
Assumed	Throughout	Mudded Elbows	Previously Sampled	Friable	Observed 20

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous sampling areas including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory.

It should be noted that the boiler had been removed along with the previously identified ACM boiler flue insulation.

Due to the non-destructive nature of the assessment, unless asbestos abatement documents are present, ACM floor tile mastic should be assumed present throughout.

4.2 Suspect or Assumed Asbestos-Containing Materials

Due to the inaccessibility or the destructive means that asbestos sampling requires, additional suspect ACMs may remain within the building hidden behind inaccessible areas that include, but are not limited to, sub-grade walls, structural members, topping slabs, sub-grade sealants, flooring located below underlayments, areas behind exterior walls, pipe trenches, and subsurface utilities, etc. These areas were deemed inaccessible and were not assessed.

If these materials are discovered during construction activities, they should be presumed to contain asbestos and be treated as ACMs or be sampled immediately upon discovery and prior to disturbance for asbestos content by a certified asbestos inspector in accordance with 29 CFR 1926.1101.

Based upon our past experience in the identification of ACMs in similarly constructed buildings, the following additional suspect ACMs may also be located in inaccessible areas of the structure:

- Underground Piping;
- Vapor Barrier on Exterior Structure of Foundation;
- Fire Doors;
- Pipe Insulation within Wall Chases; and,

- Mastic associated mirror and boards adhered to the wall.

4.3 Lead in Paint and Surface Coatings

Paint and surface coatings which contain detectable concentrations of lead considered LCP. Since OSHA has no specific action level for lead in paint, all paint on the site found to have a measurable concentration of lead should be assumed to be lead-containing. Work performed which may disturb LCP is regulated under OSHA as referenced under 29 CFR 1926.62. A total of 49 readings were collected during the survey, including calibration readings. Seven paint chip samples were collected and analyzed. Paint and other surface coatings which are defined by applicable regulation as lead-based paints are summarized in the table below and photographs of lead-based paint identified are located in the Appendix.

Lead-based paint is defined by the U.S. EPA and North Carolina as any paint or other surface coatings that contain lead equal to or in excess of 1.0 mg/cm^2 (XRF) or 0.5% by weight (paint chip).

The following types of materials were found to contain detectable concentrations of lead.

Summary of XRF Lead-Containing Paints

Location	Color	Substrate	Component
Exterior	White	Wood	Porch Overhang
Exterior	White	Wood	Porch Trim
Exterior	White	Metal	Door
Back Right Starirwell	White	CMU	Wall
Womens Restroom	Off-white	Ceramic	Tile
Interior	White	Wood	Window Sill
Halfmoon Window of Entrance	White	Wood	Window Casing
Front Office	Beige	Metal	Door Casing
Back Left Stairwell	Light Blue	CMU	Wall
2nd Floor Hallway	Tan	Metal	Door Casing
Exterior	White	Wood	Window Pannel
Exterior	White	Wood	Window Sill
Exterior	White	Wood	Window Casing

Summary of Paint Chip Lead-Containing Paint Results

Sample ID	Location	Color	Substrate	Component	Analytical Results
LBP01	Mechanical Room	White	Metal	Door	0.19%
LBP02	Mechanical Room	Gray	Concrete	Floor	0.0056%
LBP05	Exterior	Black	Metal	Stair Railing	0.033%
LBP06	Exterior	White	Wood	Window Sill	0.062%
LBP07	Exterior	White	Wood	Window Casing	0.19%

5.0 RECOMMENDATIONS AND REGULATORY REQUIREMENTS

Based on our understanding of the purpose of the Asbestos and Lead Paint Survey, the results of laboratory analysis, and our findings and observations, ECS presents the following recommendations.

5.1 Asbestos-Containing Materials

Several materials were identified as asbestos-containing as noted above. ECS recommends where a material type has been identified as asbestos-containing that other materials with similar color, texture, age and size throughout the building's interior and exterior be assumed to contain asbestos. Please refer to Section 4.1 for a complete list of building materials that were reported positive for asbestos and to Section 4.2 for materials that were assumed to contain asbestos.

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous samples including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory. Although materials that contain trace amounts of asbestos are not subject to U.S. EPA or North Carolina regulations for the handling and disposal of asbestos, OSHA still regulates any work which will disturb materials identified with trace amounts of asbestos (reference the November 24, 2003 OSHA Interpretation document - Compliance Requirements For Renovation Work Involving Materials Containing Less Than 1% Asbestos). Therefore, any Contractors disturbing these materials will need to comply with components of 29 CFR 1926.1101, as detailed in the 2003 OSHA Interpretation document.

An asbestos abatement design is required for each individually permitted removal of more than 3,000 square feet, 1,500 linear feet. or 656 cubic feet of regulated ACMs conducted in public areas. Based on quantities of ACMs identified, an asbestos abatement design is required to delineate and quantify known and suspect ACMs in the building and to outline proper procedures for the abatement. This will help protect the owner's liability in better defining the scope of work and contractors' roles and responsibilities in the abatement process and holding the contractor accountable for the performance of the project. The specification typically defines the Contractor's scope of work

and outline requirements and procedures that must be followed for the project. The intent of the specification is to give performance requirements for the Contractor so that the project can be completed safely and in compliance with applicable federal and state regulations. Typically, the specification document serves as part of the site owner's contract with the contractor.

If ACMs are to be removed, it is recommended that an industrial hygienist monitor the project. This involves collecting air samples from within and outside abatement work areas to monitor the asbestos abatement contractor's work practices over the course of the project. The industrial hygienist should evaluate if the asbestos abatement work is in accordance with project specifications, U.S. EPA regulation 40 CFR Part 61-National Emission Standards for Hazardous Air Pollutants Subpart M: National Emission Standard for Asbestos, and U.S. Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1926.1101 – Asbestos in Construction. The industrial hygienist should assess each work area to monitor the removal of ACMs. Only after the industrial hygienist has determined the identified ACMs have been removed should final clearance air samples be collected (if necessary).

Suspect ACMs not observed due to inaccessibility or not sampled due to the destructive means that sampling would require may also be encountered during construction activities. At the time of the survey, only limited destructive means were used to locate or sample suspect ACMs; therefore, additional suspect ACMs may remain within inaccessible areas that include, but are not limited to, [sub-grade walls, structural members, topping slabs, exterior areas, sub-grade sealants, flooring located below underlayments, vapor barriers, pipe trenches and other subsurface utilities, etc.] If additional suspect ACMs are uncovered which were not accessible during this survey, it is recommended that these materials either be assumed to contain asbestos or be sampled prior to disturbance upon discovery for asbestos content by an asbestos inspector in accordance with 29 CFR 1926.1101.

5.2 Lead in Paint and Surface Coatings

Based on the findings of the lead survey, detectable concentrations of lead were identified on some paints and surface coatings. The presence of lead is a concern primarily when conditions exist where it may be inhaled or ingested. Regardless of the analytical results of a material, all painted and/or glazed surfaces may still contain concentrations of lead in the paint, which when disturbed, may generate lead dust greater than the Permissible Exposure Limit (PEL) of 50 micrograms per cubic meter (ug/m3) as an 8-hour Time Weighted Average (TWA) established by the OSHA "Lead Exposure in Construction Rule (29 CFR 1926.62)."

The OSHA standard gives no guidance on acceptable levels of lead in paint at which no exposure to airborne lead (above the action level) would be expected. Rather, OSHA defines airborne concentrations, and references specific types of work practices and operations from which a lead hazard may be generated (reference 29 CFR 1926.62, section d). Environmental and personnel monitoring should be conducted during any removal/demolition process (as appropriate) to verify that actual personal exposures are below the PEL of 50 $\mu g/m^3$ as an 8-hour TWA. Under OSHA requirements, the contractor performing renovation work will be required to conduct this monitoring and follow applicable requirements under 29 CFR 1926.62 if disturbing LCP.

6.0 LIMITATIONS

The conclusions and recommendations presented within this report are based upon a reasonable level of assessment within normal bounds and standards of professional practice for a site in this particular geographic setting. ECS is not responsible or liable for the discovery and elimination of hazards that may potentially cause damage, accidents, or injuries.

The observations, conclusions, and recommendations pertaining to environmental conditions at the subject site are necessarily limited to conditions observed, and/or materials reviewed at the time this study was undertaken. No warranty, expressed or implied, is made with regard to the conclusions and recommendations presented within this report. This report is provided for the exclusive use of the client. This report is not intended to be used or relied upon in connection with other projects or by other unidentified third parties without the written consent of ECS and the client.

Our recommendations are in part based on federal, state, and local regulations and guidelines. ECS does not assume the responsibility of the person(s) in charge of the site, or otherwise undertake responsibility for reporting to any local, state, or federal public agencies, any conditions at the site that may present a potential danger to public health, safety, or the environment. Under this scope of services, ECS assumes no responsibility regarding any response actions initiated as a result of these findings. General compliance with regulations and response actions are the sole responsibility of the Client and should be conducted in accordance with local, state, and/or federal requirements.

During this study, samples were submitted for analysis at an accredited laboratory via polarized light microscopy. As with any similar survey of this nature, actual conditions exist only at the precise locations from which samples were collected. Certain inferences are based on the results of this sampling and related testing to form a professional opinion of conditions in areas beyond those from which the samples were collected. No warranty, expressed or implied, is made.

Appendix I: Figures

Figure 1

Site Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Source: Google Earth

Not to Scale

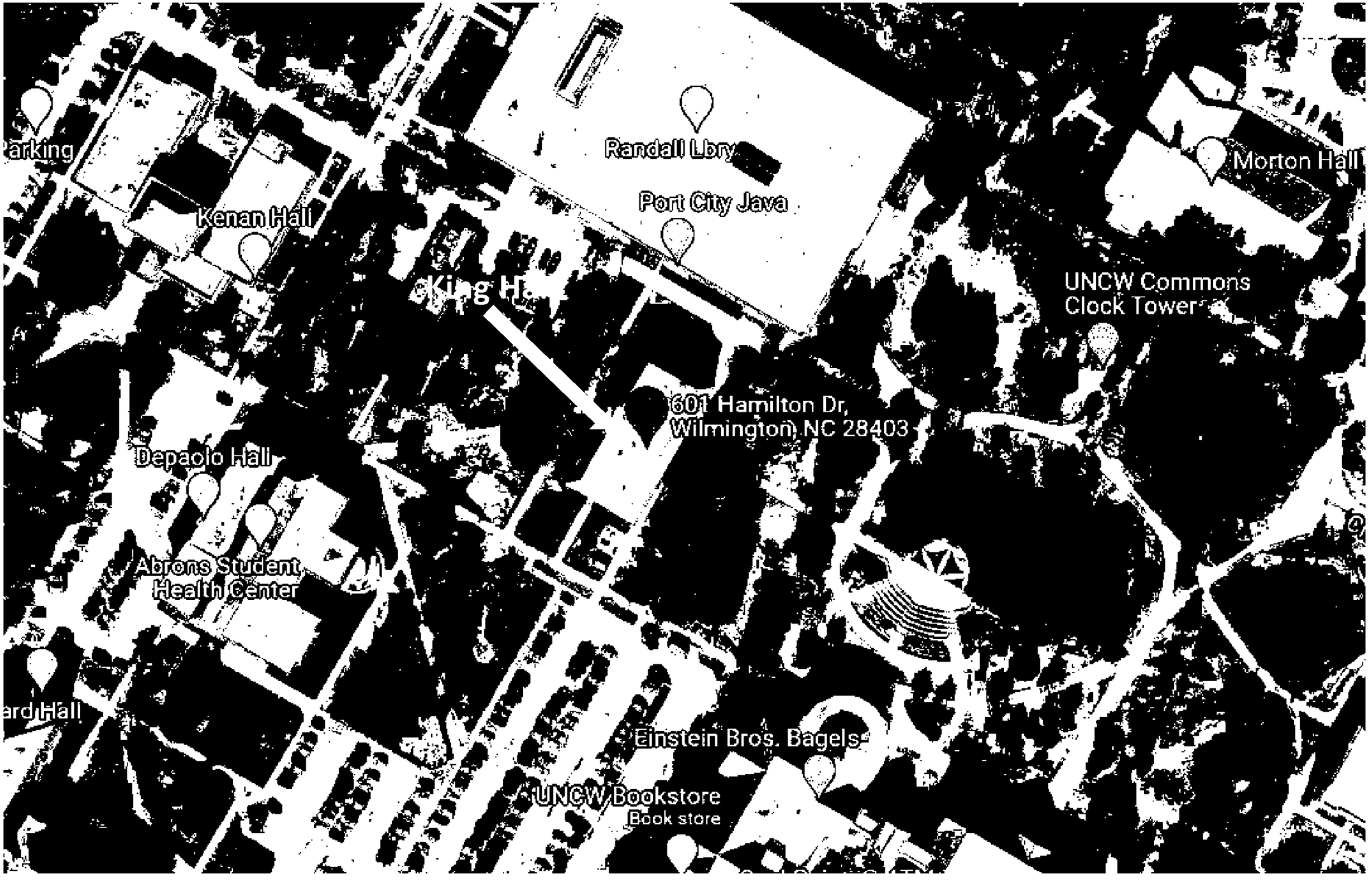


Figure 2 – First Floor
Suspect Asbestos Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1	Sample Number
●	Non-ACM Sample Location
▼	ACM Sample Location
□	Trace Asbestos (<1%)

Notes

Not to Scale

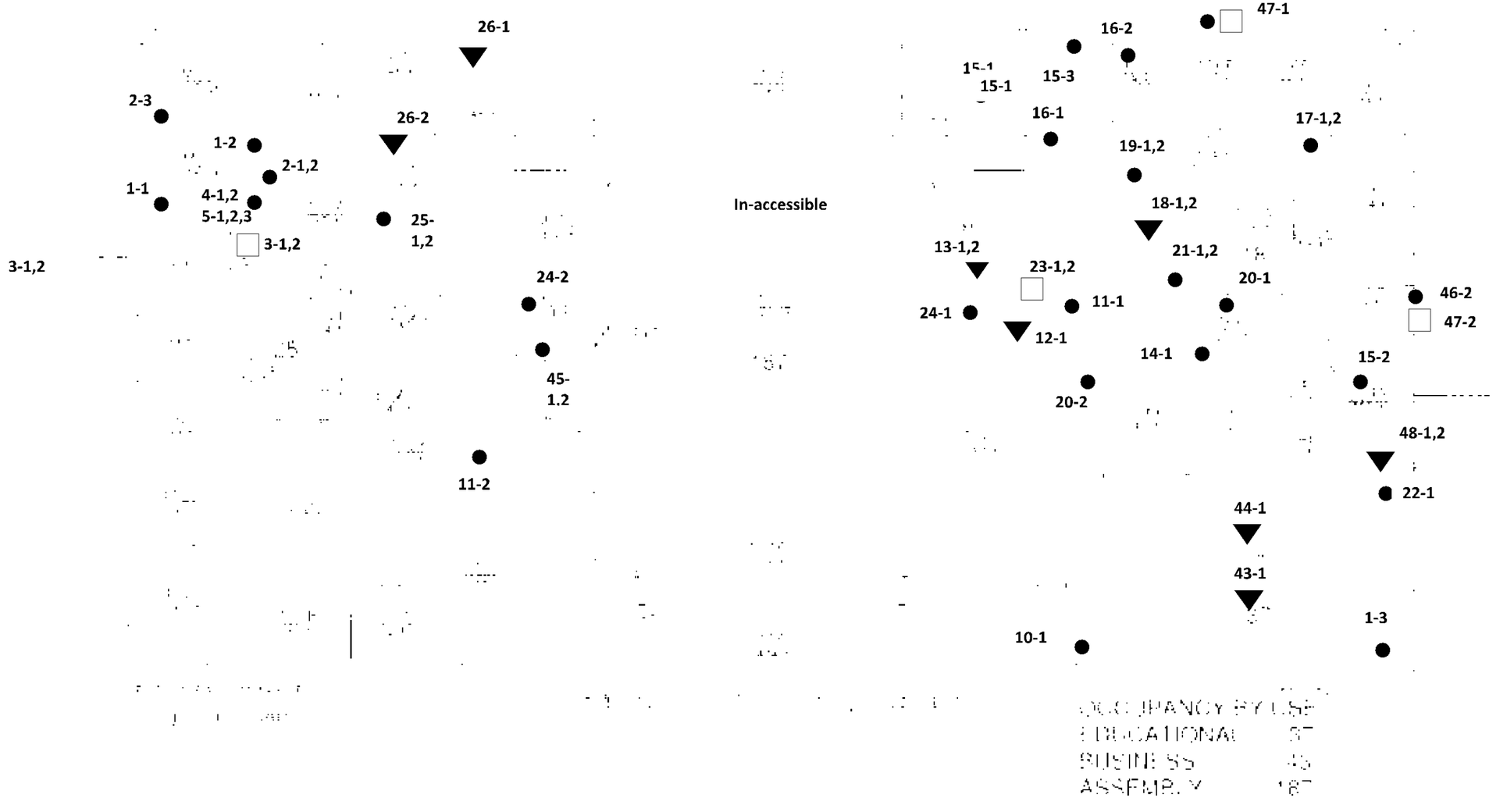


Figure 3 – Second Floor
Suspect Asbestos Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1 Sample Number
● Non-ACM Sample Location
▼ ACM Sample Location

Notes

Not to scale

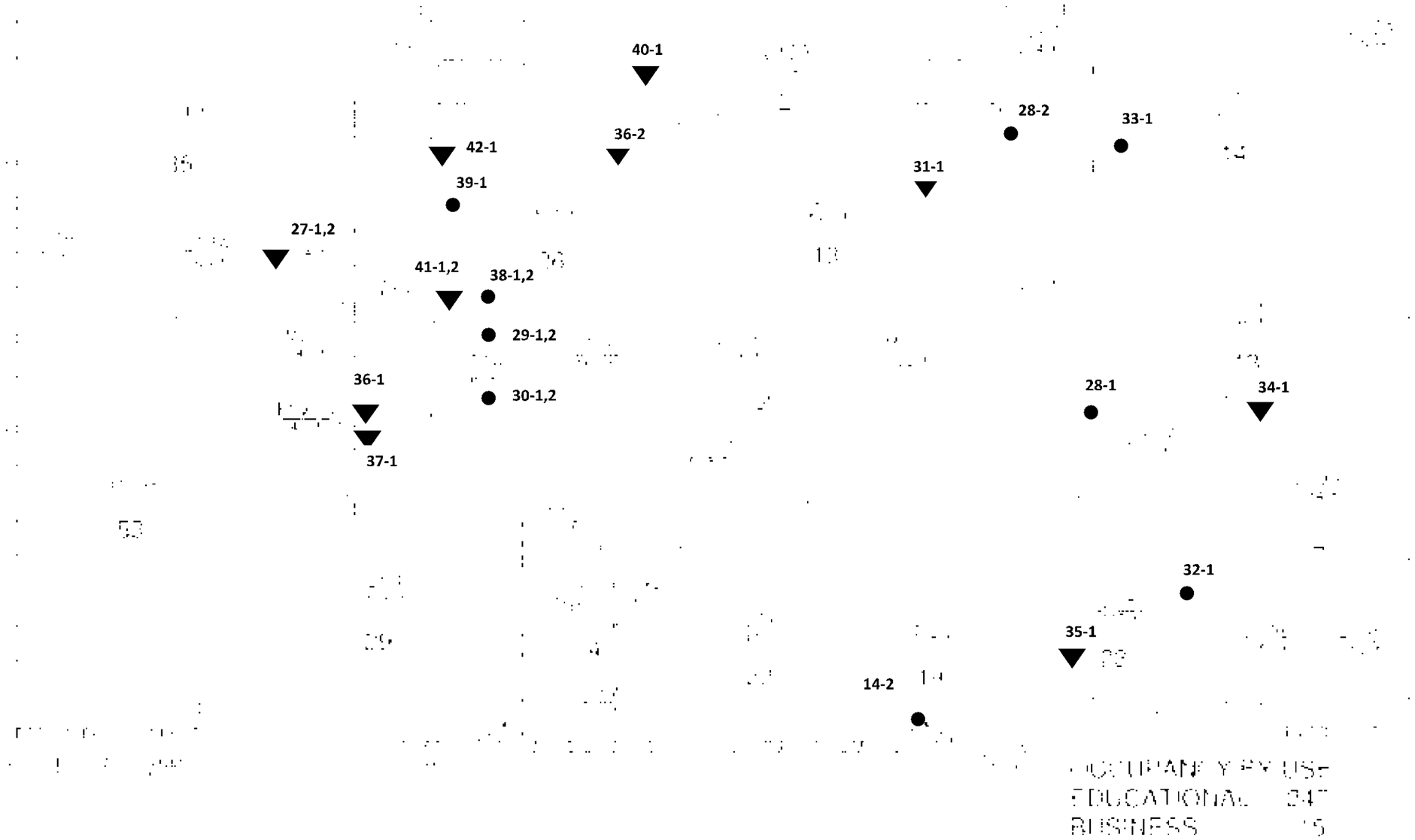


Figure 4 – First Floor
Paint Chip Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

LBP01	Sample Number
◆	Lead Not Detected
★	Lead-Containing Paint

Notes

Not to Scale

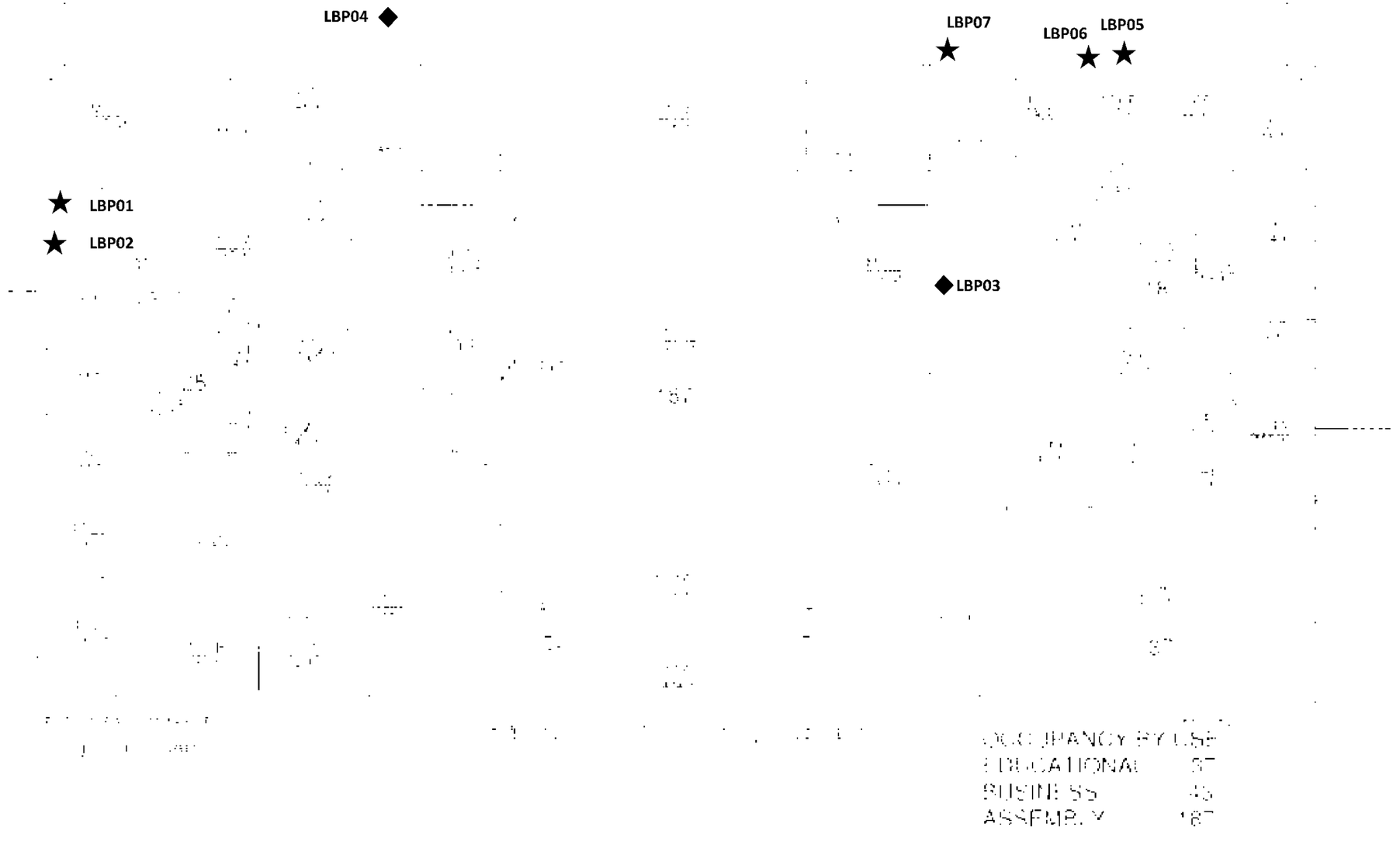


Figure 5 – Second Floor
Paint Chip Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1	Sample Number
◆	Lead Not Detected
★	Lead-Containing Paint

Notes

Not to Scale

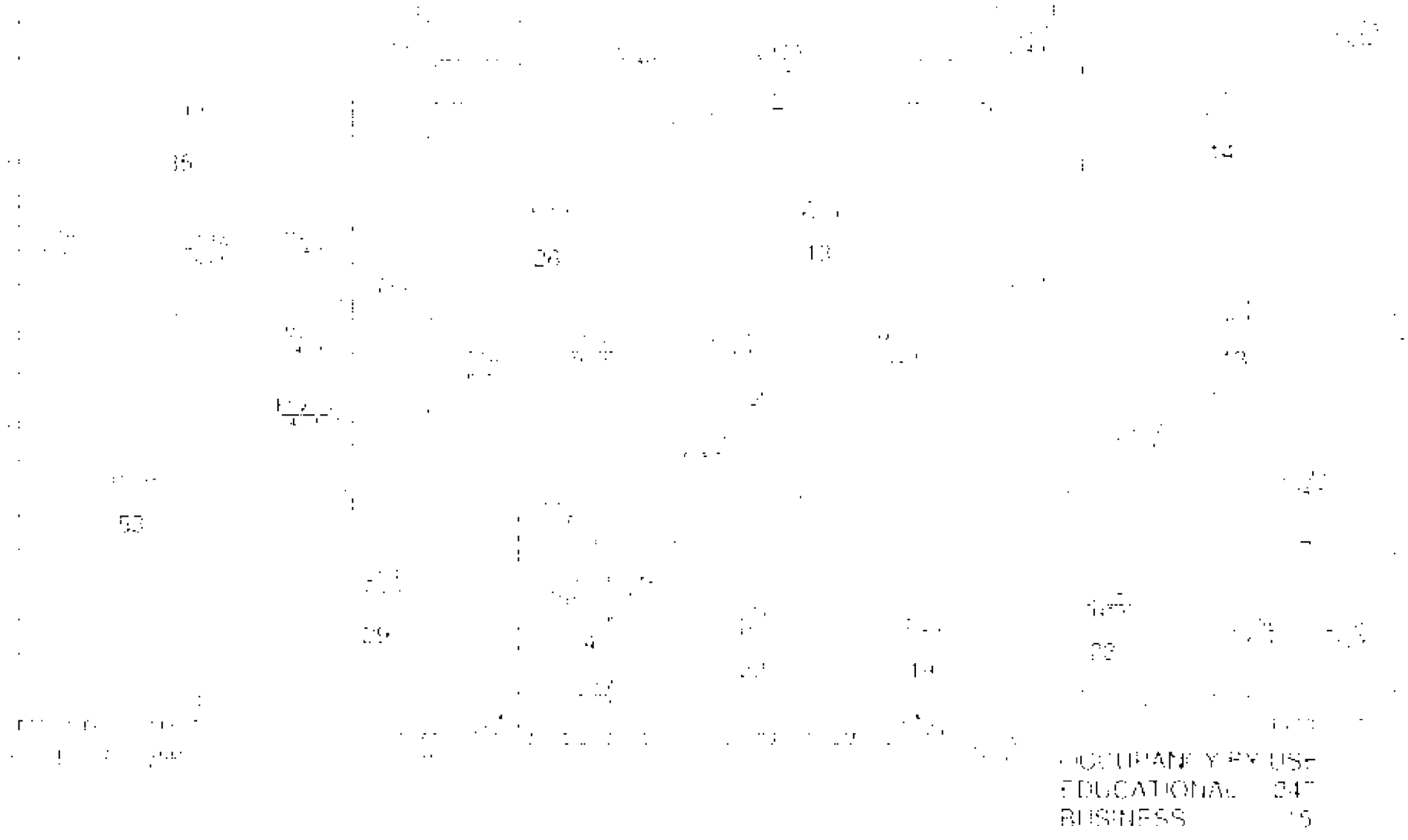


Figure 6 – First Floor
Asbestos Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

- ACM Vibration Dampener
- ACM Black Mastic TSI
- ACM FT and Mastic
- ACM Black Mastic

Notes

Not to Scale

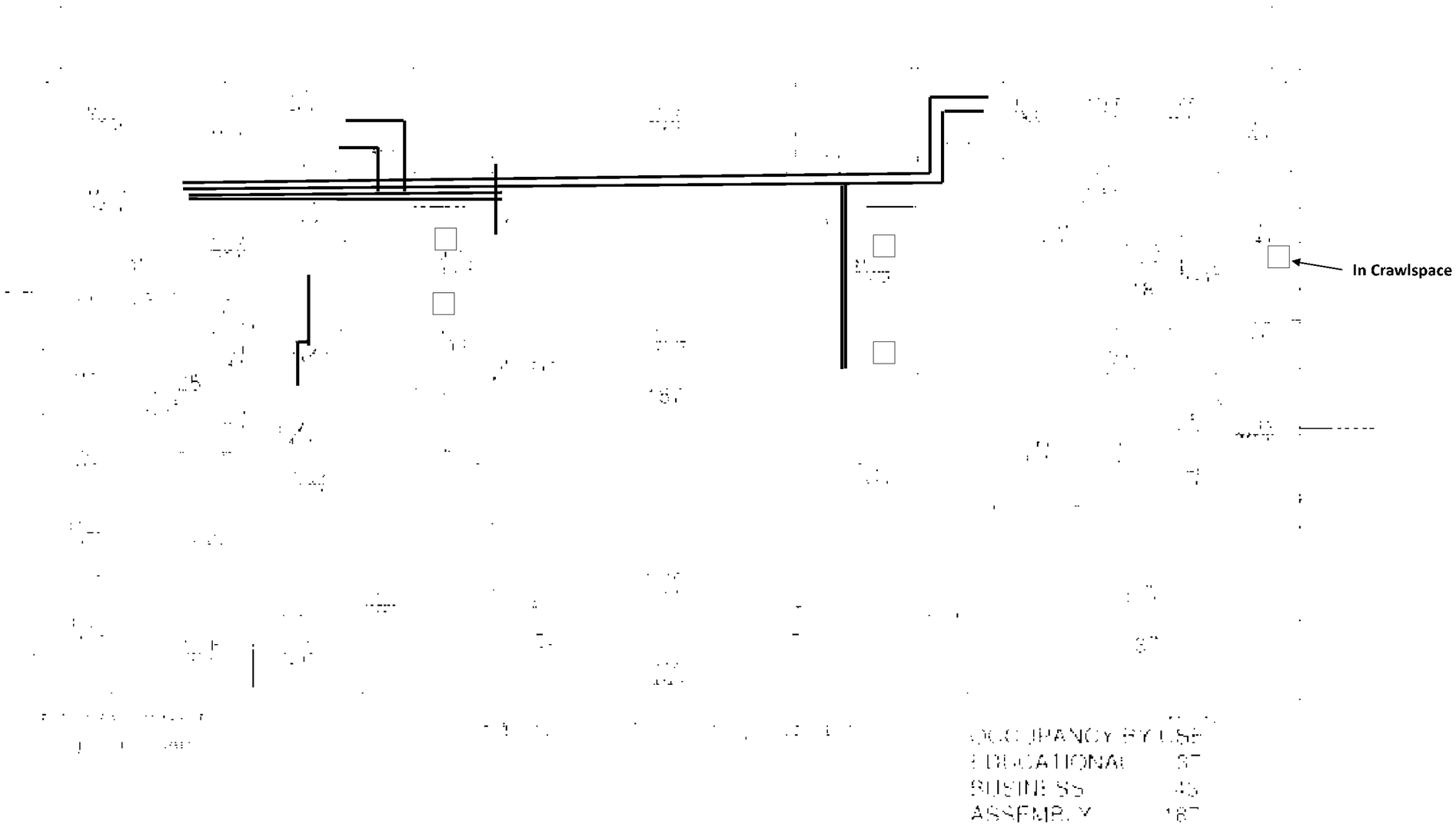


Figure 7 – Second Floor
Asbestos Location Map

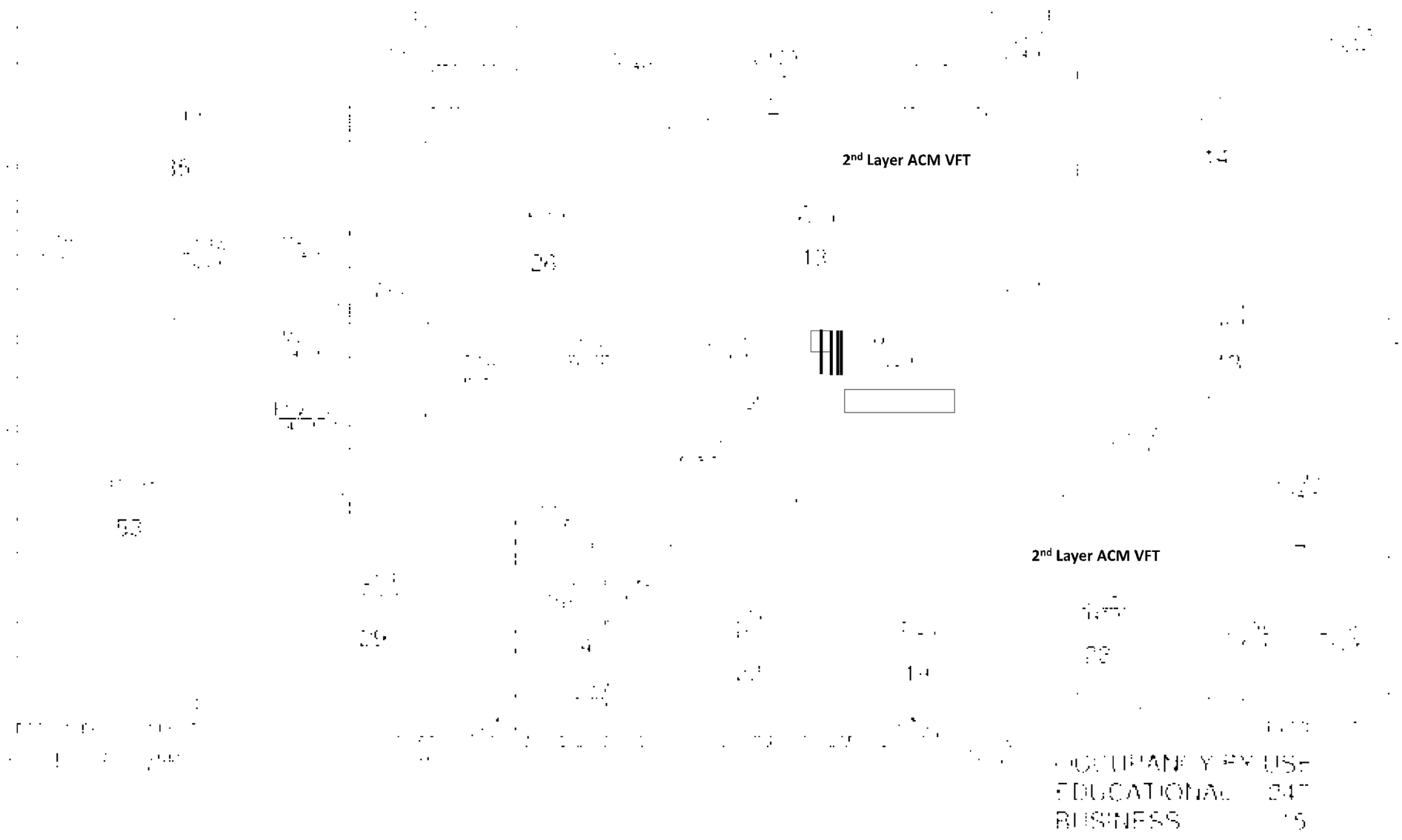
UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

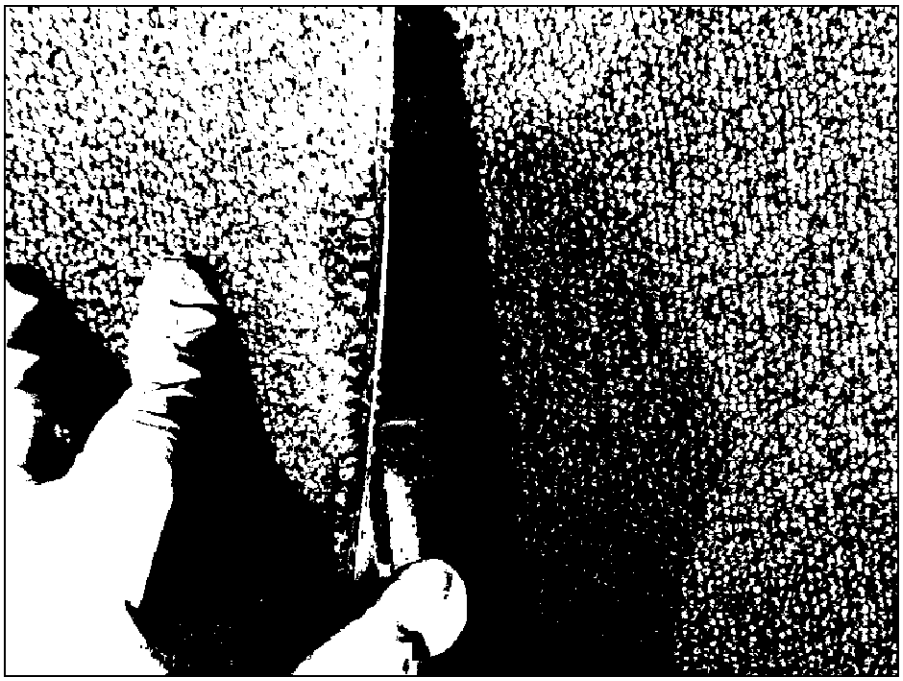
- ACM Vibration Dampener
- ACM Black Mastic TSI
- ACM FT and Mastic
- ACM Black Mastic

Notes

Not to scale



Appendix II: Site Photographs

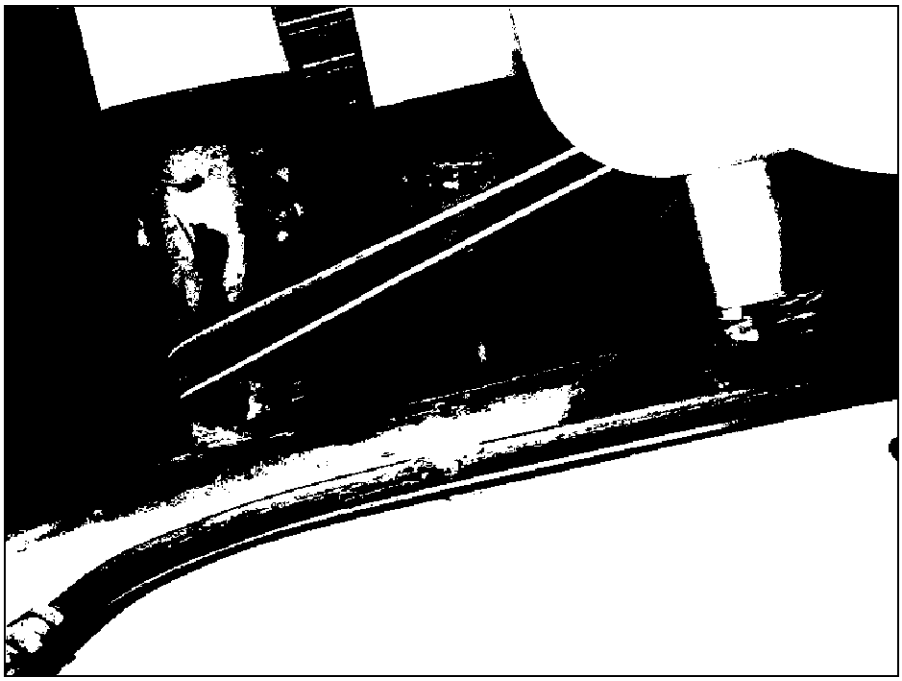


1 - View of Carpeting

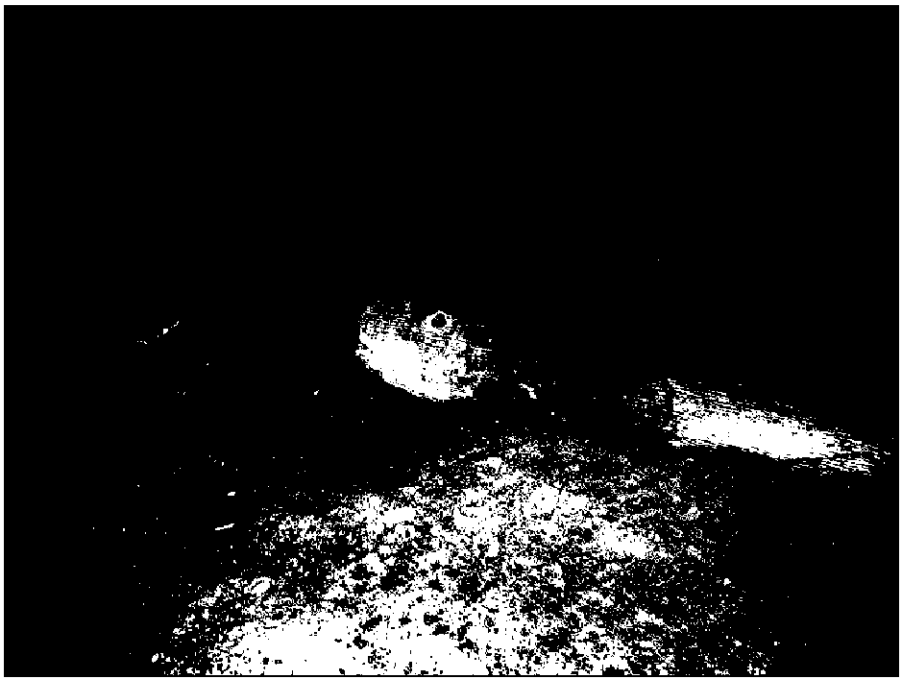
2 - View of Carpeting, Black Mastic, Black Tile, and Yellow Mastic

3 - View of Black Mastic Under Carpet

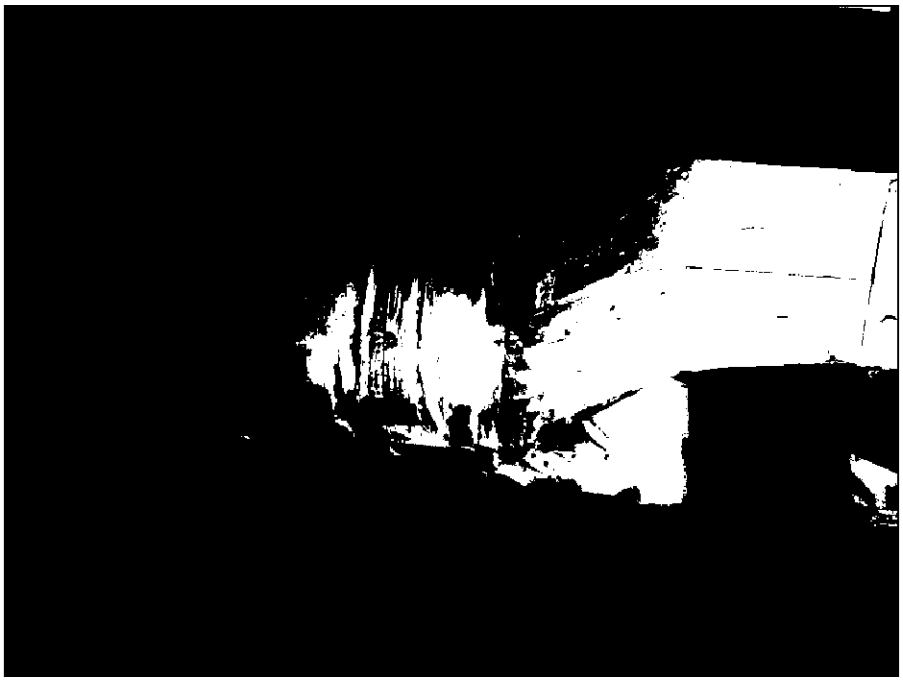
4 - View of TSI and Pipe Elbows



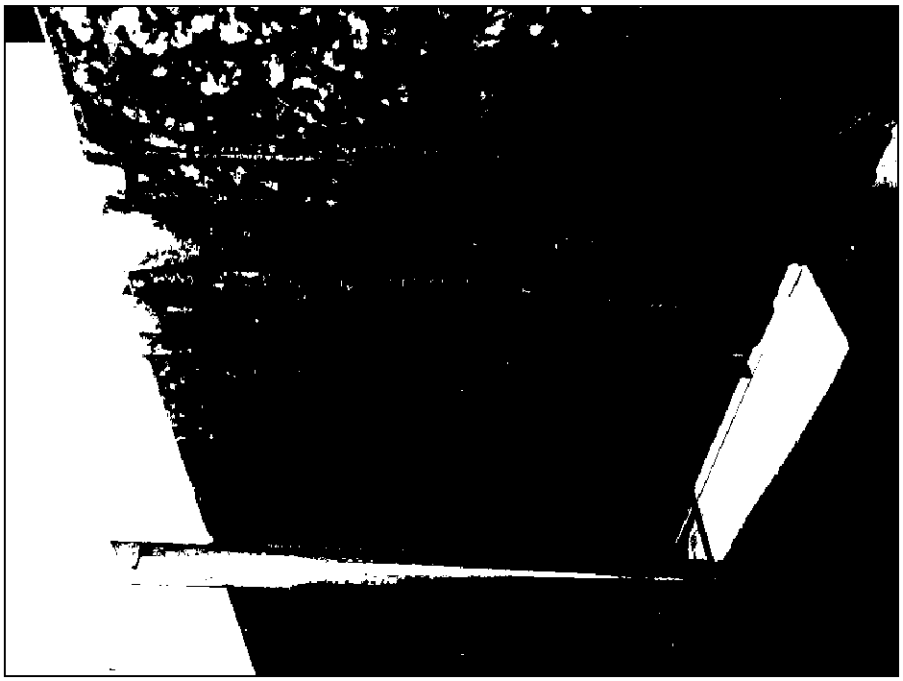
5 - View of TSI, Ceiling Tiles, and Black Caulk



6 - View of Degraded TSI



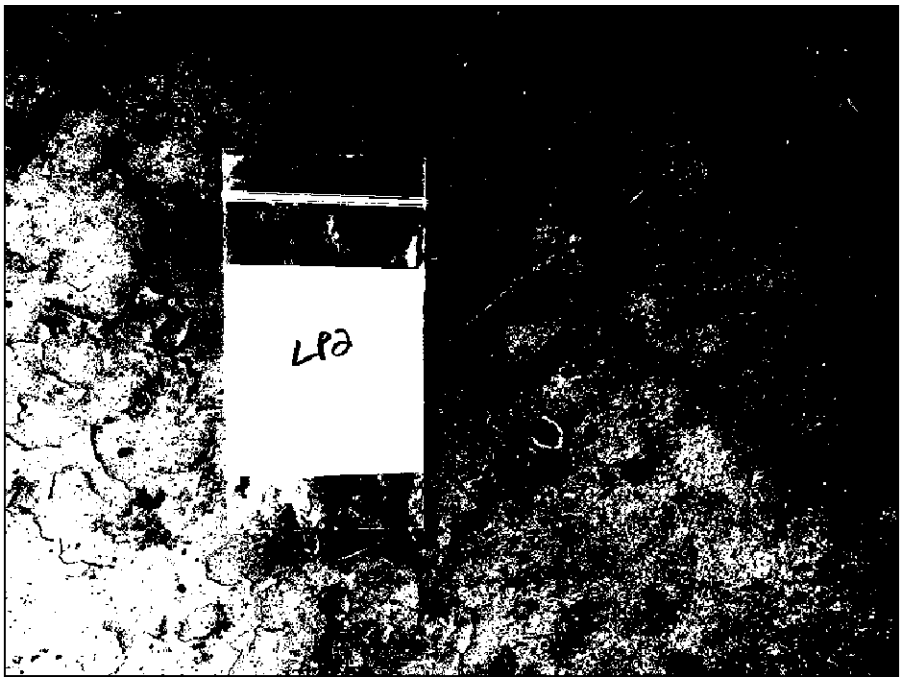
7 - View of Gray Mastic on Duct Work



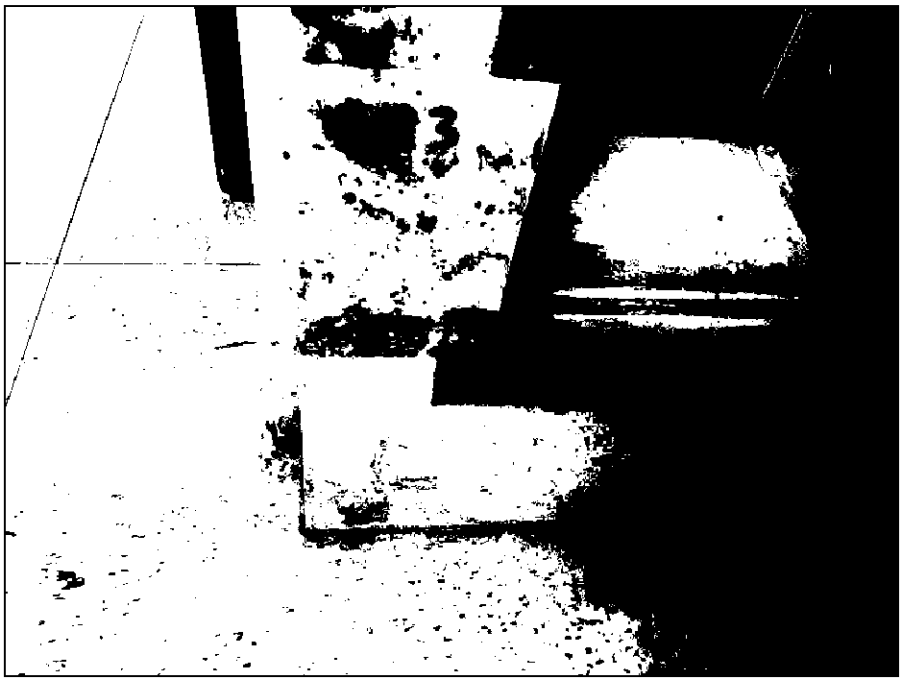
8 - View of HVAC Vibration Dampener

9 - View of Layered Tiles over Assumed ACM Black Mastic

10 - View of paint chip Sample LBP01, lead-containing



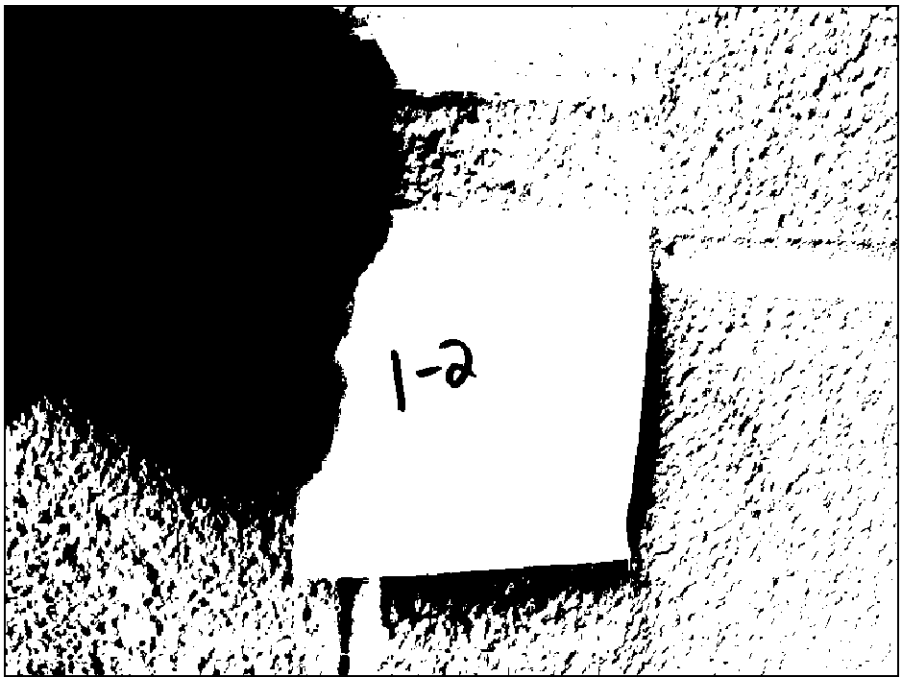
11 - View of paint chip Sample LBP02, lead-containing



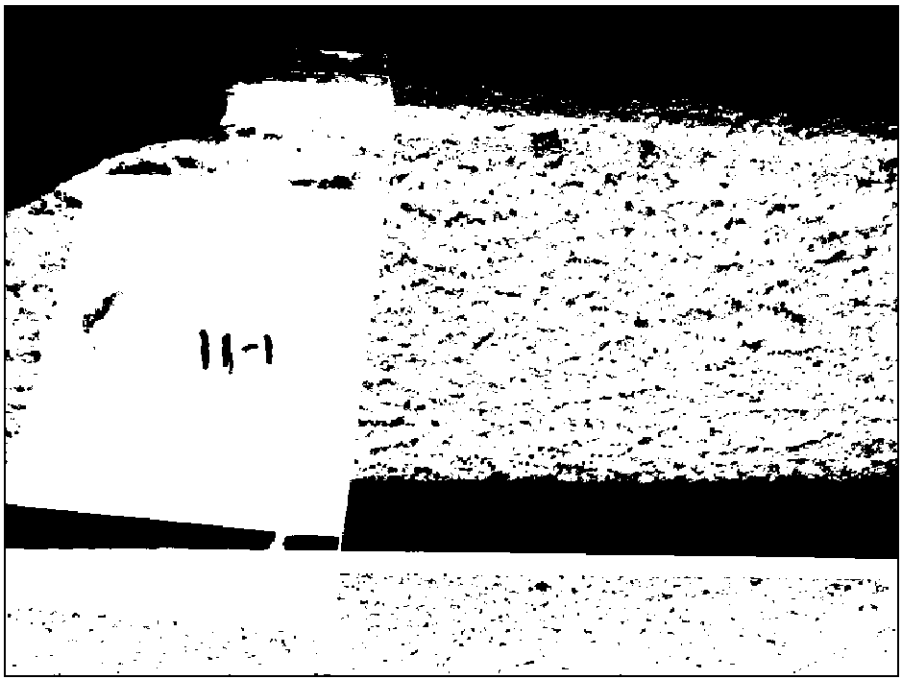
12 - View of paint chip Sample LBP03, lead paint not detected

13 - View of Lead Paint (Sample LBP04), lead paint not detected

14 - View of paint chip Sample LBP06, lead-containing



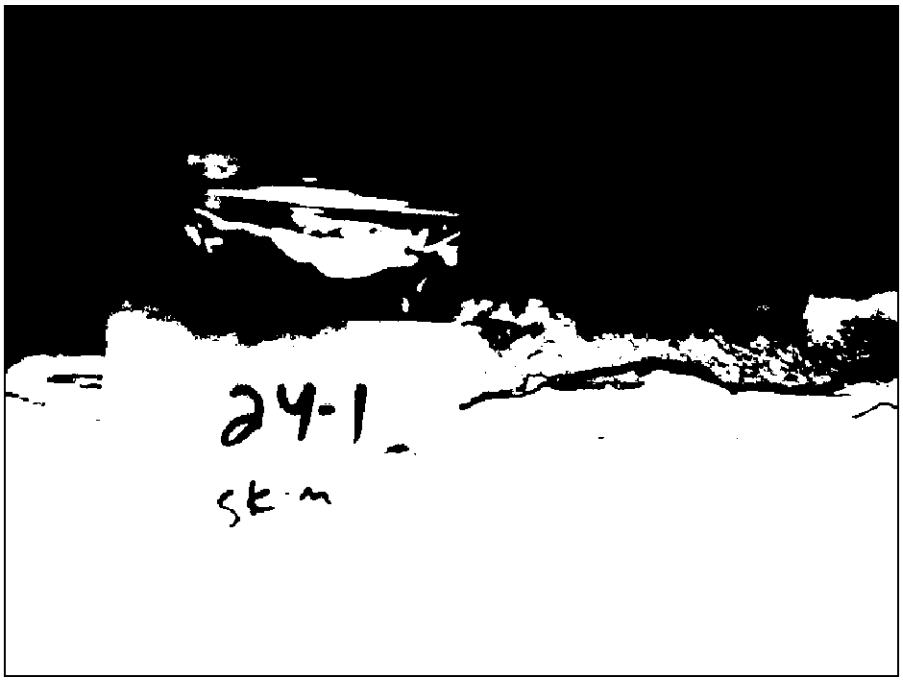
15 - View of Homogenous Area One (Samples 1-1,2,3)



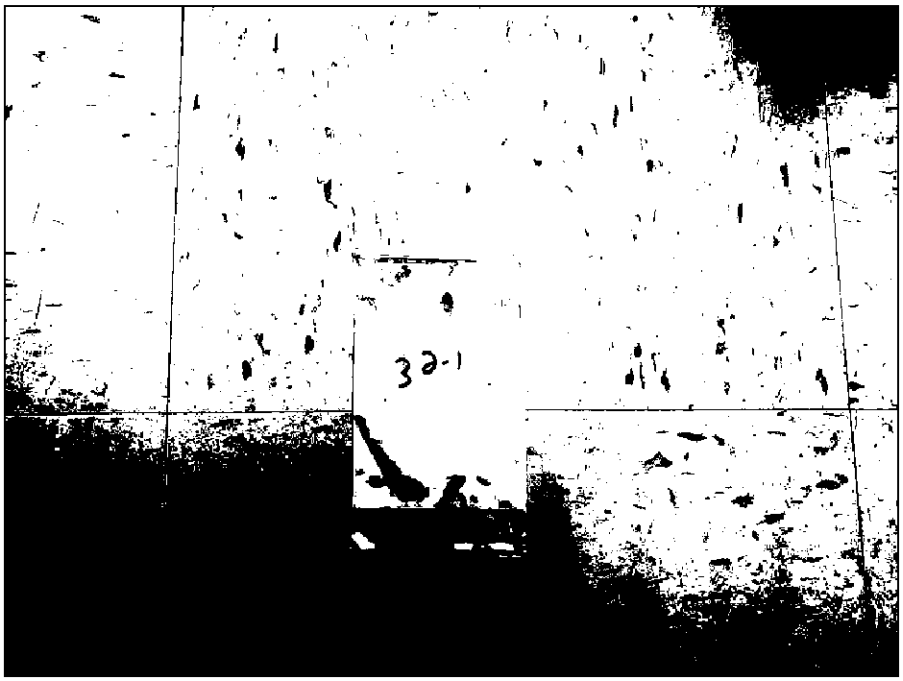
16 - View of Homogenous Area 11 (Samples 11-1,2)

17 - View of Homogenous Area 22 (Sample 22-1)

18 - View of Homogenous Area 23 (Samples 23-1,2)



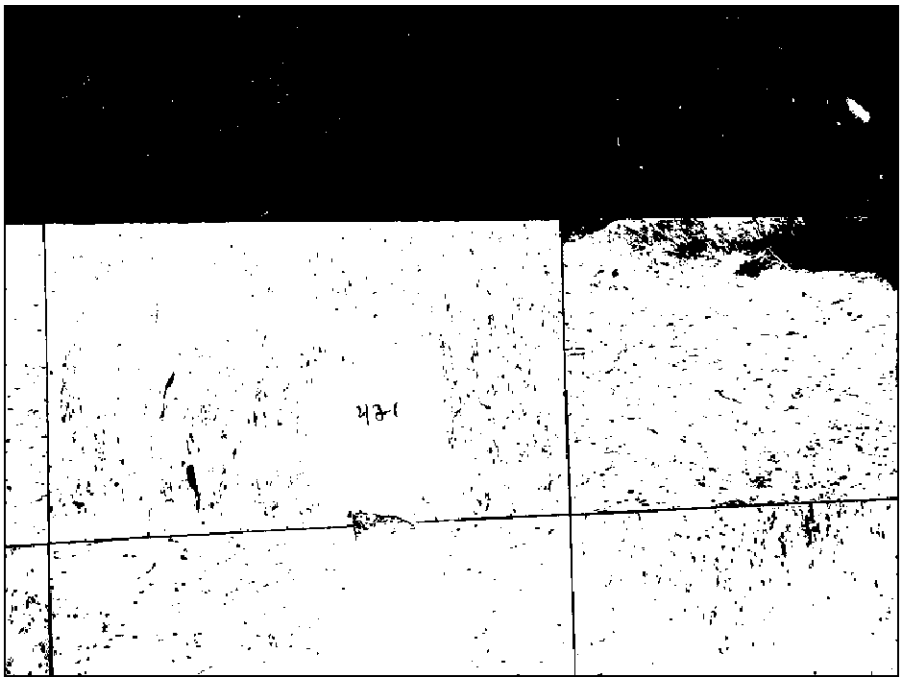
19 - View of Homogenous Area 24 (Samples 24-1,2)



20 - View of Homogenous Area 32 (Samples 32-1)

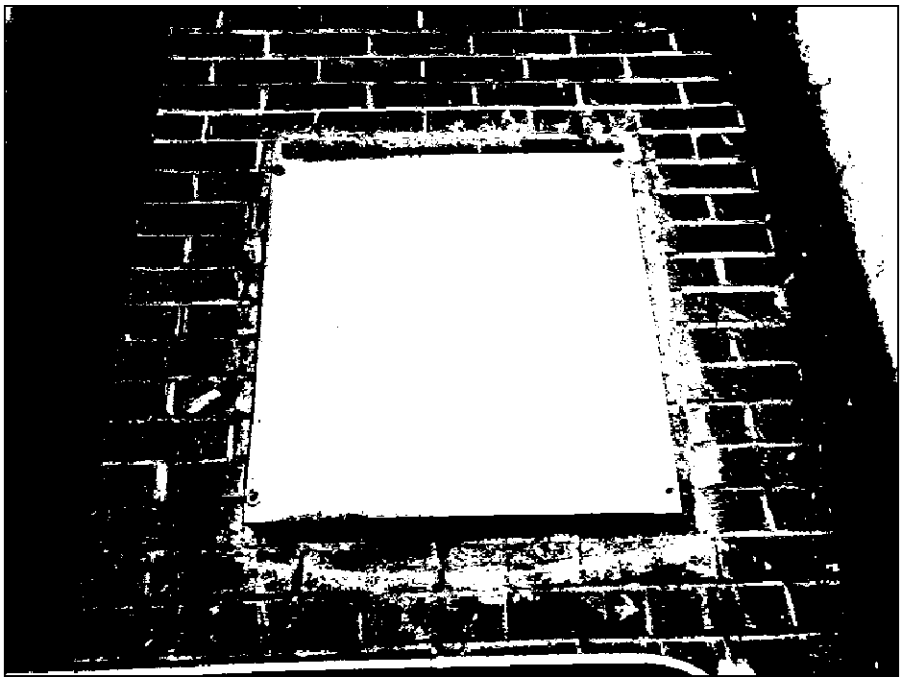
21 - View of Homogenous Areas 36 and 37

22 - View of Homogenous Area 41 (Samples 41-1,2)

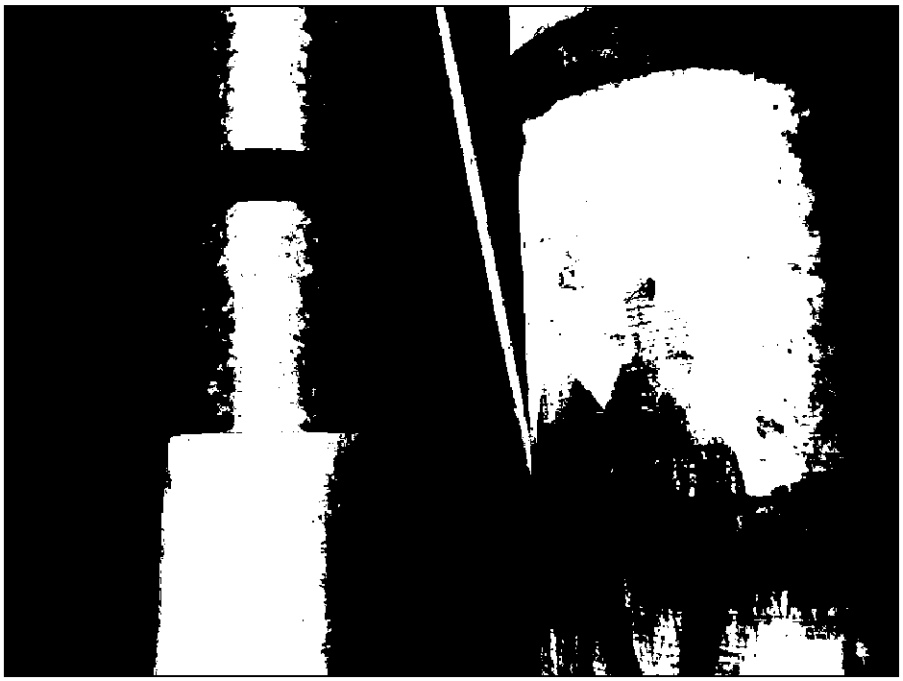


23 - View of Homogenous Area 42 (Samples 42-1)

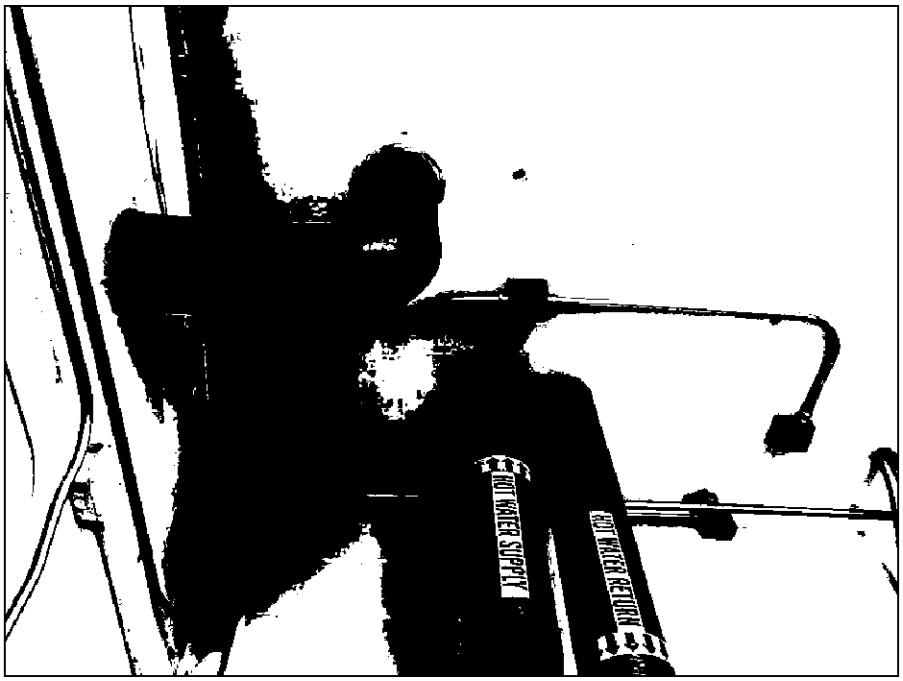
24 - View of Homogenous Area 45 (Samples 45-1,2)



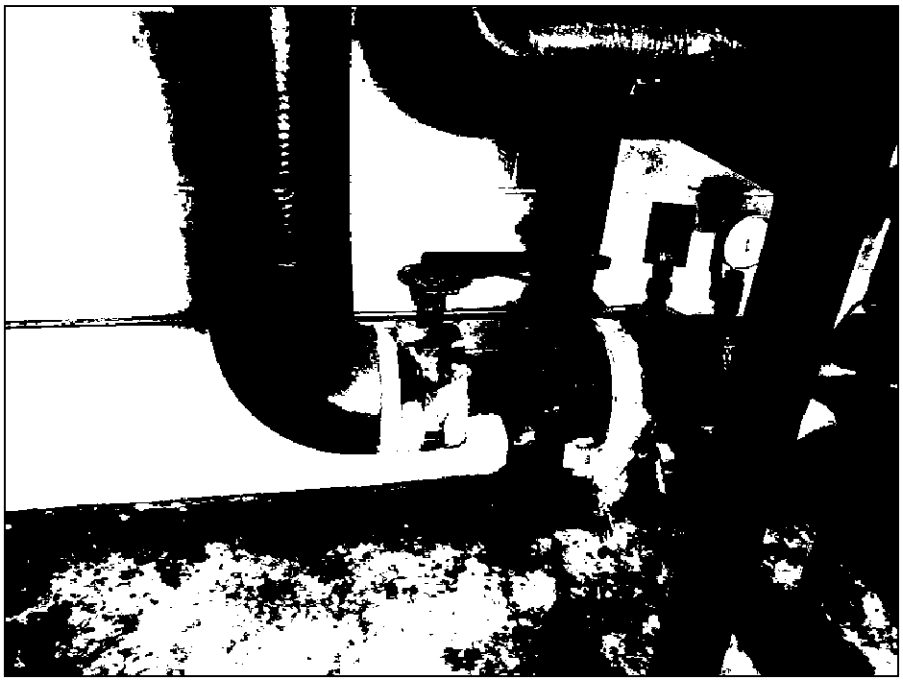
25 - IMG 8199 (Medium)



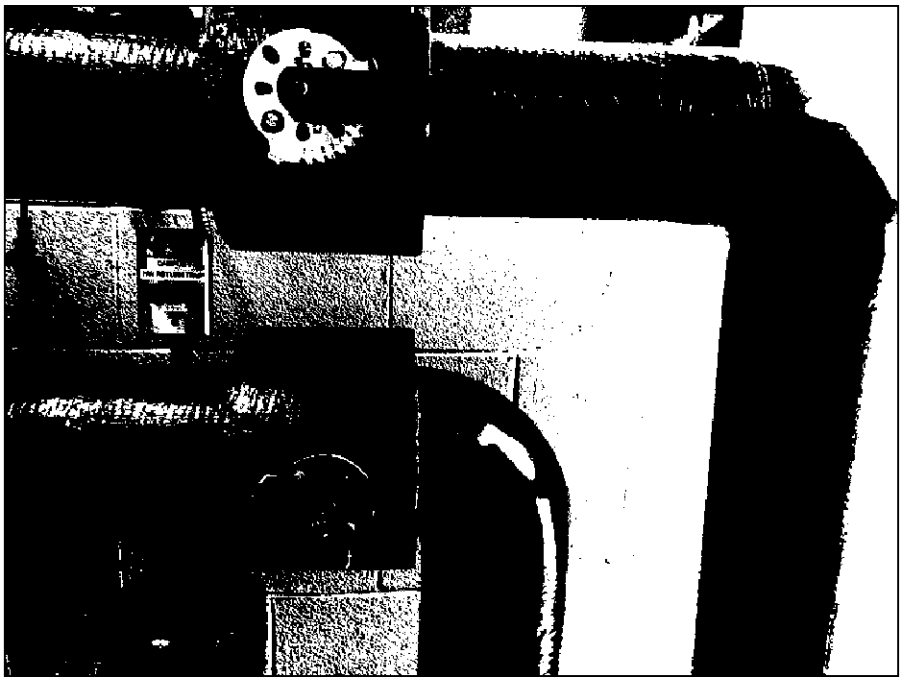
26 - View of TSI



27 - IMG 8198 (Medium)



28 - IMG 8197 (Medium)



29 - IMG 8196 (Medium)

Appendix III: Asbestos Bulk Sample Results

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September 7, 2022

ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

CLIENT PROJECT: UNCW King Hall, 49:18273
CEI LAB CODE: B2210933

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on September 1, 2022. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP®
TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

ECS Southeast, LLP

CLIENT PROJECT: UNCW King Hall, 49:18273

LAB CODE: B2210933

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 09/07/22

TOTAL SAMPLES ANALYZED: 81

SAMPLES >1% ASBESTOS: 22

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
1-1		B2210933.01	White	Cmu Wall Texture	None Detected
1-2		B2210933.02	White	Cmu Wall Texture	None Detected
1-3		B2210933.03	White	Cmu Wall Texture	None Detected
2-1	Layer 1	B2210933.04	Red,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.04	Yellow	Insulation	None Detected
2-2	Layer 1	B2210933.05	White,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.05	Yellow	Insulation	None Detected
2-3	Layer 1	B2210933.06	Blue,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.06	Yellow	Insulation	None Detected
3-1		B2210933.07	White,Gray	Insulation	Amosite <1%
3-2		B2210933.08	White,Gray	Insulation	Amosite <1%
4-1		B2210933.09	Red	Brick	None Detected
4-2		B2210933.10	Red	Brick	None Detected
5-1		B2210933.11	Gray	Liner	None Detected
5-2		B2210933.12	Gray	Liner	None Detected
5-3		B2210933.13	Gray	Liner	None Detected
6-1	Layer 1	B2210933.14	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.14	Yellow	Insulation	None Detected
6-2	Layer 1	B2210933.15	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.15	Yellow	Insulation	None Detected
6-3	Layer 1	B2210933.16	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.16	Yellow	Insulation	None Detected
7-1		B2210933.17	Gray	Hvac Sealant	None Detected
7-2		B2210933.18	Gray	Hvac Sealant	None Detected
8-1		B2210933.19	Black	Vibration Dampener	None Detected
8-2		B2210933.20	Black	Vibration Dampener	None Detected
9-1		B2210933.21	Black,Brown	Foundation Wp	None Detected
9-2		B2210933.22	Black,Brown	Foundation Wp	None Detected
10-1		B2210933.23A	Brown,Black	Covebase	None Detected
		B2210933.23B	Brown	Mastic	None Detected
11-1		B2210933.24	White	Textured Ceiling Tile	None Detected

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
11-2		B2210933.25	White	Textured Ceiling Tile	None Detected
12-1		B2210933.26	White	Vibration Dampener	Chrysotile 35%
13-1	Layer 1	B2210933.27	White	Hvac Sealant	None Detected
	Layer 2	B2210933.27	Black	Tar	Chrysotile 5%
13-2		B2210933.28		Sample Not Analyzed per COC	
14-1		B2210933.29	White,Beige	Drywall/Joint Compound	None Detected
14-2		B2210933.30	White	Drywall/Joint Compound	None Detected
15-1	Layer 1	B2210933.31	White	Pipe Wrap	None Detected
	Layer 2	B2210933.31	Yellow	Insulation	None Detected
15-2	Layer 1	B2210933.32	White	Pipe Wrap	None Detected
	Layer 2	B2210933.32	Yellow	Insulation	None Detected
15-3		B2210933.33	Gray,White	Pipe Wrap	None Detected
16-1		B2210933.34	White	Ceiling Tile	None Detected
16-2		B2210933.35	White	Ceiling Tile	None Detected
17-1		B2210933.36	Gray	Leveling Compound	None Detected
17-2		B2210933.37	Gray	Leveling Compound	None Detected
18-1		B2210933.38A	Cream Gray, Tan	Floor Tile	Chrysotile 2%
		B2210933.38B	Black	Mastic	Chrysotile 3%
18-2		B2210933.39A		Sample Not Analyzed per COC	
		B2210933.39B		Sample Not Analyzed per COC	
19-1		B2210933.40	Black	Sink Undercoating	None Detected
19-2		B2210933.41	Black	Sink Undercoating	None Detected
20-1		B2210933.42A	Cream,Brown	Covebase	None Detected
		B2210933.42B	Yellow,Beige	Mastic	None Detected
20-2		B2210933.43A	Cream,Brown	Covebase	None Detected
		B2210933.43B	Yellow,Beige	Mastic	None Detected
21-1		B2210933.44	Yellow	HVAC Mastic	None Detected
21-2		B2210933.45	Yellow	HVAC Mastic	None Detected
22-1		B2210933.46	White	Cmu Block Fill	None Detected
23-1		B2210933.47	White	Wall Caulk	Chrysotile <1%

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
23-2		B2210933.48	White	Wall Caulk	Chrysotile <1%
24-1	Layer 1	B2210933.49	White	Plaster Skim Coat	None Detected
	Layer 2	B2210933.49	Gray	Plaster Base Coat	None Detected
24-2	Layer 1	B2210933.50	White	Plaster Skim Coat	None Detected
	Layer 2	B2210933.50	Gray	Plaster Base Coat	None Detected
25-1		B2210933.51	White	Ceiling Tile	None Detected
25-2		B2210933.52	White	Ceiling Tile	None Detected
26-1		B2210933.53	Black	Mastic	Chrysotile 5%
26-2		B2210933.54		Sample Not Analyzed per COC	
27-1		B2210933.55	White	Wall Texture	Chrysotile 2%
27-2		B2210933.56		Sample Not Analyzed per COC	
28-1		B2210933.57A	Brown	Cove Base	None Detected
		B2210933.57B	Yellow	Mastic	None Detected
28-2		B2210933.58A	Brown	Cove Base	None Detected
		B2210933.58b	Yellow	Mastic	None Detected
29-1		B2210933.59	Red	Firestop	None Detected
29-2		B2210933.60	Red	Firestop	None Detected
30-1		B2210933.61	Pink	Firestop	None Detected
30-2		B2210933.62	Pink	Firestop	None Detected
31-1	Layer 1	B2210933.63A	Yellow	Mastic	None Detected
	Layer 2	B2210933.63A	White	Floor Tile	Chrysotile 2%
		B2210933.63B	Black,Yellow	Mastic	None Detected
32-1		B2210933.64	White,Black	Floor Tile	None Detected
33-1		B2210933.65A	Blue	Floor Tile	None Detected
		B2210933.65B	Yellow	Mastic	None Detected
34-1		B2210933.66	Black	Residual Mastic	Chrysotile 3%
35-1		B2210933.67A	Tan	Floor Tile	Chrysotile 2%
		B2210933.67B	Black	Mastic	Chrysotile 3%
35-2		B2210933.68A		Sample Not Analyzed per COC	
		B2210933.68B		Sample Not Analyzed per COC	
36-1		B2210933.69A	Gray	Floor Tile	None Detected

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
		B2210933.69B	Yellow,Black	Mastic	Chrysotile 5%
37-1		B2210933.70A	Gray	Floor Tile	Chrysotile 2%
		B2210933.70B	Black	Mastic	Chrysotile 5%
38-1		B2210933.71A	Gray,White	Floor Tile	None Detected
		B2210933.71B	Yellow	Mastic	None Detected
38-2		B2210933.72A	Gray,White	Floor Tile	None Detected
		B2210933.72B	Yellow	Mastic	None Detected
39-1		B2210933.73A	Tan	Floor Tile	None Detected
		B2210933.73B	Yellow	Mastic	None Detected
40-1		B2210933.74A	White	Floor Tile	Chrysotile 2%
		B2210933.74B	Black	Mastic	Chrysotile 5%
41-1		B2210933.75	White	Sink Undercoating	Chrysotile 3%
41-2		B2210933.76		Sample Not Analyzed per COC	
42-1		B2210933.77	Tan	Floor Tile	Chrysotile 2%
43-1		B2210933.78A	Tan	Floor Tile	Chrysotile 2%
		B2210933.78B	Black	Mastic	Chrysotile 5%
44-1		B2210933.79A	Olive	Floor Tile	Chrysotile 2%
		B2210933.79B	Black	Mastic	Chrysotile 5%
45-1		B2210933.80	Gray	Thin Set	None Detected
45-2		B2210933.81	Gray	Thin Set	None Detected
46-1		B2210933.82	White	Ext Window Caulk	None Detected
46-2		B2210933.83	White	Ext Window Caulk	None Detected
47-1		B2210933.84	White	Ext Window Glazing	Chrysotile <1%
47-2		B2210933.85	White	Ext Window Glazing	None Detected
48-1		B2210933.86A	White,Multicolor	Floor Tile	None Detected
		B2210933.86B	Yellow,Black	Mastic	Chrysotile 3%
48-2		B2210933.87A	White,Multicolor	Floor Tile	None Detected
		B2210933.87B		Sample Not Analyzed per COC	

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
1-1 B2210933.01	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
1-2 B2210933.02	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
1-3 B2210933.03	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
2-1 Layer 1 B2210933.04	Pipe Wrap	Heterogeneous Red,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.04	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
2-2 Layer 1 B2210933.05	Pipe Wrap	Heterogeneous White,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.05	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
2-3 Layer 1 B2210933.06	Pipe Wrap	Heterogeneous Blue,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.06	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
3-1 B2210933.07	Insulation	Homogeneous White,Gray Fibrous Loosely Bound	15%	Fiberglass	83% 2%	Binder Paint	<1% Amosite
Sample appears to be insulation. No caulking present.							
3-2 B2210933.08	Insulation	Homogeneous White,Gray Fibrous Loosely Bound	15%	Fiberglass	83% 2%	Binder Paint	<1% Amosite
Sample appears to be insulation. No caulking present.							
4-1 B2210933.09	Brick	Homogeneous Red Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
4-2 B2210933.10	Brick	Homogeneous Red Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
5-1 B2210933.11	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
5-2 B2210933.12	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
5-3 B2210933.13	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
6-1 Layer 1 B2210933.14	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected
Layer 2 B2210933.14	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
6-2 Layer 1 B2210933.15	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected
Layer 2 B2210933.15	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
6-3 Layer 1 B2210933.16	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected

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ASBESTOS BULK ANALYSIS

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2210933.16	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
7-1 B2210933.17	Hvac Sealant	Homogeneous Gray Non-fibrous Bound			100%	Mastic	None Detected
7-2 B2210933.18	Hvac Sealant	Homogeneous Gray Non-fibrous Bound			100%	Mastic	None Detected
8-1 B2210933.19	Vibration Dampener	Homogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
8-2 B2210933.20	Vibration Dampener	Homogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
9-1 B2210933.21	Foundation Wp	Heterogeneous Black,Brown Fibrous Bound	90%	Cellulose	10%	Tar	None Detected
9-2 B2210933.22	Foundation Wp	Heterogeneous Black,Brown Fibrous Bound	90%	Cellulose	10%	Tar	None Detected

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
10-1 B2210933.23A	Covebase	Homogeneous Brown,Black Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.23B	Mastic	Homogeneous Brown Non-fibrous Bound			100%	Mastic	None Detected
11-1 B2210933.24	Textured Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	15% 5%	Fiberglass Cellulose	5% 75%	Metal Foil Binder	None Detected
11-2 B2210933.25	Textured Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	15% 5%	Fiberglass Cellulose	5% 75%	Metal Foil Binder	None Detected
12-1 B2210933.26	Vibration Dampener	Homogeneous White Fibrous Bound	20%	Cellulose	45%	Binder	**35% Chrysotile**
13-1 Layer 1 B2210933.27	Hvac Sealant	Homogeneous White Non-fibrous Bound			100%	Mastic	None Detected
Layer 2 B2210933.27	Tar	Homogeneous Black Non-fibrous Bound			95%	Tar	**5% Chrysotile**
13-2 B2210933.28	Sample Not Analyzed per COC						

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
14-1 B2210933.29	Drywall/Joint Compound	Heterogeneous White,Beige Fibrous Bound	15%	Cellulose	75% 10%	Gypsum Calc Carb	None Detected
14-2 B2210933.30	Drywall/Joint Compound	Heterogeneous White Fibrous Bound	15%	Cellulose	75% 10%	Gypsum Calc Carb	None Detected
15-1 Layer 1 B2210933.31	Pipe Wrap	Homogeneous White Fibrous Bound	100%	Cellulose			None Detected
Layer 2 B2210933.31	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
15-2 Layer 1 B2210933.32	Pipe Wrap	Homogeneous White Fibrous Bound	100%	Cellulose			None Detected
Layer 2 B2210933.32	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
15-3 B2210933.33	Pipe Wrap	Heterogeneous Gray,White Fibrous Bound	80%	Cellulose	10% 10%	Metal Foil Binder	None Detected

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
16-1 B2210933.34	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
16-2 B2210933.35	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
17-1 B2210933.36	Leveling Compound	Homogeneous Gray Non-fibrous Bound	3%	Cellulose	97%	Binder	None Detected
17-2 B2210933.37	Leveling Compound	Homogeneous Gray Non-fibrous Bound	3%	Cellulose	97%	Binder	None Detected
18-1 B2210933.38A	Floor Tile	Homogeneous Cream Gray,Tan Non-fibrous Tightly Bound			98%	Vinyl	**2% Chrysotile**
B2210933.38B	Mastic	Homogeneous Black Non-fibrous Bound			97%	Mastic	**3% Chrysotile**
18-2 B2210933.39A	Sample Not Analyzed per COC						
B2210933.39B	Sample Not Analyzed per COC						

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
19-1 B2210933.40	Sink Undercoating	Homogeneous Black Non-fibrous Bound	<1%	Cellulose	90% 10%	Tar Binder	None Detected
19-2 B2210933.41	Sink Undercoating	Homogeneous Black Non-fibrous Bound	<1%	Cellulose	90% 10%	Tar Binder	None Detected
20-1 B2210933.42A	Covebase	Homogeneous Cream,Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.42B	Mastic	Homogeneous Yellow,Beige Non-fibrous Bound			100%	Mastic	None Detected
20-2 B2210933.43A	Covebase	Homogeneous Cream,Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.43B	Mastic	Homogeneous Yellow,Beige Non-fibrous Bound			100%	Mastic	None Detected
21-1 B2210933.44	HVAC Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected

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ASBESTOS BULK ANALYSIS

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6714 Netherlands Drive
Wilmington, NC 28405

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Date Received: 09-01-22
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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
21-2 B2210933.45	HVAC Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
22-1 B2210933.46	Cmu Block Fill	Homogeneous White Non-fibrous Bound		60% Binder 40% Paint	None Detected
23-1 B2210933.47	Wall Caulk	Homogeneous White Non-fibrous Bound		80% Binder 20% Calc Carb	<1% Chrysotile
23-2 B2210933.48	Wall Caulk	Homogeneous White Non-fibrous Bound		80% Binder 20% Calc Carb	<1% Chrysotile
24-1 Layer 1 B2210933.49	Plaster Skim Coat	Homogeneous White Non-fibrous Bound		80% Binder 20% Calc Carb	None Detected
Layer 2 B2210933.49	Plaster Base Coat	Homogeneous Gray Non-fibrous Bound		75% Silicates 25% Binder	None Detected
24-2 Layer 1 B2210933.50	Plaster Skim Coat	Homogeneous White Non-fibrous Bound		80% Binder 20% Calc Carb	None Detected

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ASBESTOS BULK ANALYSIS

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2210933.50	Plaster Base Coat	Homogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
25-1 B2210933.51	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
25-2 B2210933.52	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
26-1 B2210933.53	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
26-2 B2210933.54	Sample Not Analyzed per COC						
27-1 B2210933.55	Wall Texture	Heterogeneous White Non-fibrous Bound			58% 35% 5%	Binder Calc Carb Paint	**2% Chrysotile**
27-2 B2210933.56	Sample Not Analyzed per COC						
28-1 B2210933.57A	Cove Base	Homogeneous Brown Non-fibrous Bound			100%	Vinyl	None Detected

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ASBESTOS BULK ANALYSIS

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
B2210933.57B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
28-2 B2210933.58A	Cove Base	Homogeneous Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.58b	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
29-1 B2210933.59	Firestop	Homogeneous Red Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
29-2 B2210933.60	Firestop	Homogeneous Red Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
30-1 B2210933.61	Firestop	Homogeneous Pink Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
30-2 B2210933.62	Firestop	Homogeneous Pink Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected

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ASBESTOS BULK ANALYSIS

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6714 Netherlands Drive
Wilmington, NC 28405

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Date Received: 09-01-22
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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
31-1 Layer 1 B2210933.63A	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
Layer 2 B2210933.63A	Floor Tile	Homogeneous White Non-fibrous Tightly Bound			98%	Vinyl	**2% Chrysotile**
B2210933.63B	Mastic	Homogeneous Black,Yellow Non-fibrous Bound	2%	Cellulose	98%	Mastic	None Detected
32-1 B2210933.64	Floor Tile	Homogeneous White,Black Non-fibrous Tightly Bound			100%	Vinyl	None Detected
33-1 B2210933.65A	Floor Tile	Homogeneous Blue Non-fibrous Tightly Bound			100%	Vinyl	None Detected
B2210933.65B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
34-1 B2210933.66	Residual Mastic	Homogeneous Black Non-fibrous Bound			97%	Mastic	**3% Chrysotile**

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
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Lab Code: B2210933
Date Received: 09-01-22
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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
35-1 B2210933.67A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound		98%	Vinyl	**2% Chrysotile**
B2210933.67B	Mastic	Homogeneous Black Non-fibrous Bound		97%	Mastic	**3% Chrysotile**
35-2 B2210933.68A	Sample Not Analyzed per COC					
B2210933.68B	Sample Not Analyzed per COC					
36-1 B2210933.69A	Floor Tile	Homogeneous Gray Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.69B	Mastic	Homogeneous Yellow,Black Non-fibrous Bound		95%	Mastic	**5% Chrysotile**
37-1 B2210933.70A	Floor Tile	Homogeneous Gray Non-fibrous Tightly Bound		98%	Vinyl	**2% Chrysotile**
B2210933.70B	Mastic	Homogeneous Black Non-fibrous Bound		95%	Mastic	**5% Chrysotile**

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
38-1 B2210933.71A	Floor Tile	Homogeneous Gray,White Non-fibrous Tightly Bound		100% Vinyl	None Detected
B2210933.71B	Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
38-2 B2210933.72A	Floor Tile	Homogeneous Gray,White Non-fibrous Tightly Bound		100% Vinyl	None Detected
B2210933.72B	Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
39-1 B2210933.73A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound		100% Vinyl	None Detected
B2210933.73B	Mastic	Homogeneous Yellow Non-fibrous Bound		100% Mastic	None Detected
40-1 B2210933.74A	Floor Tile	Homogeneous White Non-fibrous Tightly Bound		98% Vinyl	**2% Chrysotile**

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Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
B2210933.74B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile
41-1 B2210933.75	Sink Undercoating	Homogeneous White Fibrous Bound	97%	Binder	3% Chrysotile
41-2 B2210933.76	Sample Not Analyzed per COC				
42-1 B2210933.77	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
43-1 B2210933.78A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
B2210933.78B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile
44-1 B2210933.79A	Floor Tile	Homogeneous Olive Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
B2210933.79B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
45-1 B2210933.80	Thin Set	Homogeneous Gray Non-fibrous Bound		75% 25%	Silicates Binder	None Detected
45-2 B2210933.81	Thin Set	Homogeneous Gray Non-fibrous Bound		75% 25%	Silicates Binder	None Detected
46-1 B2210933.82	Ext Window Caulk	Homogeneous White Non-fibrous Bound		100%	Caulk	None Detected
46-2 B2210933.83	Ext Window Caulk	Homogeneous White Non-fibrous Bound		100%	Caulk	None Detected
47-1 B2210933.84	Ext Window Glazing	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	<1% Chrysotile
47-2 B2210933.85	Ext Window Glazing	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	None Detected
48-1 B2210933.86A	Floor Tile	Homogeneous White,Multicolor Non-fibrous Tightly Bound		100%	Vinyl	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
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Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
B2210933.86B	Mastic	Homogeneous Yellow,Black Non-fibrous Bound		97%	Mastic	**3% Chrysotile**
Unable to separate mastics for analysis.						
48-2 B2210933.87A	Floor Tile	Homogeneous White,Multicolor Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.87B	Sample Not Analyzed per COC					

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LEGEND:	Non-Anth	= Non-Asbestiform Anthophyllite
	Non-Trem	= Non-Asbestiform Tremolite
	Calc Carb	= Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID and sample description.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP®
TESTING
NVLAP LAB CODE 101768-0

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September 22, 2022

ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

CLIENT PROJECT: UNCW King Hall, 49:18273
CEI LAB CODE: B2212107

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on September 19, 2022. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

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TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

ECS Southeast, LLP

CLIENT PROJECT: UNCW King Hall, 49:18273

LAB CODE: B2212107

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 09/22/22

TOTAL SAMPLES ANALYZED: 7

SAMPLES >1% ASBESTOS: 1

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2212107**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
49-1		B2212107.01	White	Wall Texture	None Detected
49-2		B2212107.02	White,Green	Wall Texture	None Detected
49-3		B2212107.03	White,Off-white	Wall Texture	**Chrysotile 2%**
49-4		B2212107.04	White,Green	Paint	None Detected
49-5		B2212107.05	White,Blue	Wall Texture	None Detected
49-6		B2212107.06	White	Wall Texture	None Detected
49-7		B2212107.07	White,Blue	Wall Texture	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2212107
Date Received: 09-19-22
Date Analyzed: 09-22-22
Date Reported: 09-22-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
49-1 B2212107.01	Wall Texture	Heterogeneous White Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected
49-2 B2212107.02	Wall Texture	Heterogeneous White,Green Non-fibrous Bound		60% 35% 5%	Binder Calc Carb Paint	None Detected
49-3 B2212107.03	Wall Texture	Heterogeneous White,Off-white Non-fibrous Bound		58% 35% 5%	Binder Calc Carb Paint	**2% Chrysotile**
49-4 B2212107.04 No wall texture present.	Paint	Heterogeneous White,Green Non-fibrous Bound		100%	Paint	None Detected
49-5 B2212107.05	Wall Texture	Heterogeneous White,Blue Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected
49-6 B2212107.06	Wall Texture	Heterogeneous White Non-fibrous Bound		60% 35% 5%	Binder Calc Carb Paint	None Detected
49-7 B2212107.07	Wall Texture	Heterogeneous White,Blue Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected

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LEGEND:
Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID and sample description.

ANALYST: Jacob Morgan

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Scott Minyard

NVLAP®
TESTING
NVLAP LAB CODE 101768-0

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CHAIN OF CUSTODY

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	B2210933
CEI Lab I.D. Range:	

(87)

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Jennifer Turner
Company: ECS Southeast	Email / Tel: jturner1@ecslimited.com 910 599 6285
Address: 6714 Netherlands Dr	Project Name: UNCW King Hall
Wilmington NC 28405	Project ID#: 49 18273
Email: jturner1@ecslimited.com	PO #: 49 18273
Tel: 910-599 6285 Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☒	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600	☐	☐	☐	☐	☐	☐
PLM BULK	CARB 435	☐	☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD	☐	☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16	☐	☐	☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD	☐	☐	☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD	☐	☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

Positive STOP Per HA Except Drywall Plasters / Texture

☒ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
[signature]	8-30-22 5:30PM	KF	9/1 1112

Samples will be disposed of 30 days after analysis

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast	Job Contact:
Project Name: UNCW King Hall	
Project ID #: 49 18273	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
1-1, 2, 3	CMU Wall Texture	HA1	PLM ☐	TEM ☐
2-1, 2, 3	Mech Rm Pipe Wrap	HA2	PLM ☐	TEM ☐
3-1, 2	Boiler Flu Stack White Caulking	HA3	PLM ☐	TEM ☐
4-1, 2	Boiler Flu Stack Blk. Gk	HA4	PLM ☐	TEM ☐
5-1, 2, 3	Boiler Flu Stack Liner	HA5	PLM ☐	TEM ☐
6-1, 2, 3	Crawl Space 3" Pipe Wrap	HA6	PLM ☐	TEM ☐
7-1, 2	Gray HVAC Sealant	HA7	PLM ☐	TEM ☐
8-1, 2	Crawl Space 8" Flex Vibration Damper	HA8	PLM ☐	TEM ☐
9-1, 2	Crawl Space Blk Foundation WP	HA9	PLM ☐	TEM ☐
10-1	Brn Coveburse w/ Mastics	HA10	PLM ☐	TEM ☐
11-1, 2	2'x2' White Textured Ceiling Tile	HA11	PLM ☐	TEM ☐
12-1	HVAC Vibration Dampner	HA12	PLM ☐	TEM ☐
13-1, 2	White HVAC Sealant	HA13	PLM ☐	TEM ☐
14-1, 2	Drywall / Joint Compound	HA14	PLM ☐	TEM ☐
15-1, 2, 3	2" Pipe Wrap	HA15	PLM ☐	TEM ☐
16 1, 2	2'x2' White Pinhole CT	HA16	PLM ☐	TEM ☐
17-1, 2	Gray leveling Compound	HA17	PLM ☐	TEM ☐
18-1, 2	12"x12" ~~Green~~ Cream w/	HA18	PLM ☐	TEM ☐
	Gray + Tan Mottling FT		PLM ☐	TEM ☐
19-1, 2	Blk Sink Undercoating	HA19	PLM ☐	TEM ☐
20-1, 2	Cream Coveburse w/ Blk Mastic	HA20	PLM ☐	TEM ☐
21-1, 2	Yellow HVAC Mastic	HA21	PLM ☐	TEM ☐
22-1	CMU Block Fill	HA22	PLM ☐	TEM ☐
23-1, 2	Wall Caulk	HA23	PLM ☐	TEM ☐
24-1, 2	Plaster Wall System	HA24	PLM ☐	TEM ☐
25-1, 2	2'x4' White Pinhole CT	HA25	PLM ☐	TEM ☐
26-1, 2	Black Mastic on 6" Pipe	HA26	PLM ☐	TEM ☐
27-1, 2	Wall Texture 2nd FL	HA27	PLM ☐	TEM ☐

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
28-1,2	Brn CB w/ Yellow Mastic	HA28	PLM ☐	TEM ☐
29-1,2	Red Firestop	HA29	PLM ☐	TEM ☐
30-1,2	P.nK Firestop	HA30	PLM ☐	TEM ☐
31-1	Unknow FT under 12x12 White w/ BK	HA31	PLM ☐	TEM ☐
~~32-1~~	Specs FT + Blk / Yellow Mastic		PLM ☐	TEM ☐
32-1	12" x12" White w/ Black	HA32	PLM ☐	TEM ☐
-	Specs FT		PLM ☐	TEM ☐
33-1	12x12 Gr Blue FT w/ Yellow	HA33	PLM ☐	TEM ☐
	Mastic		PLM ☐	TEM ☐
34-1	Reschurnl Black Mastic	HA34	PLM ☐	TEM ☐
35-1,2	Unknow Tan FT w/ Black Mas	HA35	PLM ☐	TEM ☐
36-1	12" x12" Gray FT w/ Gray/Blk Streaks	HA36	PLM ☐	TEM ☐
37-1	12" x12" White FT w/ Blk Streak	HA37	PLM ☐	TEM ☐
38-1,2	12" x12" Gray FT w/ White Streaks	HA38	PLM ☐	TEM ☐
39-1	12" x12" Tan FT under	HA39	PLM ☐	TEM ☐
	12" x12" Gray FT		PLM ☐	TEM ☐
40-1			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
			PLM ☐	TEM ☐
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			PLM ☐	TEM ☐
			PLM ☐	TEM ☐

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CHAIN OF CUSTODY

7

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	B212107
CEI Lab I.D. Range:	

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Jenn Turner
Company: ECS Southeast	Email / Tel: 910-599-6285 jturner1@ecslimited.com
Address: 6714 Netherlands Drive	Project Name: UNCW King Hall
Wilmington, NC 28405	Project ID#: 49:18273
Email: jturner1@ecslimited.com	PO #: 49:18273
Tel: 910-599-6285 Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☒	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600	[redacted]	☐	☐	☐	☐	☐
PLM BULK	CARB 435	[redacted]	☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD	[redacted]	☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16	[redacted]		☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD	[redacted]		☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD	[redacted]	☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

No Positive Stop

☑ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
Jennifer Turner	9/15/22 5:00 PM	BF	9/19 930

Samples will be disposed of 30 days after analysis

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast	Job Contact:
Project Name: UNCW King Hall	
Project ID #: 49:18273	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST			
49-1	Wall texture - 1st Fl by MechRm	HA 1	PLM	X	TEM	
-2	1st FL Hallway		PLM		TEM	
-3	1st FL Front Hall		PLM		TEM	
-4	1st FL Hall by Office		PLM		TEM	
-5	2nd FL by Electric Panel		PLM		TEM	
-6	2nd FL Front Hallway		PLM		TEM	
-7	2nd FL Inner Hallway		PLM		TEM	
			PLM		TEM	
			PLM		TEM	
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			PLM		TEM	

Version: CCOC.01.18.2/2.LD

Appendix IV: Lead Laboratory Analytical Results

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Eurofins CEI
730 SE Maynard Road
Cary, NC 27511

TEL: 866-481-1412
TEL: 919-481-1413
FAX: 919-481-1442

LABORATORY REPORT
LEAD IN PAINT

Client: **ECS Southeast, LLP**
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: C220783
Received: 09-01-22
Analyzed: 09-07-22
Reported: 09-07-22

Project: UNCW King Hall, 49:18273

METHOD: EPA SW846 7000B

CLIENT ID	LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT
LBP01	CA4105	1900	**0.19**
LBP02	CA4106	56	**0.0056**
LBP03	CA4107	<39	**<0.0039**
LBP04	CA4108	<35	**<0.0035**
LBP05	CA4109	330	**0.033**
LBP06	CA4110	620	**0.062**
LBP07	CA4111	1900	**0.19**
Sample contains substrate, potentially affecting results			

Eurofins CEI
730 SE Maynard Road
Cary, NC 27511

TEL: 866-481-1412
TEL: 919-481-1413
FAX: 919-481-1442

Project: UNCW King Hall, 49:18273

Lab Code: C220783

METHOD: EPA SW846 7000B

CLIENT ID	LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT

Reviewed By:

Tianbao Bai, Ph.D.
Laboratory Director

This method has been validated for sample weights of 0.020g or greater. When samples with a weight of less than that are analyzed those results fall outside of the scope of accreditations.
*** The analysis of composite wipe samples as a single samples is not included under AIHA accreditation.**

Minimum reporting limit is 10 µg total lead. Sample results denoted with a "less than" (<) sign contain less than 10.0 µg total lead, based on a 40ml sample volume.

Lead samples are not analyzed by Eurofins CEI Lead samples are submitted to an AIHA ELLAP accredited laboratory for lead analysis of soil, dust, paint, and TCLP samples.
Laboratory results represent the analysis of samples as submitted by the client. Information regarding sample location, description, area, volume, etc., was provided by the client. Unless notified in writing to return samples, Eurofins CEI discards client samples after 30 days. This report shall not be reproduced, except in full, without the written consent of Eurofins CEI.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

REGULATORY LIMITS

OSHA Standard: No safe limit.
Consumer Products Safety Standard: Greater than 0.009% lead by weight.
Federal Lead Standard / HUD: 0.5% lead by weight.

LEGEND

µg = microgram	ppm = parts per million	g = grams
ml = milliliter	Pb = lead	wt = weight

End of Report

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CHAIN OF CUSTODY

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	C220783
CEI Lab I.D. Range:	CA4105-CA4111

(1)

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact:
Company: ECS Southeast, LLP	Email / Tel:
Address: 6714 Netherlands Drive	Project Name:
Wilmington, NC 28405	ID#
Email:	PO #:
Tel: 910-686-9114 Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

Analyte	METHOD	TURN AROUND TIME					
		4 HR**	8 HR**	1 DAY**	2 DAY	3 DAY	5 DAY
LEAD PAINT	EPA SW846 7000B				☐	☐	☐
LEAD WIPE	EPA SW846 7000B				☐	☐	☐
LEAD SOIL	EPA SW846 7000B				☐	☐	☐
LEAD AIR	EPA SW846 7000B				☐	☐	☐
LEAD TCLP	EPA SW846 7000B				☐	☐	☐
RCRA 8 METALS	EPA SW846 7000B				☐	☐	☐
RCRA 8 TCLP	EPA SW846 7000B				☐	☐	☐
OTHER:					☐	☐	☐

TAT IS NOT AVAILABLE. LEAD SAMPLES ARE SUBCONTRACTED FOR ANALYSIS TO AN ELLAP ACCREDITED LAB.

REMARKS:	☒ Accept Samples ☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
		JF	9/1 10 25

Samples will be disposed of 30 days after analysis

eurofins

SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast LLP	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/AREA	COMMENTS

Appendix V: XRF Lead-Based Paint Readings

XRF shot number	XRF reading	Color	Substrate	Component	Location	Side
1	0.2	White	Wood	Porch Overhang	Exterior	A
2	0.3	White	Wood	Porch Trim	Exterior	A
3	0.4	White	Metal	Door Casing	Exterior	A
4	0.2	White	CMU	Wall	Back Right Stairwell	B
5	-0.3	Black	Metal	Stair Stinger	Back Right Stairwell	D
6	-0.1	Black	Metal	Stiar Riser	Back Right Stairwell	D
7	-0.1	Beige	Metal	Door Casing	1st Floor Hallway	C
8	-0.1	Beige	Metal	Door Casing	1st Floor Hallway	B
9	0.2	Off-White	Ceramic	Tile	Womens Restroom	C
10	0.0	White	Wood	Window Casing	Interior	C
11	0.2	White	Wood	Window Sill	Interior	C
12	-0.3	Light Blue	Gypsum	Wall	By Front Entrance	C
13	0.4	White	Wood	Window Casing	Halfmoon Entrance Wnd	C
14	-0.1	White	Gypsum	Wall	By Front Office	D
15	-0.2	White	Plaster	Wall Texture	By Womens Restroom	B
16	0.1	Beige	Metal	Door Casing	Front Office	D
17	-0.2	Light Blue	Gypsum	Wall	By Womens Restroom	B
18	0.2	Light Blue	CMU	Wall	Back Left Stairwell	D
19	0.0	White	Metal	Door Casing	Mechanical Room	B
20	-0.2	White	Gypsum	Wall	Back Left Stairwell	B
21	-0.1	White	Wood	Windown Sill	2nd Floor Interior	A
22	0.0	Gray	Metal	Eletrical Pannel	2nd Floor Hallway	D
23	-0.1	White	Metal	Door Casing	2nd Floor Hallway	B
24	0.1	Tan	Metal	Door Casing	2nd Floor Hallway	C
25	-0.2	Light Blue	Plaster	Wall Texture	2nd Floor Hallway	C
26	-0.3	White	Plaster	Wall Texture	2nd Floor Hallway	D
27	0.0	Gray	Metal	Radiator	2nd Floor Stairwell	B
28	0.0	White	Wood	Wood Casing	Exterior	A
29	0.2	White	Wood	Window Pannel	Exterior	A
30	0.5	White	Wood	Window Sill	Exterior	A
31	0.3	White	Wood	Window Casing	Exterior	A

Appendix VI: Certifications/ Licenses

NC DEPARTMENT OF
HEALTH AND
HUMAN SERVICES

ROY COOPER • Governor

KODY H. KINSLEY • Secretary

HELEN WOLSTENHOLME • Interim Deputy Secretary for Health

MARK T. BENTON • Assistant Secretary for Public Health

Division of Public Health

June 20, 2022

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

Dear Ms. Desaix:

Based upon the review of your accreditation application, the Health Hazards Control Unit (HHCU) has determined that you have fulfilled the requirements and are eligible for asbestos accreditation as a(n) ABATEMENT PROJECT DESIGNER. Your assigned North Carolina accreditation number is 40530, which is reflected on your enclosed North Carolina Accreditation card. Please be sure to take this card with you to any asbestos work site where you are employed. The State requires that all persons conducting asbestos abatement or asbestos management activities be accredited and have their identification card on site.

Your North Carolina Abatement Project Designer accreditation will expire on MAY 31, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Abatement Project Designer after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to May 31, 2023. If you should continue to perform asbestos management activities as a(n) Abatement Project Designer without a valid North Carolina accreditation, you will be in violation of State regulations and may be cited for noncompliance.

Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit

North Carolina
Asbestos Accreditation

[redacted]

DOB	SEX	HT	WT
07-19-1977	F	5'4"	140

CLASS	#	EXP
DESIGNER	40530	
INSPECTOR	12107	

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

136671

NC DEPARTMENT OF
HEALTH AND
HUMAN SERVICES

ROY COOPER • Governor

KODY H. KINSLEY • Secretary

HELEN WOLSTENHOLME • Interim Deputy Secretary for Health

MARK T. BENTON • Assistant Secretary for Public Health

Division of Public Health

August 15, 2022

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

Dear Ms. Desaix:

The Health Hazards Control Unit (HHCU) has determined that you have fulfilled the application requirements and are eligible for lead certification as a(n) INSPECTOR. Your assigned Inspector certification number is 110230, which is reflected on your enclosed North Carolina Lead Certification card. The State requires that all persons conducting regulated lead-based paint activities be certified and have their identification card on-site.

A "Lead-Based Paint Activity Summary" shall be submitted to the HHCU by the certified inspector or risk assessor within 45 days of each inspection, risk assessment, or lead hazard screen conducted. The information shall be submitted on a form provided or approved by the Program, per 10A NCAC 41C .0807(b), Lead-Based Paint Hazard Management Program Rules.

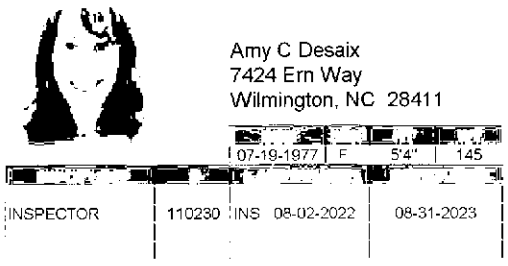
Accredited refresher training must be completed at least every 24 months from the date of the last accredited training course **AND** within twelve months prior to applying for certification. The HHCU strongly recommends that individuals note the date of certification expiration and ensure all refresher training meets the above requirements.

Your North Carolina Inspector certification will expire on AUGUST 31, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Inspector after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to August 31, 2023. If you should perform lead-based paint activities as a(n) Inspector without a valid North Carolina certification, you will be in violation of State regulations and may be cited for noncompliance.

If you have any questions, please contact our office at (919) 707-5954.

Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit



Appendix VII: Previous Reports

2242.02
B-3

ENGINEERING CONSULTING SERVICES, LTD.
Geotechnical • Construction Materials • Environmental

August 20, 2003

Mr. Rick Wash
Wash Hatem Nelson Architects
330 West Tenth Street
Charlotte, North Carolina 28202

Reference: Report of Lead-Based Paint Survey
University of North Carolina Wilmington
King Hall
Wilmington, North Carolina
ECS, Ltd. Project G-8042

Dear Mr. Wash:

Engineering Consulting Services, Ltd. (ECS) has completed a lead-based paint survey at the above referenced property. The purpose of the testing was to determine the presence and general location of lead-based paint (LBP) on the interior and exterior of the building prior to planned renovation activities. This report contains the testing procedures and our conclusions and recommendations.

PROJECT INFORMATION

We understand that renovations are planned for King Hall located on the campus of the North Carolina Wilmington (UNCW) in Wilmington, North Carolina. King Hall is a two-story, 22,000 square foot building brick building that was constructed in the 1960s. The building contains a lecture auditorium, classrooms, offices, and laboratories. The building has brick and wood exterior walls and a pitched roof with shingles. Interior finishes in the building consist of drywall and masonry block walls; ceiling tile ceilings; and terrazzo, carpet, tile or linoleum floors over a concrete slab.

1.0 LEAD - BASED PAINT (LBP) TESTING

1.1 Lead-Based Paint Survey Procedures

The building was reportedly constructed in the 1960s. The Consumer Products Safety Commission banned the use of LBP in 1978. Therefore, there is the potential that lead-based paint may have been used in the facility. Lead-based paint testing was performed on July 22, 2003 by Mr. Shawn Tucker (NC Lead Inspector/Risk Assessor #120049) of ECS. The survey began by randomly selecting painted surfaces in the different areas of the building (storage areas, restrooms, offices, common areas, exterior areas, etc.) and exterior painted areas of the building. Typical test areas included walls, ceilings, doors, door frames, interior trim, columns, exterior walls, and handrails, gutters, etc. Lead testing was performed based on planned renovations to the building as communicated to us by Mr. Greg Walker with UNCW.

1.2 Lead-Based Paint Test Procedures

The sampling was performed using a calibrated Scitec Spectrum Analyzer (X-Ray Fluorescence Lead-Based Paint Analyzer). An XRF screen reading was taken at each test location. The Department of Housing and Urban Development (HUD) and the State of North Carolina defines a lead-based paint as having "a lead content of 1.0 mg/cm^2 of painted surface". Approximately 94 test locations were analyzed in the building using the XRF. The results of the lead based paint survey using the XRF are presented in Table 2 - Summary of Lead Survey.

1.3 Lead-Based Paint Results

Lead in excess of EPA and State of North Carolina levels was detected in window sills and interior and exterior window mullions of the building.

1.4 Lead-Based Paint Conclusions and Recommendations

The lead-based paint can be maintained and monitored as part of an operations and maintenance program. It appears that lead-based paint is confined to older painted surfaces of the building. There are several options for managing lead-based paint during renovations to the facility. The most practical method for dealing with lead-based paint is to remove (in whole components) and dispose of the building components that contain lead-based paint (windows, etc.) and replace them with new components that do not contain lead-based paint. This option can increase building material costs on a renovation project, but it eliminates the majority of the lead-based paint at the facility. If lead-based paint will be disturbed (sanded, scraped), you must follow applicable EPA, State of North Carolina and OSHA lead-based paint guidelines when working with, handling and disposing of lead-based paint. In addition, subcontractors (such as painting contractors) must be informed of the location of lead-based paint prior to disturbing it. In most cases it is recommended that lead abatement contractors remove loose flakes and prepare the surface prior to repainting.

1.5 Qualifications of Lead-Based Paint Survey

This report summarizes our evaluation of the conditions observed at the site. The findings prepared by ECS are based upon testing performed in the facility. Additional lead-based paint may exist (undetected) in other areas due to their inaccessibility or due to the limited nature of our testing. Our recommendations are based on the guidelines presented in EPA, State of North Carolina or OSHA lead-based paint regulations.

2.0 CLOSING

ECS appreciates the opportunity to provide our environmental services for this project. We can assist you with preparing lead removal plans and specifications, holding pre-bid meetings, and air monitoring and clearance testing. If you have questions or need additional information, please contact us at (336) 856-7150.

Respectfully,

ENGINEERING CONSULTING SERVICES, LTD.

Shawn M Tucker, REM
Project Scientist

Brian E. Maas, REM, CMR
Principal Scientist

Attachments: Table 1 - Summary of Lead Survey
Drawing 1 - Lead Sample Locations - 1st Floor
Drawing 2 - Lead Sample Locations - 2nd Floor

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
1	Exterior Door	West Entrance	White	Wood	Fair	0.23	0.18
2	Exterior Door Frame	West Entrance	White	Metal	Fair	0.15	--
3	Exterior Handrail	West Entrance	Black	Metal	Fair	0.10	--
4	Exterior Handrail	West Entrance	Black	Metal	Fair	0.47	0.31
5	Exterior Door	Northeast Entrance	White	Wood	Fair	0.30	-0.10
6	Exterior Door Frame	Northeast Entrance	White	Metal	Fair	0.02	--
7	Exterior Window Sill	Northeast Entrance	White	Metal	Fair	0.23	0.16
8	Exterior Window Mullion	Northeast Entrance	White	Metal	Fair	**6.12**	0.59
9	Exterior Window Mullion	Southeast Entrance	White	Metal	Fair	**5.65**	0.94
10	Exterior Window Sill	Southeast Entrance	White	Metal	Fair	0.58	0.10
11	Exterior Handrail	South Entrance	Black	Metal	Fair	0.03	--
12	Gutter	South Side of Building	Brown	Metal	Fair	0.31	--
13	Exterior Door	South Entrance	White	Wood	Fair	-0.15	0.04
14	Exterior Door Frame	South Entrance	White	Metal	Fair	-0.08	--
15	Handrail	North Side	Yellow	Metal	Fair	0.16	--
16	Gutter	North Side	Brown	Metal	Fair	0.25	--
17	Piping	Boiler Room	Green	Metal	Fair	0.28	--
18	Piping	Boiler Room	Blue	Metal	Fair	0.39	--
19	Piping	Boiler Room	Red	Metal	Fair	0.06	--
20	Piping	Boiler Room	Gray	Metal	Fair	0.19	--
21	Wall	Boiler Room	White	Masonry	Fair	0.29	0.34
22	Door	Boiler Room	White	Metal	Fair	0.33	--
23	Door Frame	Boiler Room	White	Metal	Fair	0.44	--
24	Wall	Lobby	Green	Concrete	Good	0.11	0.32
25	Wall	Exterior of Room 104	White	Drywall	Good	-0.16	0.17

K & L Values are in mg/cm^2
A result greater than 1.0 mg/cm^2 is considered lead-based paint
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
26	Wall	Across from Room 104	Tan	Ceramic Tile	Good	0.54	-0.98
27	Baseboard	Across from Room 104	Tan	Ceramic Tile	Good	0.06	0.29
28	Wall	Outside of Room 106	White	Drywall	Good	-0.23	0.48
29	Wall	Outside of Room 106G	White	Masonry Block	Good	-0.42	-0.14
30	Window Sill	Lobby, Near Room 104	White	Wood	Good	-0.26	-0.00
31	Window Frame	Lobby, Near Room 104	White	Wood	Good	0.28	0.38
32	Wall	Outside of Women's Restroom	White	Drywall	Good	-0.33	--
33	Door	Northeast Entrance	White	Wood	Good	0.08	0.15
34	Door Frame	Northeast Entrance	White	Metal	Good	-0.06	0.30
35	Wall Panel	Outside of Room 102	Green	Wood	Good	0.25	--
36	Wall	Room 102	White	Drywall	Good	0.12	0.40
37	Wall	Near Room 103A	White	Drywall	Good	-0.08	0.43
38	Wall	Room 103	White	Masonry Block	Good	-0.03	0.30
39	Wall	Near Room 102G	White	Drywall	Good	0.26	0.62
40	Door	Room 102I	Stain	Wood	Good	0.03	0.09
41	Door Frame	Room 102I	White	Metal	Good	-0.04	--
42	Window	Room 102C	Stain	Wood	Good	0.09	0.23
43	Window Sill	Room 102C	Stain	Wood	Good	-0.22	0.12
44	Door Frame	Room 102K	White	Metal	Good	-0.35	--
45	Door	Room 102K	Stain	Wood	Good	-0.08	-0.09
46	Baseboard	Women's Room	Green	Ceramic Tile	Good	0.30	-0.62
47	Floor	Women's Room	Green	Ceramic Tile	Good	0.00	0.18
48	Baseboard	Lobby	Tan	Ceramic Tile	Good	0.68	-1.01
49	Wall	Room 208	White	Masonry Block	Good	0.01	-0.30
50	Wall	Room 208	White	Drywall	Good	-0.12	0.18

K & L Values are in mg/cm²
A result greater than 1.0 mg/cm² is considered lead-based paint
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
51	Window Mullion	Room 208	White	Wood	Good	0.26	0.40
52	Window Sill	Room 208	White	Wood	Good	**2.49**	0.46
53	Window Sill	Room 208	White	Wood	Good	0.05	0.05
54	Window Mullion	Room 208	White	Wood	Good	**8.22**	0.91
55	Wall	2nd Floor, Mechanical Room	Gray	Drywall	Fair	0.21	0.18
56	Wall	Room 104	White	Masonry Block	Good	0.11	0.20
57	Window Mullion	Room 104	White	Wood	Good	**6.66**	0.94
58	Window Sill	Room 104	White	Wood	Good	-0.04	0.04
59	Window Mullion	Near Room 104	White	Wood	Good	**7.44**	0.55
60	Door	Room 106D	Stain	Wood	Good	-0.13	0.20
61	Door Frame	Room 106D	Stain	Wood	Good	0.19	0.30
62	Wall	Room 106 Hall	White	Drywall	Good	0.12	0.29
63	Door	Room 106	Stain	Wood	Good	0.32	0.11
64	Door Frame	Room 106	White	Metal	Good	-0.22	--
65	Window Mullion	Room 106	White	Wood	Good	**8.35**	0.89
66	Window Sill	Room 106	White	Wood	Good	-0.10	0.14
67	Wall	Room 106 Hall	White	Masonry Block	Good	-0.14	0.11
68	Wall	Auditorium	Gray	Masonry Block	Good	0.12	0.35
69	Wall	Auditorium	Gray	Masonry Block	Good	0.05	0.05
70	Stringer	South Stairwell	Black	Metal	Good	0.21	--
71	Riser	South Stairwell	Black	Metal	Good	-0.07	--
72	Newel Post	South Stairwell	Black	Metal	Good	0.17	--
73	Radiator	South Stairwell	Gray	Metal	Good	0.63	--
74	Window Mullion	South Stairwell	White	Wood	Good	**1.01**	0.27
75	Window Frame	South Stairwell	White	Wood	Good	0.07	0.28

K & L Values are in mg/cm^2
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Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
76	Wall	Room 212	White	Drywall	Good	-0.04	0.37
77	Window Mullion	Room 212	White	Wood	Good	**10.27**	**1.17**
78	Window Sill	Room 212	White	Wood	Good	0.11	0.06
79	Door	Room 211	Stain	Wood	Good	-0.13	0.17
80	Door Frame	Room 211	White	Steel	Good	0.15	--
81	Wall	Room 211	White	Drywall	Good	-0.04	0.09
82	Window Mullion	Room 209E	White	Wood	Good	**6.00**	0.63
83	Window Sill	Room 209E	White	Wood	Good	0.03	0.17
84	Wall	Room 209E	White	Masonry Block	Good	0.27	0.29
85	Cabinet	Room 209, Breakroom	White	Wood	Good	-0.23	-0.08
86	Wall	Room 206	Blue	Drywall	Good	0.13	0.35
87	Door Frame	Room 206	Blue	Steel	Good	-0.14	--
88	Window Mullion	Room 206	White	Wood	Good	**7.31**	0.87
89	Window Sill	Room 206	White	Wood	Good	0.01	0.04
90	Wall	Room 203	White	Drywall	Good	0.00	0.15
91	Wall	Room 203, Kitchen	Yellow	Drywall	Good	0.14	0.21
92	Door	2nd Floor, Elevator	Tan	Steel	Good	0.11	--
93	Door Frame	2nd Floor, Elevator	Tan	Steel	Good	0.20	--
94	Cabinet	Room 201	Stain	Wood	Good	-0.05	0.23

K & L Values are in mg/cm²
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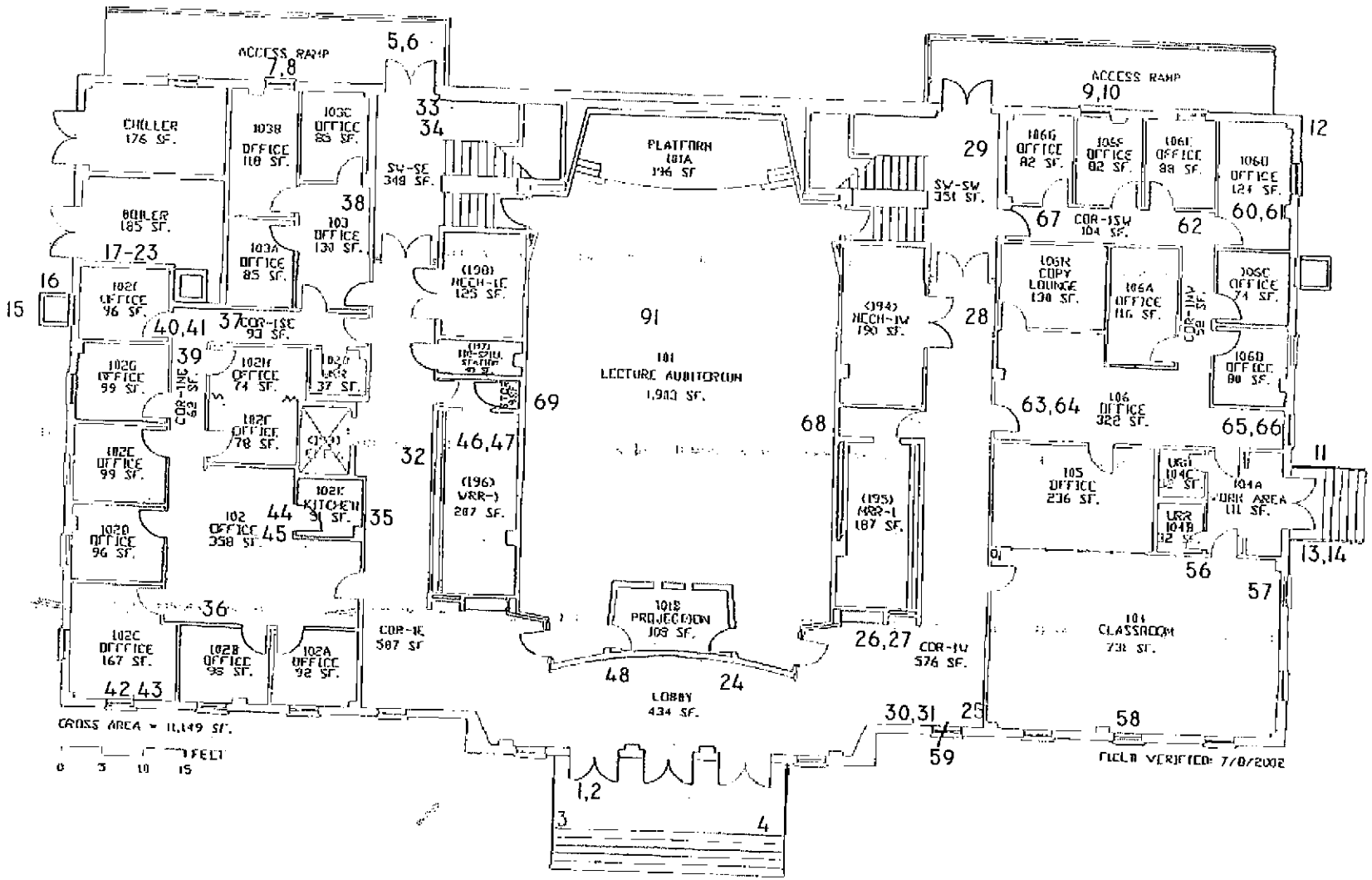
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present



KING HALL FIRST FLOOR PLAN

NOT TO SCALE

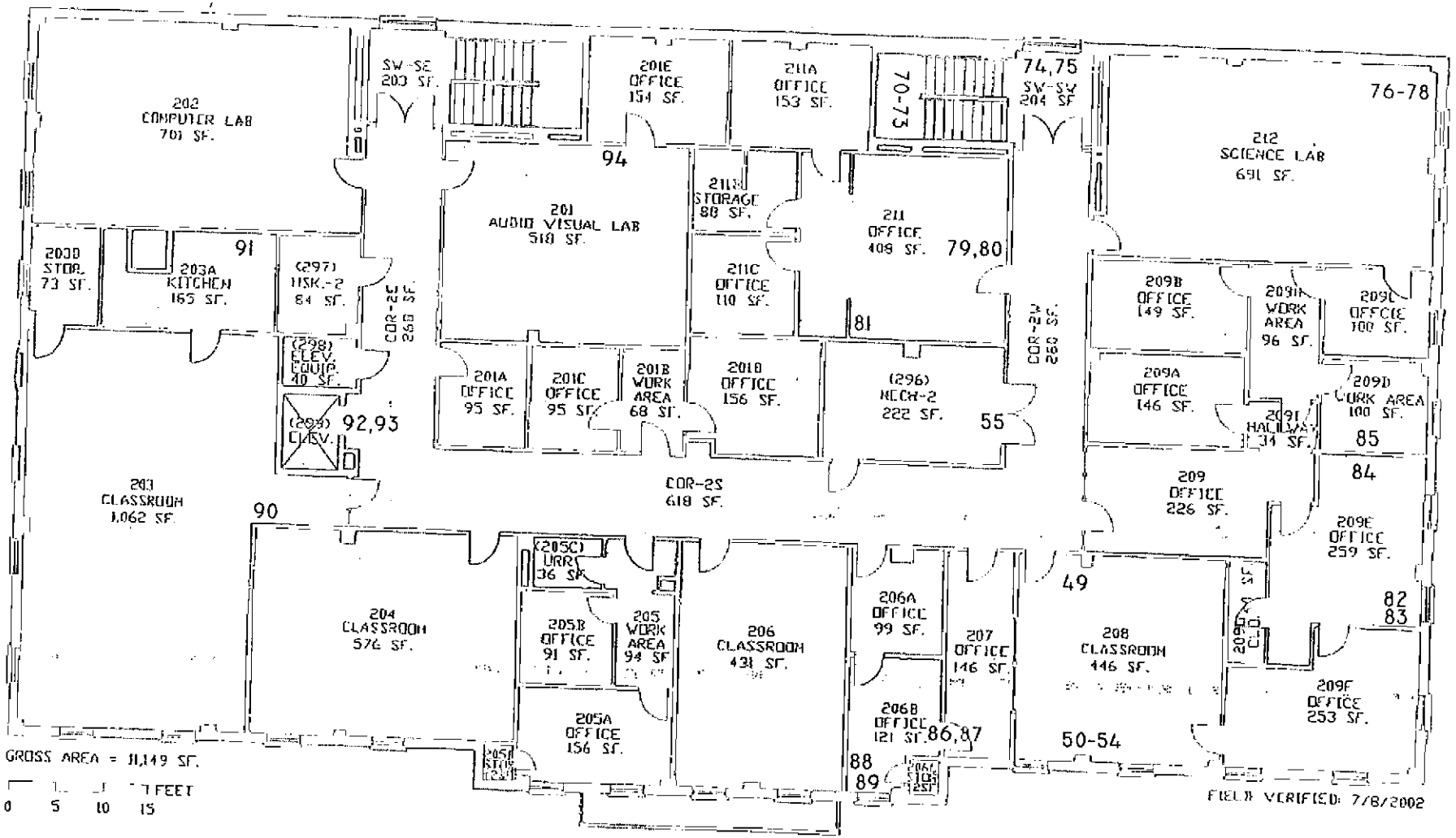
REFERENCE:
SITE PLAN PROVIDED BY
WASH HATEM NELSON AND
ASSOCIATES

ECS LTD
ENGINEERING
CONSULTING
SERVICES, LTD

FIGURE 2
LEAD SAMPLE LOCATIONS

UNCW
KING HALL–1ST FLOOR
WILMINGTON, NORTH CAROLINA

DRAWN BY/DATE:	CHECKED BY/DATE:	PROJECT NO.
TAC/08-05-03		G-8042



61 KING HALL SECOND FLOOR PLAN

NOT TO SCALE

REFERENCE:
SITE PLAN PROVIDED BY
WASH HATEM NELSON AND
ASSOCIATES

ECS LTD
ENGINEERING
CONSULTING
SERVICES, LTD

FIGURE 3
LEAD SAMPLE LOCATIONS

UNCW
KING HALL–2ND FLOOR
WILMINGTON, NORTH CAROLINA

DRAWN BY/DATE:	CHECKED BY/DATE:	PROJECT NO.
TAC/08-05-03		G-8042

S&ME

April 15, 2002

Lee Nichols Architecture
301 East Ninth Street, Suite 110
Charlotte, North Carolina 28202

ATTENTION: Mr. Garry Neavitt

Reference: **ASBESTOS SURVEY**
King Hall
University of North Carolina - Wilmington
Wilmington, North Carolina
S&ME Project No. 1355-02-251

Dear Mr. Neavitt:

S&ME, Inc. (S&ME) is pleased to provide you with the results of an asbestos survey of King Hall classroom building at the University of North Carolina Wilmington (UNCW). On March 28, 2002 Jonathan Borntrager and Chris Hamblet of S&ME, Inc. (S&ME) visited the site in Wilmington, North Carolina to perform the fieldwork associated with the asbestos survey. The roof, building exterior and interior were included in the scope of work. This assessment was performed according to our Proposal No. 1355-10244-01, dated June 12, 2001 and is needed for the renovation plans that are being designed for the building.

BACKGROUND INFORMATION

King Hall is presently in use and houses classrooms, offices and an auditorium. The building is a two-story structure, approximately 23,000 square feet in size. It is a masonry structure with metal support beams that are not insulated. The perimeter walls and interior load bearing walls are concrete block covered with plaster. The non-load bearing walls are drywall construction. The floors throughout the building are concrete and are covered with various selections of floor tiles or carpet. Suspended ceiling tiles are located throughout the building, creating an open air-plenum for the ventilation system.

S&ME, Inc.
3118 Spring Forest Road
Raleigh, North Carolina 27616

Mailing address:
P.O. Box 58069
Raleigh, North Carolina 27658-8069

(919) 872-2660
(919) 790-9827 fax
www.smeinc.com

All accessible areas of the building were included in the asbestos survey. However, surveys performed by S&ME for suspect asbestos-containing materials (ACM's) are limited to materials that are reasonably accessible. Suspect materials hidden in pipe chases, under a layer of flooring, behind walls and mechanical equipment, above solid ceilings or encased in columns should be assumed to contain asbestos if the inspector was not able to collect a sample of these materials. Further sampling may be needed to confirm the presence or absence of asbestos if a hidden suspect material becomes accessible during the renovation operations.

FINDINGS

During the asbestos survey, a total of 55 samples were collected for analysis, represent 25 types of suspect materials. Types of materials sampled include floor coverings, ceiling tiles, plaster, drywall components, textured wall covering, thermal system insulation and roofing materials.

Samples of suspect materials were placed in containers for transportation to S&ME's analytical laboratory in Charlotte, North Carolina. The samples were analyzed using polarized light microscopy (PLM) coupled with dispersion staining. This technique identifies asbestos fibers based on six unique optical and morphological characteristics: morphology, color, refractive index, extinction angle, signs of elongation, and dispersion staining colors. Refer to the appendix for a table displaying the results of the samples collected. Asbestos content is estimated and expressed as a percent of the total sample. Analytical forms can also be found in the appendix.

The United States Environmental Protection Agency (USEPA) considers a material to be asbestos containing if the asbestos content is greater than 1% by weight/volume. Asbestos material can be classified as friable or non-friable. A friable material can be easily crushed when dry with moderate hand pressure. Friable materials are more susceptible to damage and may potentially release fibers more readily than non-friable materials.

The following materials tested positive for the presence of asbestos.

Friable Asbestos-Containing Materials

- (KHK) A cloth vibration damper located in the second floor mechanical room contains 20% to 55% chrysotile asbestos. The damper is approximately three inches wide and 80 feet long (~20 square feet). It is installed in a large air-handling unit that occupies most of the room. This damper is in good condition.

- (KHW-KHP-KHO) The mud type insulation used on the steam and hot water pipes (2", 3" and 4" diameter pipes) throughout the building contain 2% amosite asbestos. The outer wrap on the 4" pipe fittings contains as much as 4% chrysotile asbestos. These pipe fitting insulations were found to be in good to fair condition. The inspector's noted approximately 22 2"-fittings, 46 3"-fittings, and 26 4"-fittings during the survey. However, additional fittings insulated with ACM may be located above the suspended ceiling tiles or in pipe chases.

- (KHY) In addition, the boiler flue located in the boiler room is insulated with a thermal system insulation that contains 15% amosite asbestos and 2% chrysotile asbestos. There is approximately 50 cubic feet of the insulation and it is in good condition.

Non-friable Asbestos-Containing Materials

- (KHB) A sample of the silver and black roof flashing was found to contain 2% chrysotile asbestos. This material is located around the 12 roof risers (approximately 12 square feet) that penetrate the field of the roof and is in good condition.

- Most of the floor tiles and mastics located throughout the building were found to contain 2% to 4% chrysotile asbestos. Following is a list of the positive floor tiles, which were all found to be in good condition:

(KHG)	1' x 1' white with gray and black specks	7,000 square feet
(KHI)	black mastic beneath carpet	300 square feet
(KHJ)	1' x 1' cream with white and gray flecks	27 square feet
(KHQ)	1' x 1' off-white with gray streaks	4,000 square feet
(KHR)	1' x 1' cream with gray and tan streaks	145 square feet
(KHS)	1' x 1' grayish black tiles	370 square feet
(KHU)	1' x 1' white with black dots	2,200 square feet

RECOMMENDATIONS

For building renovation, the asbestos-containing materials are required to be removed if they are friable and will be disturbed or if the material is nonfriable and the renovation operations will render

the material to be a "Regulated Asbestos-Containing Material (RACM)". RACM is (a) friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces expected to act on the material during demolition or renovation operations. These criteria are outlined in the "Asbestos/NESHAP Regulated Asbestos-Containing Materials Guidance, EPA 340/1-90-018".

It is probable that the thermal system insulations, vibration damper, roof flashing, floor tiles and mastics could be disturbed during the renovation to the building and should be carefully considered. Materials that will be disturbed will need to be properly removed before the renovations continue. The ACM should be removed in accordance with USEPA National Emission Standards for Hazardous Air Pollutants (NESHAP) Asbestos Regulations (40 CFR 61, Subpart M) and/or the approved state or local requirements equivalent to this regulation. It is required that a North Carolina Licensed Asbestos Abatement Contractor be used to properly remove and dispose of the ACM, because friable materials are involved.

CLOSING

We appreciate the opportunity to provide environmental services to Lee Nichols Architecture. If you have any questions, please call our office at (919) 872-2660.

Sincerely,
S&ME, Inc.

Beth Roberts
Project Professional

C. Mike Cashio, CIH
IH Department Manager

Enclosures
S:\Environ\2002 Jobs\1355-02-251 UNCW King Hall\1355-02-251-Report-SR.doc

TABLES

TABLE 1A
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHA	MISC-NF-I Roof flashing - black	Roof - perimeter flashing	KHA-01	Roof - ND Insulation - ND	Good	N/A
			KHA-02	Roof - ND Insulation - ND		
KHB	MISC-NF-I Roof flashing - silver and black	Roof - around penetrations	KHB-03	ND	Good	~ 12 square feet (12 risers)
			KHB-04	2% Chrysotile		
KHC	MISC-NF-I Roof felt and shingles	Roof - field	KHC-05	ND	Good	N/A
			KHC-06	ND		
KHD	MISC-F Drywall components	Wall partitions in the classrooms and offices	KHD-07	ND	Good	N/A
			KHD-08	<1% Chrysotile		
KHE	SURF-F Plaster	Walls partitions in the restrooms, auditorium, chiller room and boiler room	KHE-09	Smooth Coat - ND Plaster - ND	Good	N/A
			KHE-32	ND		
KHF	MISC-F Suspended ceiling tiles - 2' x 2' with fissures & pinholes	Offices and classrooms throughout most of the building and the back part of the auditorium	KHF-10	ND	Good	N/A
			KHF-45	ND		
KHG	MISC-NF-I Floor tiles - 1' x 1' white with gray and black specks	Flooring used throughout most of the second floor	KHG-11	Tile - 2% chrysotile Mastic - 3% chrysotile	Good	~ 7,000 square feet
			KHG-12	Tile - 2% chrysotile Mastic - 4% chrysotile		
			KHG-21	Tile - 2% chrysotile Mastic 1 - 3% chrysotile Mastic 2 - ND		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1B
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHH	MISC-F Suspended ceiling tiles - 2' x2' white textured tiles	Lobby and corridor around the auditorium on 1st floor and the main corridor on the 2nd floor	KHH-13	ND	Good	N/A
			KHH-38	ND		
KHI	MISC-NF-I Black Mastic - Beneath carpet and atop concrete in 206 Offices	Beneath the carpet in the 205 offices	KHI-14	2% chrysotile	Good	~ 300 square feet
			KHI-15	2% chrysotile		
KHJ	MISC-NF-I Floor tiles - 1' x 1' cream with white and gray flecks	205 Offices Restroom	KHJ-16	Tile - ND Mastic - 2% chrysotile	Good	~ 27 square feet
			KHJ-48	Tile - ND Mastic - <1% chrysotile		
KHK	MISC-F Cloth vibration damper	Mechanical Room - 2nd Floor	KHK-17	55% chrysotile	Good	~ 20 square feet
			KHK-18	20% chrysotile		
KHL	MISC-F Suspended ceiling tiles - 2' x 4' white with fissures and pinholes	Mechanical Room - 2nd Floor	KHL-19	ND	Fair	N/A
			KHL-28	ND		
KHM	MISC - F Suspended ceiling tiles - 2' x 4' white textured tiles	206 and 207 offices	KHM-20	ND	Good	N/A
			KHM-22	ND		
KHN	MISC-NF-I Floor tile - 1' x 1 dark gray with black & white spots	Corridor outside of the Dean's office on the 2nd floor	KHN-23	ND	Good	N/A
			KHN-24	ND		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1C
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHO	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical equipment rooms, chiller room, boiler room and above plenum on 3" pipes	KHO-25	Wrap - ND Insulation - 2% amosite	Good	~ 46 fittings (visible)
			KHO-26	Wrap - ND Insulation - 2% amosite		
			KHO-27	Insulation - 2% amosite		
KHP	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical equipment rooms, chiller room, boiler room and above plenum on 4" pipes	KHP-29	Wrap 1 - ND Wrap 2 - 4% chrysotile Insulation - 2% amosite	Good	~ 26 fittings (visible)
			KHP-30	Wrap 1 - ND Wrap 2 - 3% chrysotile Insulation - <1% amosite		
			KHP-31	Wrap 1 - ND Insulation - 2% amosite		
			KHP-53	Wrap - ND Insulation - 2% amosite		
KHQ	MISC-NF-I Floor tiles - 1' x 1' off-white with gray streaks	Throughout most of the 1st floor office and classroom area.	KHQ-34	Tile - 3% chrysotile Mastic - 4% chrysotile	Good	~ 4,000 square feet
			KHQ-37	Tile - 3% chrysotile Mastic - 2% chrysotile		
			KHQ-39	Tile - 3% chrysotile Mastic - ND		
KHR	MISC-NF-I Floor tiles - 1' x 1' cream with gray and tan streaks	1st floor kitchen areas	KHR-33	Tile - 2% chrysotile Mastic - 2% chrysotile	Good	~ 145 square feet
			KHR-42	ND		
KHS	MISC-NF- I Floor tiles - 1' x 1' grayish black tiles	Classroom 104 - 1st Floor	KHS-35	Tile - 4% chrysotile Mastic - 4% chrysotile	Good	~ 370 square feet
			KHS-36	Tile - 4% chrysotile Mastic - <1% chrysotile		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1D
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHT	MISC-F Suspended ceiling tiles - 2' x 4' white with fissures and pinholes	Office supply room and adjacent offices	KHT-40	ND	Good	N/A
			KHT-41	ND		
KHU	MISC-NF-I Floor Tiles - 1' x 1' white with black dots	Auditorium and adjacent storage room	KHU-43	Tile - 3% chrysotile Mastic - 4% chrysotile	Good	~ 2,200 square feet
			KHU-44	Tile - 3% chrysotile Mastic - 4% chrysotile		
KHV	MISC-F Drywall components with a white textured finish	Corridors, east mechanical room, bio. spill room and women's bathroom foyer	KHV-46	<1% chrysotile	Good	N/A
			KHV-47	ND		
KHW	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical areas, boiler room, chiller room and above the plenum on the 2" pipes	KHW-49	Wrap - ND Insulation - 2% amosite, <1% chrysotile	Fair	~ 22 fittings (visible)
			KHW-50	Wrap - ND Insulation - 2% amosite		
KHX	MISC-NF-II Window glazing	Window exteriors throughout the building	KHX-51	ND	Fair	N/A
			KHX-52	ND		
KHY	TSI-F Boiler flue insulation	Boiler Room - 1st Floor	KHY-54	Wrap - ND Insulation - 15% amosite, 2% chrysotile	Good	~ 50 cubic feet
			KHY-55	Wrap - ND Insulation - 15% amosite, 2% chrysotile		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

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MISC = Miscellaneous material
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NF-II = Category II non-friable material

APPENDIX

S&ME

9751 Southern Pine Boulevard
Charlotte, NC 28273
704-523-4726 Fax 704-523-3953
NVLAP ID 102075-0

POLARIZED LIGHT MICROSCOPY
Performed by EPA 600/R-93/116 Method

Asbestos Analysis Summary

Client Name Charlotte Branch
9751 Southern Pine Blvd.
Charlotte
Client Job UNCW King Hall
NC 29273

Job Number 1355-02-251

Date Received 4/1/02
Date Analyzed 4/4/02

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4304A	KH-A-01	BLACK FIBROUS	ROOF	ND	10 GLASS	90 OTHER
02-4304B	KH-A-01	GREY FIBROUS	INSULATION	ND	98 CELLULOSE	2 PERLITE
02-4305A	KH-A-02	BLACK FIBROUS	ROOF	ND	10 GLASS	90 OTHER
02-4305B	KH-A-02	GREY FIBROUS	INSULATION	ND	98 CELLULOSE	2 PERLITE

Analyzed by: Jane Wasilewski

Jane Wasilewski
Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4306	KH-B-03	BLACK/SILVER FIBROUS		ND	25 SYNTHETIC <1 GLASS	75 OTHER
02-4307	KH-B-04	BLACK/SILVER FIBROUS		2 CHRYSOTILE	15 SYNTHETIC 2 GLASS	81 OTHER
02-4308	KH-C-05	BLACK FIBROUS		ND	20 GLASS	80 OTHER
02-4309	KH-C-06	BLACK FIBROUS		ND	20 GLASS	80 OTHER
02-4310	KH-D-07	TAN FIBROUS		ND	15 CELLULOSE 2 GLASS	60 GYPSUM 23 OTHER
02-4311	KH-D-08	TAN FIBROUS		<1 CHRYSOTILE	35 CELLULOSE 2 GLASS	63 GYPSUM <1 OTHER
02-4312A	KH-E-09	WHITE NONFIBROUS	SMOOTH COAT	ND		100 OTHER

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Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4312B	KH-E-09	GREY GRANULAR	PLASTER	ND		100 OTHER
02-4313	KH-F-10	GREY FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	
02-4314A	KH-G-11	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4314B	KH-G-11	BLACK FIBROUS	MASTIC	3 CHRYSOTILE		97 OTHER
02-4315A	KH-G-12	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4315B	KH-G-12	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4316	KH-H-13	SILVER/GREY FIBROUS		ND	95 MINERAL WOOL 2 CELLULOSE	3 OTHER

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4317	KH-I-14	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4318	KH-I-15	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4319A	KH-J-16	GREY NONFIBROUS	TILE	ND		100 OTHER
02-4319B	KH-J-16	BLACK/YW FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4320	KH-K-17	GREYS FIBROUS		55 CHRYSOTILE	45 SYNTHETIC	
02-4321	KH-K-18	GREYS FIBROUS		20 CHRYSOTILE	40 GLASS 30 SYNTHETIC	10 OTHER
02-4322	KH-L-19	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4323	KH-M-20	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4324A	KH-G-21	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4324B	KH-G-21	BLACK FIBROUS	MASTIC 1	3 CHRYSOTILE		97 OTHER
02-4324C	KH-G-21	YELLOW NONFIBROUS	MASTIC 2	ND		100 OTHER
02-4325	KH-M-22	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4326	KH-N-23	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4327	KH-N-24	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4317	KH-I-14	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4318	KH-I-15	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4319A	KH-J-16	GREY NONFIBROUS	TILE	ND		100 OTHER
02-4319B	KH-J-16	BLACK/YW FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4320	KH-K-17	GREYS FIBROUS		55 CHRYSOTILE	45 SYNTHETIC	
02-4321	KH-K-18	GREYS FIBROUS		20 CHRYSOTILE	40 GLASS 30 SYNTHETIC	10 OTHER
02-4322	KH-L-19	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	

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Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4323	KH-M-20	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4324A	KH-G-21	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4324B	KH-G-21	BLACK FIBROUS	MASTIC 1	3 CHRYSOTILE		97 OTHER
02-4324C	KH-G-21	YELLOW NONFIBROUS	MASTIC 2	ND		100 OTHER
02-4325	KH-M-22	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4326	KH-N-23	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4327	KH-N-24	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4328A	KH-O-25	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4328B	KH-O-25	GREY FIBROUS	INSULATION	2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4329A	KH-O-26	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4329B	KH-O-26	GREY FIBROUS	INSULATION	2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4330	KH-O-27	GREY FIBROUS		2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4331	KH-L-28	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	
02-4332A	KH-P-29	GREY FIBROUS	WRAP 1	ND	100 CELLULOSE	<1 PAINT

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4332B	KH-P-29	BLACK FIBROUS	WRAP 2	4 CHRYSOTILE	35 GLASS	61 OTHER
02-4332C	KH-P-29	GREY/YELLOW FIBROUS	INSULATION	2 AMOSITE	55 MINERAL WOOL	43 OTHER
02-4333A	KH-P-30	GREY FIBROUS	WRAP 1	ND	100 CELLULOSE	<1 PAINT
02-4333B	KH-P-30	BLACK/SILVER FIBROUS	WRAP 2	3	40 GLASS 20 CELLULOSE	37 OTHER
02-4333C	KH-P-30	GREY/YELLOW FIBROUS	INSULATION	<1 AMOSITE	75 MINERAL WOOL	25 OTHER
02-4334A	KH-P-31	BEIGE FIBROUS	WRAP	ND	100 CELLULOSE	
02-4334B	KH-P-31	GREY/YELLOW FIBROUS	INSULATION	2 AMOSITE	55 MINERAL WOOL	43 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4335	KH-E-32	WHITE NONFIBROUS		ND		100 OTHER
02-4336A	KH-R-33	TAN NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4336B	KH-R-33	BLACK FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4337A	KH-Q-34	GREY NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4337B	KH-Q-34	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4338A	KH-S-35	GREY NONFIBROUS	TILE	4 CHRYSOTILE		96 OTHER
02-4338B	KH-S-35	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4339A	KH-S-36	GREY NONFIBROUS	TILE	4 CHRYSOTILE		96 OTHER
02-4339B	KH-S-36	BLACK NONFIBROUS	MASTIC	<1 CHRYSOTILE		100 OTHER
02-4340A	KH-Q-37	GREY NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4340B	KH-Q-37	BLACK FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4341	KH-H-38	GREY FIBROUS		ND	96 MINERAL WOOL 2 CELLULOSE	2 OTHER
02-4342A	KH-Q-39	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4342B	KH-Q-39	YELLOW NONFIBROUS	MASTIC	ND		100 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4343	KH-T-40	GREY FIBROUS		ND	40 MINERAL WOOL 30 CELLULOSE	30 PERLITE
02-4344	KH-T-41	GREY FIBROUS		ND	40 MINERAL WOOL 30 CELLULOSE	30 PERLITE
02-4345	KH-R-42	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4346A	KH-U-43	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4346B	KH-U-43	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4347A	KH-U-44	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4347B	KH-U-44	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4348	KH-F-45	GREY FIBROUS		ND	80 MINERAL WOOL 20 CELLULOSE	<1 PERLITE
02-4349	KH-V-46	TAN FIBROUS		<1 CHRYSOTILE	25 CELLULOSE	75 OTHER
02-4350	KH-V-47	TAN FIBROUS		ND	75 CELLULOSE <1 GLASS	25 OTHER <1 GYPSUM
02-4351A	KH-J-48	BEIGE NONFIBROUS	TILE	ND		100 OTHER
02-4351B	KH-J-48	YW/BLK NONFIBROUS	MASTIC	<1 CHRYSOTILE		100 OTHER
02-4352A	KH-W-49	GREY FIBROUS	WRAP	ND	100 CELLULOSE	
02-4352B	KH-W-49	GREY FIBROUS	INSULATION	2 AMOSITE <1 CHRYSOTILE	40 MINERAL WOOL	58 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4353A	KH-W-50	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4353B	KH-W-50	GREY FIBROUS	INSULATION	2 AMOSITE	40 MINERAL WOOL	58 OTHER
02-4354	KH-X-51	BEIGE NONFIBROUS		ND		100 OTHER
02-4355	KH-X-52	BEIGE NONFIBROUS		ND		100 OTHER
02-4356A	KH-P-53	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4356B	KH-P-53	GREY FIBROUS	INSULATION	2 AMOSITE	40 MINERAL WOOL	58 OTHER
02-4357A	KH-Y-54	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4357B	KH-Y-54	GREY FIBROUS	INSULATION	15 AMOSITE 2 CHRYSOTILE	5 MINERAL WOOL	78 OTHER
02-4358A	KH-Y-55	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4358B	KH-Y-55	GREY FIBROUS	INSULATION	15 AMOSITE 2 CHRYSOTILE	5 MINERAL WOOL	78 OTHER

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TECHNICAL SPECIFICATIONS FOR ASBESTOS ABATEMENT

King Hall Abatement
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273-A

Prepared For:
UNC-Wilmington
601 South College Road
Wilmington, North Carolina 28403

Prepared By:
ECS Southeast, LLP
4811 Koger Boulevard
Greensboro, North Carolina 27407
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Ryan C. Abrahamson, REM
North Carolina Project Designer No. 40528

Lindsey Thompson, REM
North Carolina Project Designer No. 40513

March 23, 2023

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GENERAL PROJECT REQUIREMENTS TECHNICAL SPECIFICATIONS

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Drawings

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SECTION 01043

PROJECT COORDINATION

1.1 GENERAL

A. ECS Southeast, LLP (ECS) has prepared this document for Asbestos Abatement Guidelines to address the removal requirements associated with this project. The locations of Asbestos Containing Materials (ACM) to be removed are depicted on the attached drawings.

B. The site consists of King Hall, a two-story educational building located on the campus of UNC Wilmington, New Hanover County, North Carolina.

C. ECS conducted an Asbestos and Lead Paint Survey of the building in 2022. Additionally, UNCW provided prior reports from 2002 and a spreadsheet with identified asbestos-containing materials (ACMs) including samples collected from 2018. The following materials were determined to contain asbestos:

- Cloth vibration dampener in mechanical closets;
- Mudded Insulation on the steam and hot water pipes throughout the building;
- Silver/black roof flashing;
- Various floor tiles and associated mastics;
- Black mastic beneath carpet;
- Black tar on white HVAC wrap;
- Black mastic on 6” pipes;
- White wall texture;
- Residual black floor mastic; and,
- Sink coating.

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous sampling areas including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing analyzed by the laboratory.

D. An asbestos contractor will be selected to conduct asbestos abatement and will contract directly with Muter Construction, the General Contractor for the Project. Contact Muter for contract requirements for this project.

E. The asbestos abatement contractor shall be a licensed general contractor in either the specialty interior, building, unclassified or asbestos categories by the North Carolina Licensing Board of General Contractors and limited for the bid amount.

F. The asbestos abatement contractor must provide a Certificate of Insurance for Public liability and property damage insurance and builder's risk policy, as required in the General Conditions of the Contract. Per SCO Article 34. for the Designers review prior to award of this contract.

G. The contractor shall be responsible for inspecting the site prior to bidding to confirm the scope of the work. Any quantities listed by the designer in the plans, specifications or survey are done so as approximations. The actual quantities of asbestos-containing material to be encountered is the responsibility of the contractor. Contingency bids and unit rates not referenced in the Updated Hazardous Materials Assessment is to be included in this bid.

H. The contractor shall furnish and is responsible for all costs including, but not limited to: permit fees, containment preparation, labor, materials, services, insurance, bonding, and equipment necessary to carry out the abatement operations and disposal of all asbestos material in accordance with the plans and specifications, the EPA and OSHA regulations, and any applicable state and local government regulations.

I. The contractor/employer has and assumes the responsibility of proceeding in such a manner that he offers his employees a workplace free of recognized hazards causing or likely to cause death or serious injury. The contractor shall be responsible for performing this abatement and disposal so that airborne asbestos fiber levels do not exceed established levels.

J. The contractor will be responsible for all costs associated with employee monitoring to meet the OSHA requirements.

K. The contractor is responsible for all costs, including additional visits, should the designer and/or the industrial hygiene firm determine that the contractor failed a final inspection. Notification and scheduling of the final inspection during the project is the responsibility of the contractor. The contractor will allow a minimum notice of 48 hours unless a different time frame is agreed upon by the designer and the contractor.

1.2 PERSONNEL

A. Supervisor

1. All supervisors shall be accredited by the Health Hazards Control Branch (HHCB).

2. All supervisors on the project shall have two years' experience in the administration and supervision of asbestos abatement projects including work practices, protective measures for building and personnel, disposal procedures, etc.

3. One supervisor shall be provided for every 10 workers inside the containment. A minimum of one supervisor shall be provided per project.

4. The contractor shall have at least one employee on the job site in either a foreman or supervisor's position who is bilingual in the appropriate languages when employing workers who do not speak fluent English.

5. A minimum of one supervisor per company shall have attended a 24-hour respiratory protection course.

B. Worker

1. All workers shall be accredited by the HHCB.

C. Competent Person

1. A competent person, as defined in the OSHA asbestos standard 29 CFR 1926.1101, employed by the contractor must be outside the work area at all times to monitor activity, ensure containment security, provide information to visitors, and provide access to the work area.

D. Employees

1. The contractor is responsible for the behavior of workers within his employment. If at any time during the contracted work, any of his employees are judged to exhibit behavior unfitting for the area or judged to be a nuisance by the owner or designer, the contractor shall remove them immediately from the project.

2. The contractor shall be responsible for compliance with the following concerning employee behavior:

   a. Under no circumstances are alcohol, drugs or any other type of controlled substances permitted on state property.

   b. All workers are restricted to the construction project site only.

   c. All vehicles must be parked in areas prearranged with the owner.

   d. All workers must conform to the following basic dress code when in public areas of the project confines: long pants, shirts, no tank tops, no shorts, no bare backs.

   e. The contractor is responsible for disposal of all trash brought on state property by his employees, including drink cans, bottles or other food containers and wrappers.

3. Failure to adhere to these rules could result in criminal prosecution and/or removal from the State property.

1.3 MEETINGS

A. Pre-bid

1. A mandatory pre-bid conference will be held at the site. The time and date have not been determined at this time.

2. The Design Team will review the plans and specifications, present required techniques, and safeguards for the removal of the asbestos and identify locations of water, electrical sources, etc.

3. Any questions or clarifications raised by the bidders will be addressed by Muter with assistance from ECS.

B. Bid Opening

1. The date and time that bids are due will be determined by Muter in their bid documents.

C. Pre-Construction Meeting

1. A pre-construction meeting will be held with UNCW, Muter and ECS following notice of award. The date for the pre-construction meeting will be determined after the project is awarded.

1.1 PRE-JOB SUBMITTALS

A. Submit an electronic copy of pre-job submittals to the designer at least five days prior to start of work. A copy of the approved submittals shall be kept in a three-ring binder (project log) by the contractor at the project site in the clean room or in the on-site office of the contractor.

1. Notifications: Provide copies of Asbestos Permit Application and Notification for Demolition/Renovation (DEHNR 3768), which provide written notice to all required agencies, including North Carolina HHCB.

2. Employee List: Provide copies of lists of supervisors and workers, along with their accreditation and Social Security numbers, to be utilized on the project.

3. Permits: Provide copies of approval of a waste disposal site in compliance with 40 CFR 61.154.

4. Respirator Training: Copies of most recent fit testing records, individually signed for each worker to be utilized on the project.

5. Project Schedule: Time schedule for the project, outlining the proposed start, setup, clearances, etc. for the various phases of the project.

6. Initial Exposure Assessment: As required by the OSHA construction asbestos standard 29 CFR 1926.1101.

7. Any other programs or training as outlined by the OSHA and EPA standards.

1.2 POST-JOB SUBMITTALS

A. Submit an electronic copy of post-job submittals to the designer following the final completion of the work. Requests for final payment will not be approved until the submittal package has been reviewed and approved by the designer.

1. Manifest: North Carolina Asbestos Waste Shipment Record (DEHNR 3787) receipt from landfill operator which acknowledges the contractor's delivery(s) of waste material. Include date, quantity of material delivered and signature of authorized representative of landfill. Also, include name of waste transporter.

2. Daily Log: A notarized copy of all daily logs showing the following: name, date, entering and leaving time, company or agency represented, reason for entry for all persons entering the work area, employee's daily air monitoring data as required by the OSHA standard and written comments by inspectors, industrial hygienists, designers and visitors.

3. Special Reports: All documents generated under Section 01043.1.6.

1.3 SPECIAL REPORTS

A. General: Except as otherwise indicated, submit special reports to designer within one day of occurrence requiring special report, with copies to others affected by occurrence. Also keep a copy in the project logbook.

B. Reporting Unusual Events: When an event of unusual and significant nature occurs at site (examples: failure of negative pressure system, rupture of temporary enclosures), prepare and submit a special report to the designer immediately, listing chain of events, persons participating, response by contractor's personnel, evaluation of results or effects, and similar pertinent information. When such events are known or predictable in advance, advise designer in advance at earliest possible date.

C. Reporting Accidents: Prepare and submit reports of significant accidents, at site and anywhere else work is in progress. Record and document date and actions; comply with industry standards for reporting accidents. For this purpose, a significant accident is defined to include events where personal injury is sustained, or property loss of substance is sustained, or where the event posed a significant threat of loss or personal injury.

1.4 CONTINGENCY PLAN

A. Contingency Plan: Prepare a contingency plan for emergencies including fire, accident, power failure, negative pressure system failure, supplied air system failure (if applicable), evacuation of injured persons for both life threatening and non-life threatening, or any other event that may require modification or abridgment of decontamination or work area isolation procedures. Include in plan specific procedures for decontamination or work area isolation. Note that nothing in this specification should impede safe exiting or providing of adequate medical attention in the event of an emergency. Keep these plans in the on-site office.

B. Post outside/in clean room of Personnel Decontamination Unit:

1. Telephone numbers and locations of emergency services including but not limited to, fire, ambulance, doctor, hospital, police, power company, telephone company and the North Carolina HHCB.

2. A copy of Safety Data Sheets (SDS) for any chemicals used during the asbestos project.

3. The contractor shall post asbestos signs in each appropriate language as per the OSHA 29 CFR 1926.1101 standard.

SECTION 01092

CODES AND REGULATIONS

1.1 REFERENCE SPECIFICATIONS

The contractor shall assume full responsibility and liability for compliance with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the site, and persons occupying areas adjacent to the site.

Unless modified by these project specifications, all specifications for stripping, removal, repair, and disposal work shall conform to the following specifications and standards, as applicable, as if completely reproduced herein.

A. The following regulations published by the Environmental Protection Agency (EPA):

1. "National Emissions Standards for Hazardous Air Pollutants Asbestos," 40 CFR Part 61, Subpart M.

2. "General Provisions," 40 CFR Part 61, Subpart A.

3. "Guidance for Controlling Asbestos-Containing Materials in Buildings" June 1985. (EPA # 560/5-85-024).

4. "Asbestos-Containing Materials in Schools," 40 CFR Part 763, Subpart E including appendices.

B. The following regulations published by the U.S. Department of Labor, OSHA:

1. “Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules,” Title 29, Part 1910, Section 1001 and Part 1926, Section 1101 of the Code of Federal Regulations.

2. “Respiratory Protection,” Title 29, Part 1910, Section 134 of the Code of Federal Regulations.

3. Construction Industry, Title 29, Part 1926, of the Code of Federal Regulations.

4. “Access to Employee Exposure and Medical Records,” Title 29, Part 1910, Section 20 of the Code of Federal Regulations.

5. “Hazard Communication,” Title 29, Part 1926, Section 59 of the Code of Federal Regulations.

6. “Specifications for Accident Prevention Signs and Tags,” Title 29, Part 1910, Section 145 of the Code of Federal Regulations.

C. The following regulations published by North Carolina state agencies:

1. North Carolina Asbestos Hazard Management Program Rules as adopted by 15A NCAC 19C .0600.

2. "North Carolina Occupational Safety and Health Standards for the Construction Industry," 29 CFR Part 1926 as adopted by T13 NCAC 07F .0201, and shipyard T13:07F.0500.

3. North Carolina General Statutes, Chapter 95, 97, 130.

D. The following documents published by the American National Standards Institute:

1. "Fundamentals Governing the Design and Operation of Local Exhaust Systems," Z9.2-1979.

2. "American National Standard for Respiratory Protection Respiratory Use - Physical Qualifications for Personnel," Z88.6-1984.

3. "Practices for Respiratory Protection," Z88.2-1992.

1.2 NOTICES

A. The contractor shall notify the following offices in writing within the time frame specified by the NESHAP regulations prior to beginning any asbestos removal operations.

The contractor shall notify the following offices in writing within the time frame specified by the NESHAP regulations prior to beginning any **friable** asbestos removal operations.

1. State Agencies

Health Hazards Control Unit
N.C. Department of Health and Human Services –OEEB
Division of Public Health

(Regular Mail)
1912 Mail Service Center
Raleigh, N.C. 27699-1912
Telephone: (919) 733-0820
Fax: (919) 733-8493

(UPS, Fed Ex, etc.)
5505 Six Forks Road
Second Floor
Room D-1
Raleigh, N.C. 27609

N.C. Department of Labor
Division of Occupational Safety and Health
319 Chapanoke Road, Suite 105
Raleigh, N.C. 27603-3432
Telephone: 1-800-LABOR-NC or (919) 662-4602
Fax: (919) 662-4625

1. Emergency Departments

   Notify the local emergency medical services, police, and fire departments in writing of the type and scope of work being performed and request these departments make an inspection prior to beginning the work.

2. Licenses

   Maintain current licenses for contractor and accreditation for workers and supervisors as required by applicable State or local jurisdictions for the removal, transporting, disposal or other regulated activity relative to the work of this contract.

SECTION 01410

AIR MONITORING - INDUSTRIAL HYGIENE FIRM

1.1 GENERAL

A. ECS has been contracted to conduct air monitoring and clearance testing. Services of ECS will be paid by the owner.

B. Air monitoring shall be done under the direct supervision of a North Carolina accredited supervising air monitor (SAM), except for sampling performed by the contractor to satisfy OSHA requirements.

C. SAM shall be accredited per the Asbestos Hazard Management Program rules.

D. Air monitor shall be accredited as per the Asbestos Hazard Management Program rules and work under the direct supervision of a SAM.

E. The SAM representing each firm shall have taken a 24-hour respiratory protection course that is either NIOSH, AIHA, or HHCB recognized.

F. The Air Monitors shall submit copies of their NC accreditations and documentation on respiratory protection training to the designer prior to the award of the contract.

G. If specific project activities are assigned to an air monitor, the SAM is expected to be in direct control and responsible for industrial hygiene work completed on the project. The SAM shall approve and sign all air monitoring results performed by the air monitor. The SAM signature must be an original. No rubber stamp signature shall be accepted.

H. Employees of the HHCB shall have right of entry into the project. The HHCB's SAM shall have final authority over the industrial hygiene firm on the project.

1.2 DESCRIPTION OF WORK

A. The industrial hygiene firm shall offer expertise to the designer and contractor but is not directly responsible for the performance of the job.

B. At the job site, the industrial hygiene firm is expected to observe, be aware, and comment on general work site conditions and activities as they relate to the specifications and profession of industrial hygiene and make recommendations in writing to the designer and contractor.

C. The industrial hygiene firm is responsible for overseeing the protection of the environment from contamination, protection of persons in adjacent areas, and assurance that the areas are acceptable for occupancy.

D. The industrial hygiene firm has the authority to direct the contractor relative to safety and environmental concerns. This includes stopping the work if necessary. All directions and comments made by the industrial hygiene firm to the contractor shall be written with a copy to the designer.

E. The industrial hygiene firm shall furnish the contractor a copy of his field report within 24 hours of the visit. Copies of field notes and reports of observations shall be kept in project logbook.

F. The SAM shall review and make comments to the designer on the submittals listed in Section 01043.

G. The SAM shall approve any change in contractor's respiratory protection. This includes a review of the historical data.

H. The industrial hygiene firm is to conform to the contractor's schedule and shall respond to necessary changes, provided an advance notice is given as outlined in Section 01043.

I. The industrial hygiene firm's project monitor shall furnish designer and contractor with a pager or mobile phone number where he can be reached quickly at all times.

J. The industrial hygiene firm shall notify the designer and contractor, in writing, of any failed clearance visits.

K. At the completion of the project, the industrial hygiene firm shall prepare a report describing the assessment of the project, all air monitoring data, acceptance letters, calibration records, and a description of the project as it proceeded to completion.

1.3 AIR MONITORING

A. Ambient Air Monitoring: The purpose of ambient air monitoring by the industrial hygiene firm will be to detect discrepancies in the work area isolation such as:

1. Contamination of the building outside of the work area with airborne asbestos fibers.

2. Failure of filtration or rupture in the negative pressure system.

3. Confirm the work practices established by the contractor and respiratory protection provided for employees are adequate.

B. Work Area Airborne Fiber Levels: The owner's industrial hygiene firm will monitor airborne fiber levels in the work area. The purpose of this air monitoring will be to detect airborne fiber levels which may challenge the ability of the work area isolation procedures to protect the balance of the building or outside of the building from contamination by airborne fibers.

C. Work Area Clearance: To determine if the elevated airborne fiber levels encountered during abatement operations have been reduced to an acceptable level, the industrial hygiene firm will sample and analyze air per Section 01714.

D. In accordance with AHMB Program Rules, the SAM shall develop an Abatement Project Monitoring Plan which complies with EPA and OSHA analytical criteria and will provide a valid representation of airborne fiber concentrations both inside and outside the work area. This program is not intended to satisfy the contractor's requirement for sampling under the OSHA regulation. All personnel and area sampling conducted by the industrial hygiene firm shall be personally observed. Air sampling pumps shall not be left unattended for extended periods of time.

1. The SAM shall submit a written project monitoring plan to the designer with a copy to the contractor. The following information shall be required for the submittal.

   a. The name, address and telephone number of the industrial hygiene firm.

   b. The name, address, telephone number and NIOSH's PAT designation and proficiency data for the laboratory analyzing the air samples. Analysis of all samples collected shall be by a laboratory currently proficient in NIOSH's "Proficiency Analytical Testing Program for Laboratory Quality Control" for asbestos. The acceptable sampling and analysis method is NIOSH 7400, latest revision.

   c. A proposed air sampling strategy which shall include: a projected number of air samples, locations, the types of air samples to be collected (personal, area, ambient), how the air samples are to be collected (TWA, ceiling, other), the equipment to be used (pumps, calibration equipment, filters, other), and how the samples will be transported to the laboratory.

      1. All personal air samples will be collected in such a manner as to comply with OSHA collection and analytical regulations and to provide a valid representation of airborne fiber levels. The samples collected by the industrial hygiene firm on personnel do not satisfy the contractor’s responsibility under OSHA.

      2. All final area air sampling will comply with all State and Federal requirements in measuring airborne asbestos following an abatement action.

3. Air samples will be analyzed and results made available as per the AHMB Program Rules. Copies of all air sampling results shall be signed by the SAM and a copy posted at the job site. These copies shall include the following: sample number, sample location, activity represented by sample, flow rate, sample time, comments and sample results. A statement will be included on each submission that the requirements of this contract have been met as they apply to the activities of the SAM.

4. If TWA samples are being collected by the contractor for the purpose of reducing respiratory protection requirements, the industrial hygiene firm shall directly observe the conditions and work practices represented by each sample and make appropriate notes in the bound book on site. The SAM shall review all TWA air sampling results which are used for reducing respiratory protection requirements before accepting the results.

E. Supplemental air monitoring may be conducted inside and outside the work area by the HHCB. This supplemental sampling does not fulfill air monitoring responsibilities required by OSHA, EPA, or this contract.

SECTION 01503

TEMPORARY FACILITIES

1.1 GENERAL

A. Provide temporary connection to existing building utilities or provide temporary facilities as required herein or as necessary to carry out the work.

B. Use qualified tradesmen for installation of temporary services and facilities.

C. Locate, modify, and extend temporary services and facilities where they will serve the project adequately and result in minimum interference with the performance of the work.

D. In occupied buildings, the owner's maintenance personnel shall lock and tag out all electrical and HVAC equipment in the asbestos abatement area. The contractor shall verify that the power and HVAC have been locked and tagged out prior to beginning work.

E. In unoccupied buildings, the contractor is responsible for the lock and tag out of all power sources and HVAC equipment.

F. The owner shall move all furniture, books, computers, records, equipment, etc. prior to the contractor's arrival date as specified.

1.2 WATER SERVICE

A. Owner shall supply a source of water. Contractor bears all expense of heating and getting water to the work and decontamination areas.

B. Supply hot and cold water to the decontamination unit in accordance with Section 01563. Hot water shall be supplied at a minimum temperature of 100 degrees Fahrenheit.

C. After completion of use, connections and fittings shall be removed without damage or alteration to existing water piping and equipment.

1.3 ELECTRICAL SERVICE

A. General: Comply with applicable NEMA, NEC and UL standards and governing state and local regulations for materials and layout of temporary electric service.

B. Ground Fault Protection: Provide receptacle outlets equipped with ground fault circuit interrupters, reset button and pilot light, for plug-in connection of power tools and equipment.

C. Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work during the construction period.

D. Install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in every area of work.

E. Provide services of an electrician, on a standby basis, to service electrical needs during the abatement process.

F. Provide additional power service and distribution service, consisting of individual dedicated 15-amp 120-volt circuits to electrical drops with receptacle outlets equipped with ground fault interrupt protection, color coded for the exclusive use of the industrial hygiene firm.

1.4 FIRST AID

A. A minimum of one first aid kit shall be located in the clean room. Additional first aid kits as the contractor feels is adequate or is required by law shall be located throughout the work area.

1.5 FIRE EXTINGUISHERS

A. Comply with the applicable recommendations of NFPA Standard 10 - "Standard for Portable Fire Extinguishers." Locate fire extinguishers where they are most convenient and effective for their intended purpose but provide not less than one extinguisher in each work area equipment room and one in the clean room of the personnel decontamination unit.

1.6 TOILET FACILITIES

A. Requirements about toilet facilities are included in the bid documents provided by Muter to bidders. See requirements for toilet facilities.

1.7 PARKING

A. Park only in areas designated by the owner.

1.8 BUILDING SECURITY

A. Maintain personnel on-site at all times. Secure any portion of the work areas are open or not properly secured. Secure work areas completely at the end of each day.

1.9 STORAGE

A. Supply temporary storage required for storage of equipment and materials for duration of project. Trailer and storage dumpsters will be maintained in areas designated by the owner.

SECTION 01513

NEGATIVE PRESSURE SYSTEM

1.1 GENERAL

A. High efficiency particulate air (HEPA) filter exhaust systems equipped with new HEPA filters for each project shall be used. Exhaust equipment and systems shall comply with ANSI Z9.2-79 and used according to manufacturer's recommendations.

B. A system of HEPA-equipped air filtration devices shall be configured so that a pressure differential is established between the work area and the surrounding area (-0.02 to -0.04" water column). A continuous chart-recorded manometer shall be used to confirm this condition.

C. Additional air filtration devices shall be provided inside the work area for emergency standby as well as for circulation of dead air spaces.

D. The pressure differential is maintained at all times after preparation is complete and until the final visual inspection and air tests confirm the area is clean and acceptable for occupancy and the designer confirms verbally with written follow- up to discontinue the use of the negative pressure system.

E. Air shall be exhausted outside the building. Any variations must be approved by the HHCB.

F. The contractor shall check daily for leaks and log his checks in the bound logbook. This includes checks internal to air-moving devices.

G. There shall be a minimum of four air changes per hour in any containment.

SECTION 01526

WORK AREA PREPARATION

A.1 GENERAL

A. Before work begins in an area, a decontamination unit must be in operation as outlined in Section 01563.

B. Completely isolate the work area from other parts of the building so as to prevent contamination beyond the isolated area.

C. Temporary facilities shall be addressed as outlined in Section 01503.

D. The Owner shall arrange for the removal of furnishings and/or non-stationary items from the proposed work areas prior to the start of the project.

E. The contractor shall set up a work area, load out, and decontamination area as shown in the plans and specifications. Any variations must be approved by the designer. The decontamination facility outside of the work area shall consist of a change room, shower room, and equipment room as described in Section 01563.

F. The contractor shall wet clean and/or HEPA vacuum all items and equipment in the work area suspected of being contaminated with asbestos, but not in direct contact with the asbestos material and either secure these items in place with polyethylene sheeting or have them removed from the work area.

G. Critical Barriers: The contractor shall thoroughly seal the work area for the duration of the work by completely sealing off all individual openings and fixtures in the work area, including, but not limited to, heating and ventilation ducts, doorways, corridors, windows, skylights, and lighting, with polythylene sheeting taped securely in place. If the contractor is using sealant materials to fill in small holes or cracks, the material shall have appropriate fire ratings.

H. Floors (if required): Apply two layers of 6 mil (minimum) polythylene plastic sheeting with joints overlapped 24 inches and taped securely. Plastic shall be carried up walls a minimum of 12 inches and secured.

I. Walls (if required): Apply one or more layers of 4 mil (minimum) polythylene plastic sheeting with joints lapped 24 inches and taped securely. Plastic shall be lapped over floor coverings and taped securely.

J. Floors and walls shall be installed in such a manner that they may be removed independently of the critical barriers. Walls or partitions which do not extend above the ceiling grid or air plenum should be sealed with two layers of 6 mil polythylene plastic.

K. Entrances and exits from the work area will have triple barriers of polythylene plastic sheeting so that the work area is always closed off by one barrier when workers enter or exit.

L. No water may be left standing on the floor at the end of the workday.

M. Floor surfaces, walls, finishes or coverings, etc., that in the contractor's opinion will likely be damaged by water or that may become contaminated with asbestos, shall have additional protective preparation as the contractor sees appropriate, at his cost, to protect the original condition of the surfaces.

N. Any costs associated with physical damage caused by water or securing polyethylene sheeting to areas inside or outside the abatement area shall be the contractor's responsibility.

O. The contractor shall establish and mark emergency and fire exits from the work area. Emergency procedures shall have priority over established decontamination entry and exit procedures. Audible and visible fire and emergency evacuation alarms shall be installed so as to be heard and seen throughout the entire work area.

P. Integrity of these seals shall be regularly checked and maintained by the contractor.

Q. After work area preparation, the contractor shall notify ECS verbally with written follow-up that he is ready for a prework inspection and first day/background air testing (if required).

SECTION 01560

WORKER PROTECTION

1.1 GENERAL

A. Provide worker protection as required by OSHA, state, and local standards applicable to the work. Contractor is solely responsible for enforcing worker protection requirements at least equal to those specified in this Section.

B. Each time the work area is entered the contractor shall require all persons to remove all street clothes in the changing room of the personnel decontamination unit and put on new disposable coverall, new head cover, and a clean respirator. Proceed through shower room to equipment room and put on work boots.

C. Workers shall not eat, drink, smoke, chew gum or chew tobacco in the work area, the equipment room, the load out area, or the clean room.

1.2 WORKER TRAINING

A. Train all workers in accordance with 29 CFR 1926 and North Carolina state regulations regarding the dangers inherent in handling asbestos, breathing asbestos dust, proper work procedures and personal and area protective measures.

1.3 MEDICAL EXAMINATIONS

A. Provide medical examinations for all workers. Examination shall as a minimum meet OSHA requirements as set forth in 29 CFR 1926.

1.4 PROTECTIVE CLOTHING

A. Provide disposable full-body coveralls and disposable head covers and require that they be worn by all workers in the work area. Provide a sufficient number for all required changes, for all workers in the work area.

B. Boots: Provide work boots with non-skid soles and, where required by OSHA, foot protection for all workers.

C. Gloves: Provide work gloves to all workers and require that they be worn at the appropriate times. Do not remove gloves from work area. Dispose of work gloves as asbestos-contaminated waste at the completion of the project.

1.5 ADDITIONAL PROTECTIVE EQUIPMENT

A. Respirators, disposable coveralls, head covers, and footwear covers shall be provided by the contractor for the owner, ECS, and other authorized representatives who may inspect the job site.

B. Scaffolding used during asbestos removal will comply with appropriate OSHA regulations.

C. Gloves, hardhats, harnesses, lanyards, safety glasses - provide appropriate safety equipment to all workers.

D. Mechanical lifts used for the project shall be operated in accordance with the manufacturer's instructions. Mechanical lifts must be rated for indoor use.

1.6 DECONTAMINATION PROCEDURES

A. Require that all workers use the following decontamination procedure as a minimum requirement whenever leaving the work area:

1. Remove disposable coveralls, disposable head covers, and disposable footwear covers or boots in the equipment room.

2. Still wearing respirators, proceed to showers. Showering is mandatory. Care must be taken to follow reasonable procedures in removing the respirator to avoid asbestos fibers while showering. The following procedure is required as a minimum:

   a. Thoroughly wet body including hair and face.

   b. With respirator still in place thoroughly wash body, hair, respirator face piece, and all exterior parts of the respirator.

   c. Take a deep breath, hold it and/or exhale slowly, completely wet hair, face, and respirator. While still holding breath, remove respirator and hold it away from face before starting to breathe.

   d. Carefully wash face piece of respirator inside and out.

   e. Shower completely with soap and water; rinse thoroughly.

   f. Rinse shower room walls and floor prior to exit.

   g. Proceed from shower to changing (clean) room and change into street clothes or new disposable work items.

3. After showering, each employee shall inspect, clean, and repair his respirator as needed. The respirator shall be dried, placed in a suitable storage bag, and properly stored.

SECTION 01562

RESPIRATORY PROTECTION

1.1 DESCRIPTION OF WORK

A. Instruct and train each worker involved in asbestos abatement in proper respirator use and require that each worker always wear a respirator, properly fitted on the face, in the work area from the start of any operation which may cause airborne asbestos fibers until the work area is completely decontaminated. Use respiratory protection appropriate for the fiber level encountered in the workplace or as required for other toxic or oxygen-deficient situations encountered.

1.2 GENERAL

A. Provide workers with personally issued and marked respiratory equipment approved by NIOSH and MSHA and suitable for the asbestos exposure level in the work areas according to OSHA Standard 29 CFR 1926.1101 and other possible contaminants employees might be exposed to during the project.

B. Provide respiratory protection from the time the first operation involved in the project requires contact with asbestos-containing materials (including construction of decontamination units, construction of airtight barriers/barricades, and placing of plastic sheeting on walls) until acceptance of final air clearance test results by the industrial hygiene firm.

C. The minimum respiratory protection for the project during gross removal of friable materials shall be powered air purifying respirators (PAPR).

D. Half-face respirators with replaceable HEPA filters can be used during the removal of non-friable materials, if removed using non-friable, wet methods, as specified.

E. The designer may, under certain circumstances, allow the contractor to use a half-face respirator with replaceable HEPA filters during the final cleaning phase. However, the eight-hour TWA air sampling data must document the exposure level, and the SAM must write a letter to the designer allowing the contractor to reduce respiratory protection.

F. Respirator fit testing shall be performed as a minimum at the beginning of the project, at any change in respiratory protection equipment, and at any time during the project if requested by the employee or SAM. Fit testing is to be performed by one of the methods listed in the 29 CFR 1926.1101, Appendix C.

G. If supplied air respirators are used, the contractor shall provide a minimum of Grade "D" breathing air as set forth in the Compressed Gas Association's "Commodity Specifications for Air," G-7.1. The contractor shall test for Grade "D" breathing air initially and daily thereafter. Daily testing is not needed if the contractor has an air purification system which has CO and organic purging.

capabilities as well as a continuous CO monitor and alarm calibrated at 10 ppm. The system must be calibrated at least once a week or when it is moved.

H. Provide emergency backup air supply, egress SCBA or egress HEPA filters for each worker in work area at all times when Type-C (supplied air) respirators are required. Breathing air system shall provide one hour of reserve air, calculated for maximum crew size for emergency evacuation.

I. If Type C respirators are utilized, the contractor is required to have an employee in the vicinity of the source of air. The contractor shall take into account the location of the fresh air intake to ensure no pollutant source is in the vicinity. The audible alarm shall be located where the employees inside and outside containment can hear the alarm.

J. Do not allow the use of single-use, disposable or quarter-face respirators for any purpose.

K. The contractor may submit a new exposure assessment (as per 29 CFR 1926.1101) to the SAM with a request to downgrade to less protective respirators. The SAM will make a recommendation to the designer, who will issue a decision in writing to the contractor approving or denying his request. If the contractor disagrees with the decision, then the representative air sampling data may be reviewed by the HHCB for a final decision.

SECTION 01563

DECONTAMINATION UNITS

1.1 DESCRIPTION OF WORK

A. Provide separate personnel and equipment/loadout decontamination facilities. Require that the personnel decontamination unit be the only means of ingress and egress for the work area. Require that all materials exit the work area through the equipment/loadout decontamination unit. Contractor shall comply with 29 CFR 1926.1101, specifically paragraph (j) Hygiene facilities and practices for employees.

1.2 GENERAL

Provide separate personnel decontamination units and equipment/loadout decontamination units when practical.

A. Personnel Decontamination Unit

1. Provide a Personnel Decontamination Unit consisting of a serial arrangement of connected rooms or spaces, changing room, shower room, equipment room. Each shall be separated by a minimum of three curtain doorways. Require all persons without exception to pass through this decontamination unit for entry into and exiting from the work area for any purpose. Do not allow parallel routes for entry or exit. Do not remove equipment or materials through Personnel Decontamination Unit.

2. Provide temporary lighting within decontamination units as necessary to reach an adequate lighting level.

3. Maintain floor of changing room dry and clean at all times. Do not allow the overflow water from the shower to escape the shower room.

4. Damp-wipe all surfaces twice after each shift change with a disinfectant solution.

5. Provide hot and cold water, drainage and standard fixtures including an elevated shower head as necessary for a complete and operable shower. A water hose and bucket are not an acceptable shower.

6. Arrange water shut off and drain pump operation controls so that a single individual can shower without assistance from either inside or outside of the work area.

7. Pump shower wastewater to drain. Provide 20 micron and 5-micron waste water filters in line to drain. Change filters daily or more often if necessary.

8. If the decontamination area is located within an area containing friable asbestos on overhead ceilings, ducts, piping, etc., provide the area with a

minimum 3/8-inch plywood "ceiling" with two layers of polythylene sheeting covering the top of the "ceiling."

9. Visual Barrier: Where the decontamination area is immediately adjacent to and within view of occupied areas, provide a visual barrier of opaque plastic sheeting so that worker privacy is maintained, and work procedures are not visible to building occupants. Where the area adjacent to the decontamination area is accessible to the public, construct a solid barrier on the public side of the sheeting to protect the sheeting. Construct barrier with wood or metal studs, max. 16 inches on center, covered with minimum 3/8 inch plywood.

B. Equipment Decontamination Units:

1. Provide an equipment decontamination unit consisting of a serial arrangement of rooms, clean room, holding area, and washroom, each room separated by a minimum of three curtain doorways, for removal of equipment and material from work area. Do not allow personnel to enter or exit work area through equipment decontamination unit.

2. Washroom: Provide washroom for cleaning of bagged or drummed asbestos-containing waste materials passed from the work area.

3. Holding Area: Provide holding area as a drop location for sealed drums and bagged asbestos-containing materials passed from the washroom.

4. Clean Room: Provide clean room to isolate the holding area from the building exterior or occupied areas.

5. Equipment or Material: Obtain all equipment or material from the work area through the equipment decontamination unit according to the following procedure:

a. When passing contaminated equipment, sealed plastic bags, drums or containers into the washroom, close all doorways of the equipment decontamination unit, other than the doorway between the work area and the washroom. Keep all outside personnel clear of the equipment decontamination unit.

b. Once inside the washroom, wet-clean the bags and/or equipment.

c. When cleaning is complete, insert bagged material into a clean bag/drum during the pass between the washroom and holding area. Close all doorways except the doorway between the washroom and holding area.

d. Workers from the building exterior enter the clean room then the holding area to remove decontaminated equipment and/or containers for disposal. Require these workers to wear full protective clothing and respiratory protection as described in Section 01562.

C. Decontamination Unit Contamination:

1. If the air quality in the decontamination unit exceeds 0.01 fibers per cc analyzed by PCM or 70 structures per mm squared analyzed by TEM or its integrity is diminished through use as determined by the designer or industrial hygiene firm, no employee shall use the unit until corrective steps are taken and approved by the designer and industrial hygiene firm.

SECTION 01711

PROJECT DECONTAMINATION

1.1 GENERAL

A. Carry out a first cleaning of all surfaces of the work area including plastic sheeting, tools, scaffolding and/or staging by use of damp-cleaning and mopping and/or a high efficiency particulate air (HEPA) filter vacuum until there is no visible debris from removed materials or residue on plastic sheeting or other surfaces. Do not perform dry-dusting or dry-sweeping.

B. Equipment shall be cleaned, and all contaminated materials removed before removing polyethylene from the walls and floors.

C. The contractor shall remove all prefilters and clean the inside and outside of the HEPA exhaust units. Pre-filters shall be disposed of as asbestos waste in accordance with Section 02084.

D. The contractor shall fine clean, and HEPA vacuum all scaffolding and/or mechanical lifts used inside the asbestos work areas.

E. After polythylene sheets have been removed from walls and floors, but are still remaining on all windows, doors and the critical components, the contractor shall clean all surfaces in the work area, including ducts, electrical conduits, steel beams, roof deck, etc., with amended water and/or HEPA-filtered vacuum.

F. After cleaning the work area, the contractor shall allow the area to thoroughly dry and then wet-clean and/or HEPA vacuum all surfaces in work area again.

G. At the completion of the cleaning operation, the contractor's supervisor shall perform a complete visual inspection of the work area to ensure that the work area is dust- and fiber-free. If the supervisor believes he is ready for a final project decontamination inspection, he shall notify the designer.

H. ECS will perform the final project decontamination inspection requested by the contractor.

I. Visual inspection for acceptance shall be performed after all areas are dry.

J. ECS shall perform the final visual inspection and conduct the final air clearance. Any discrepancies found shall be documented in the form of a punch list.

K. Final air sampling shall not commence until the visual inspection is completed and passed.

L. If the industrial hygiene firm finds that the work area has not been adequately decontaminated, cleaning and/or air monitoring shall be repeated at the

contractor’s expense, including additional industrial hygiene fees, until the work area is in compliance.

M. After the work area is found to be in compliance, all entrances and exits shall be unsealed and the plastic sheeting, tape and any other trash and debris shall be disposed of in sealable plastic bags (6 mil minimum) and disposed of as outlined in Section 02084.

N. All HEPA unit intakes and exhausts shall be wrapped with six mil polythylene before leaving the work area.

O. After the industrial hygiene firm has approved the final project decontamination and the contractor has completed the tear down for occupancy by others, the designer shall perform the project final inspection as outlined in the general conditions.

P. Any residual asbestos that may be present after removing critical barriers, that in the designer’s judgment should have been cleaned during the precleaning phase prior to installing critical barriers, shall be cleaned, and cleared at the contractor’s expense.

Q. There shall be appropriate seals totally enclosing the inspection area to keep it separate from clean areas or other areas where abatement is or will be in progress. Once an area has been accepted and passed air tests, loss of the critical barrier integrity or escape of asbestos into an already clean area shall void previous acceptance and tests. Additional visual and final air clearance sampling shall be required at the contractor's expense.

SECTION 01714

WORK AREA CLEARANCE

1.1 GENERAL

A. Notification and scheduling of the final inspection during the project is the responsibility of the contractor.

1.2 FINAL CLEARANCE TESTING

A. After the second cleaning operation and after the area is completely dry, the following procedure test shall be performed:

1. A final visual inspection shall be conducted by ECS. The inspection shall be conducted following the guidelines set forth in the American Society for Testing and Materials, Standard Practices for Visual Inspection of Asbestos Abatement Projects, Designation: E1368.90. If the work area is found visibly clean, air samples will be collected by the air monitor.

2. During the clearance air testing, the North Carolina accredited air monitor shall cause disruptive air currents as described in the EPA-AHERA regulations (40 CFR Part 763, Subpart E, Appendix A).

3. First Day and periodic air samples are to be analyzed using Phase Contrast Microscopy (PCM) with a minimum of five samples per unit using NIOSH 7400 method. Clearance criteria shall be less than 0.01 F/cc for all samples analyzed.

4. Final clearance criteria shall be in accordance with North Carolina AHMP Rules in public buildings. Final clearance samples within the removal work area shall be analyzed using the Mandatory Transmission Electron Microscopy (TEM) Method described in 40 CFR Part 763, Subpart E, Appendix F. Clearance criteria for TEM samples shall be an arithmetic mean less than or equal to 70 structures per square millimeter or a z-test less than or equal to 1.65.

5. The air monitor shall immediately report the final air sampling clearance results to the designer and contractor.

6. The use of the negative pressure system may be discontinued after the industrial hygiene firm instructs the contractor that he has passed the final TEM air clearance and project decontamination inspection.

SECTION 02080

ASBESTOS REMOVAL

1.1 GENERAL

A. Prior to starting asbestos removal, the contractor's equipment, work area and decontamination units will be inspected and approved by the Air Monitor.

B. Loose asbestos material removed in the work area shall be adequately wet with a surfactant, bagged, sealed and labeled properly before personnel breaks or end of shift. The surfactant to be utilized with asbestos-containing materials shall consist of soapy water mixed in a proportion of two (2) fluid ounces of liquid soap to five (5) gallons of water. An asbestos removal encapsulant may be utilized as a substitute for surfactant use to control airborne fibers.

C. All plastic sheeting, tape, cleaning material, clothing and all other disposable material or items used in the work area shall be packed into sealable plastic bags (6 mil minimum) and treated as contaminated material.

D. All material shall be double-bagged, “goose necked”, and sealed with duct tape.

E. All excess water (except shower water) shall be combined with removed material or other absorptive material and properly disposed of as per EPA regulations. Contractor shall not place water in storm drains, onto lawns, or into ditches, creeks, streams, rivers, or oceans.

F. If the Owner or their field representative presents a written Stop Asbestos Removal Order, the Abatement Contractor/Personnel shall immediately stop all asbestos removal and adequately wet any exposed ACM. The Contractor shall not resume any asbestos removal activity until authorized to do so by Owner. A stop asbestos removal order may be issued at any time the Owner determines abatement conditions/activities are not within specification requirements. Work stoppage will continue until conditions have been corrected to the satisfaction of Owner. Standby time and costs for corrective actions will be borne by the Abatement Contractor, including the industrial hygienist’s time. The occurrence of any of the following events shall be reported immediately by the Abatement Contractor in writing to the Owner and shall require the Contractor to immediately stop asbestos removal activities and initiate fiber reduction activities:

1. =/> 0.01 f/cc outside regulated area
2. Breach/break in regulated area barrier(s)
3. Serious injury/death within regulated area
4. Fire/safety emergency within the regulated area
5. Respiratory protection system failure

6. Power failure

7. Excessive airborne fibers (>0.5 f/cc) in the regulated area.

1.2 SCOPE OF WORK

A. Base Bid

- Floor Tile and Mastic - This is considered a Class 2 OSHA asbestos material. Please note that approximately 10,200 square feet of asbestos-containing floor tile and mastic will be included in the base bid. At may be necessary to conduct selective removal of cabinets and other fixed items to access the floor tile and mastic. The abatement contactor is also to include a unit rate per square foot for additional mastic if identified during abatement/demolition.

- Vibration Dampener – This is considered a Class 1 OSHA asbestos material. include in base bid a budget for removal and disposal seven vibration dampeners (approximately 20 sf each). The abatement contractor is to also include a unit rate per linear foot if additional material is identified.

- Mudded Elbows and Black Mastic on 6” pipes – This is considered a Class 1 OSHA asbestos material. Mudded pipe elbows and black mastic on 6” pipes is to be abated as part of the base bid. Approximately 20 elbows were observed. The quantity of black mastic on 6” pipes is not known at this time. The abatement contractor is to also include a unit rate per linear foot if additional is identified.

- Black Tar on HVAC Wrap – This is considered a Class 1 OSHA asbestos material. include in base bid a budget for removal and disposal of approximately 20 square feet of black tar on HVAC wrap. The abatement contractor is to also include a unit rate per linear foot if additional is identified.

- Wall Texture – The finished walls in the hallway of the 1st floor have asbestos-containing texture. This is considered a Class 2 OSHA asbestos material. The textured walls identified in the figure are to be demolished by the abatement contractor as part of the base bid. There is approximately 1,750 square feet of asbestos texture on walls on the 1st floor that is to be removed as part of the base bid. The asbestos contactor is to include a unit rate per square foot on the bid form for demolition and disposal of walls with asbestos-containing texture.

The quantities and locations of ACM as indicated, and the extent of the work included in this section are estimates which are limited by the physical constraints of the buildings. Accordingly, minor variations (+/- 10%) in quantities of ACM within the regulated areas are considered as having no impact on contract price and time requirements of this contract. Where additional work is required beyond the above variation, the contract time and price will be adjusted under provisions of the applicable clause in the contract. Additional or reduced abatement work beyond the variations will be basis for adjusting the contract price.

1.3 ACM PRODUCTS TO BE REMOVED

Mudded Pipe Elbows, Black Pipe Mastic, Black Tar on HVAC

A. The abatement contractor has the option to remove pipe insulation and fittings either by glove bag removal or wrap and cut removal methods in select locations of the building. It may be necessary for the abatement contractor to conduct demolition of hard ceilings where needed to access piping to be removed. The piping can either be removed using wrapped-and-cut or glovebag methods.

1. The asbestos abatement contractor will meet the requirements listed under the OSHA standard 29 CFR 1926.1101 section g(4) for Class 1 friable asbestos work.

2. Glove Bag Removal Method (pipe insulation) – Glove-bag removal of pipe insulation shall meet the requirements of the OSHA standard 29 CFR 1926.1101 section g(5)ii regarding construction and work practices. The minimum requirements for glovebag removal shall be:

   a. Preparation: Before any work commences, a layer of polyethylene sheeting shall be placed on the floor, as a drop cloth, beneath the glove bag abatement work area. If necessary, any TSI material that has fallen off piping or other equipment shall be wetted, and carefully placed in a polyethylene bag, and the area shall be cleaned of visible material with a HEPA vacuum prior to placing the sheeting. Appropriate warning signs shall be posted outside this barrier in areas of high visibility. A HEPA filtered air filtration unit shall be on-site to be used to contain an emergency fiber release.

   b. Remove TSI inside a glovebag according to manufacturer's guidelines. Thoroughly wet material to be removed with amended water or removal encapsulant and allow to soak through to substrate.

   c. Each glovebag shall be installed so that it completely covers the circumference of pipe or other structure where the work is to be done.

   d. Glovebags shall be smoke-tested for leaks and any leaks sealed prior to use.

   e. Glovebags may be used only once and may not be moved.

   f. Before beginning the operation, loose and friable material adjacent to the glovebag/box operation shall be wrapped and sealed in two layers of 0.15 mm plastic or otherwise rendered intact.

   g. Use two people for glove-bag operation. One shall remove insulation, the other shall operate water sprayer and repair any leaks in bag.

   h. Using a small HEPA vacuum, create a negative pressure inside the glove-bag before starting any asbestos removal and maintain throughout the use of the bag.

i. After removal of insulation, brush and wet-clean pipe to remove residual material. Continue wet cleaning until surfaces are free of visible material. Clean area of all debris and notify PM for visual inspection.

j. Where system uses attached waste bag, such bag shall be connected to collection bag using hose or other material that shall withstand pressure of ACM waste and water without losing its integrity.

k. Glove-bag shall be considered the first container for material. Seal glove bag within clean contaminant bag with duct tape.

l. Encapsulate or Lockdown abated section of pipe and any adjacent piping as required. Note: the use of a lock-down surface coating material will seal in fungal growth on surfaces making them extremely difficult to remediate. Care should be taken not to spray lock-down over fungal impacted materials that are to remain in the building and will require remediation/cleaning.

m. Remove and dispose of all friable asbestos materials in accordance with all state, local and federal regulations.

3. Wrap-and-cut Methods – If the abatement contractor elects this option, the pipe substrate and insulation will be disposed as ACM in accordance with provisions set forth in this specification.

a. Establish a control area as outlined within Section 10-01526 and 10-01563 of this specification.

b. Divide piping with insulation intact into manageable sections.

c. Remove insulation using the glove-bag techniques referenced above at the ends of each section where piping is to be cut.

d. Double wrap each section with 6-mil poly. Seal ends using duct tape leaving enough area of exposed pipe substrate to completely cut through the piping.

e. Candy-stripe the double-wrapped section of piping with duct tape prior to disposal. Place sections piping in lined dumpster or container. Label and dispose as ACM in approved landfill.

<u>Floor Tile and Associated Mastic</u>

A. Based on the quantities, the floor tile and mastic are to be removed under full containment. Any cabinets, storage closets or fixed items that are present over floor tile and mastic will require selective removal and disposal to access the floor tile and mastic, as needed. Floor tile and mastic is to be removed in accordance with the requirements below:

1. The abatement contractor will meet the requirements listed under the OSHA standard 29 CFR 1926.1101 section g for Class II friable materials. Minimum requirements for abatement of Class II friable materials will be:

    a. A full decontamination unit including a shower and separate bag loadout will be constructed at the entrance to the work area. See Appendix B for the tentative layout of the decontamination unit.

    b. Negative air pressure of 0.02 inches of water shall be maintained in the work area at all times.

    c. Minimum personnel protection equipment for the abatement workers shall be PAPR respiratory protection, disposable clothing, gloves, and boots during gross removal.

    d. The asbestos abatement contractor will provide separate personnel and equipment/loadout decontamination facilities. The personnel decontamination unit will be the only means of ingress and egress for the work area. All materials will exit the work area through the equipment/loadout decontamination unit. The Asbestos abatement contractor will comply with 29 CFR 1926.1101, specifically paragraph (j) Hygiene facilities and practices for employees.

    e. Abatement workers will wear protective clothing and respiratory protection in accordance with OSHA regulations during the abatement. The minimum respiratory protection during gross removal of friable materials will be a powered air purifying half-faced respirator. The asbestos abatement contractor may downgrade respiratory protection to a half-face air purifying respirator during the final cleaning based on the results of the OSHA required personnel air sampling.

    f. Critical barriers will be placed over all doors, windows, electrical panels, HVAC equipment, wall penetrations and accordion wall partitions. The critical barriers will consist of two layers of 6-mil poly secured in place. All walls and floors will be covered with a layer of 6-mil poly as required.

    g. High efficiency particulate air (HEPA) filter exhaust systems equipped with new HEPA filters for each project will be used. Exhaust equipment and systems will comply with ANSI Z9.2-79 and be used according to manufacturers' recommendations. Filtered air from the work area will be exhausted outside the building.

    h. A system of HEPA-equipped air filtration devices will be configured so that a pressure differential is established between the work area and the surrounding area (-0.02 to -0.04" water column).

    i. Additional air filtration devices will be provided inside the work area for emergency standby as well as for circulation of dead air spaces.

    j. The pressure differential is maintained at all times after preparation is complete and until the final visual inspection and air tests confirm the area is

clean and acceptable for occupancy and the designer confirms verbally with written follow-up to discontinue the use of the negative pressure system.

k. The above minimum requirements are intended as a guide and do not supersede OSHA requirements.

l. After the negative pressure decontamination unit is constructed and prior to gross removal, ECS/industrial hygiene firm will conduct a poly visual inspection and first day air monitoring. ECS/industrial hygiene firm must conduct a final visual inspection and can use PCM clearance. ECS requires at least 48 hours' notice prior to conducting a site visit or final clearance.

B. When using chemical removers (if the contractor elects to do so for removal of floor tile mastic), the contractor shall use a product that meets the following criteria:

a. The product shall not create a hazardous waste as a by-product.

b. The product shall be "low to no odor".

c. The product shall not contain any carcinogenic compounds or chlorinated hydrocarbons.

d. When using chemical removers, the contractor shall protect the walls in all adjacent areas. The contractor shall be responsible for any damage that occurs and for the complete repair of the damage.

e. The contractor shall add cat litter, oil-sorb or equivalent so that no free-standing liquid will be left in the asbestos bag.

f. The asbestos abatement contractor will dispose of asbestos-containing materials in accordance with applicable Federal, State, and local regulations.

Friable or Regulated Removal: Textured Walls

A. Textured walls are to be removed as Class 1 OSHA in a negative pressure containment (or several negative pressure containments). A full decontamination unit including a clean room, shower and equipment room will be constructed at the entrance or on the exterior of the building to the work area and will include a separate waste exit (See attached Decontamination Area Arrangement). It will be necessary to conduct select demolition to removal walls, ceilings and other materials to access fireproofing and overspray.

B. Negative air pressure of 0.02 inches of water shall be maintained in the work area at all times.

C. Minimum personnel protection equipment for the abatement workers shall be Powered Air Purifying Respirator (PAPR) respiratory protection, disposable clothing, gloves and boots during gross removal.

D. The asbestos abatement contractor will provide separate personnel and equipment/loadout decontamination facilities. The personnel decontamination unit will be the only means of ingress and egress for the work area. All materials will exit

the work area through the equipment/loadout decontamination unit. The Asbestos abatement contractor will comply with 29 CFR 1926.1101, specifically paragraph (j) Hygiene facilities and practices for employees.

E. Abatement workers will wear protective clothing and respiratory protection in accordance with OSHA regulations during the abatement. The minimum respiratory protection during gross removal of friable materials will be a powered air purifying respirator. The asbestos abatement contractor may downgrade respiratory protection to a half-face air purifying respirator during the final cleaning based on the results of the OSHA required personnel air sampling.

F. Full containment must be used during gross removal of all friable materials or materials that will become friable during removal. One layer of 6-mil poly must be used during construction of the containment (walls, floors and ceilings).

G. High efficiency particulate air (HEPA) filter exhaust systems equipped with new HEPA filters for each project will be used. Exhaust equipment and systems will comply with ANSI Z9.2-79 and be used according to manufacturers' recommendations. Filtered air from the work area will be exhausted outside the building.

H. A system of HEPA-equipped air filtration devices will be configured so that a pressure differential is established between the work area and the surrounding area (-0.02 to -0.04" water column).

I. Additional air filtration devices will be provided inside the work area for emergency standby as well as for circulation of dead air spaces.

J. It will be necessary to conduct selective demolition in portions of the building to access fireproofing and overspray for removal.

K. First day air monitoring and Clearance air sampling of friable/regulated ACM will be performed using PCM. After the negative pressure decontamination unit is constructed and prior to gross removal, ECS or a representative of ECS will conduct a poly visual inspection and first day air monitoring using PCM. ECS will be available for a final visual inspection and air clearance using TEM at completion of abatement activities. The above minimum requirements are intended as a guide and do not supersede OSHA requirements.

Vibration Dampeners

A. Vibration Dampeners will be removed in their entirety from the ductwork and double wrapped in a 2-mil poly sheet for proper disposal. Applicable State, EPA and OSHA regulations will be followed. A final visual inspection by ECS will be conducted to confirm vibration dampeners have been removed.

SECTION 02084

DISPOSAL OF ASBESTOS-CONTAINING WASTE MATERIAL

1.1 GENERAL

A. All asbestos materials and miscellaneous contaminated debris shall be properly sealed and protected, and the loadout vehicle/dumpster shall be locked, while located on the facility site and then transported to a predesignated disposal site in accordance with 40 CFR 61.150 and DOT 49 CFR Parts 100-399.

B. An enclosed vehicle will be used to haul waste material to the disposal site. No rental vehicles or trailers shall be used. Vehicle selection, vehicle covers, and work practices shall assure that no asbestos becomes airborne during the loading, transport and unloading activity, and that material is placed in the waste site without breaking any seals.

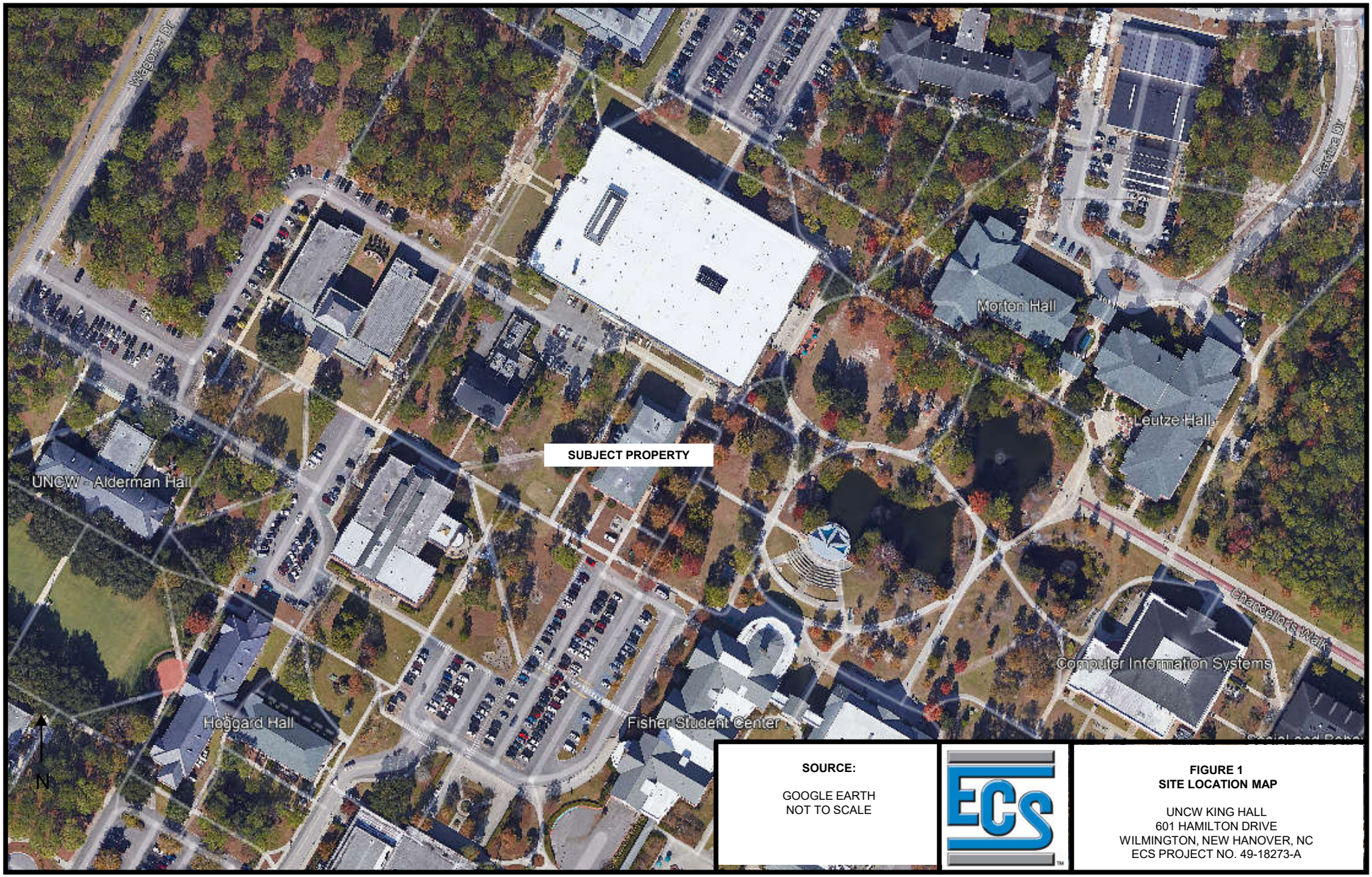
C. Waste disposal polyethylene bags (6 mil) and containers, non-porous (steel/plastic) drums or equivalent, with labels, appropriate for storing asbestos waste during transportation to the disposal site shall be used. In addition to the OSHA labeling requirements, all containers shall be labeled with the name of the waste generator and the location at which the waste was generated.

D. The contractor shall transport the containers and bags of waste material to the approved waste disposal site. The sealed plastic bags shall be placed into the burial site unless the bags have been broken or damaged. Upon the landfill's approval damaged bags shall be left in the non-porous containers and the entire contaminated package shall be buried. Uncontaminated containers may be reused.

E. Workers loading and unloading the asbestos will wear respirators and disposable clothing when handling material. Asbestos warning signs shall be posted during loading and unloading of asbestos waste.

F. The contractor shall use the HHCB's Waste Shipment Record for disposal records as per 40 CFR 61.150 and distribute a copy of all waste shipment records to the designer after the completion of the project.

END OF SPECIFICATION

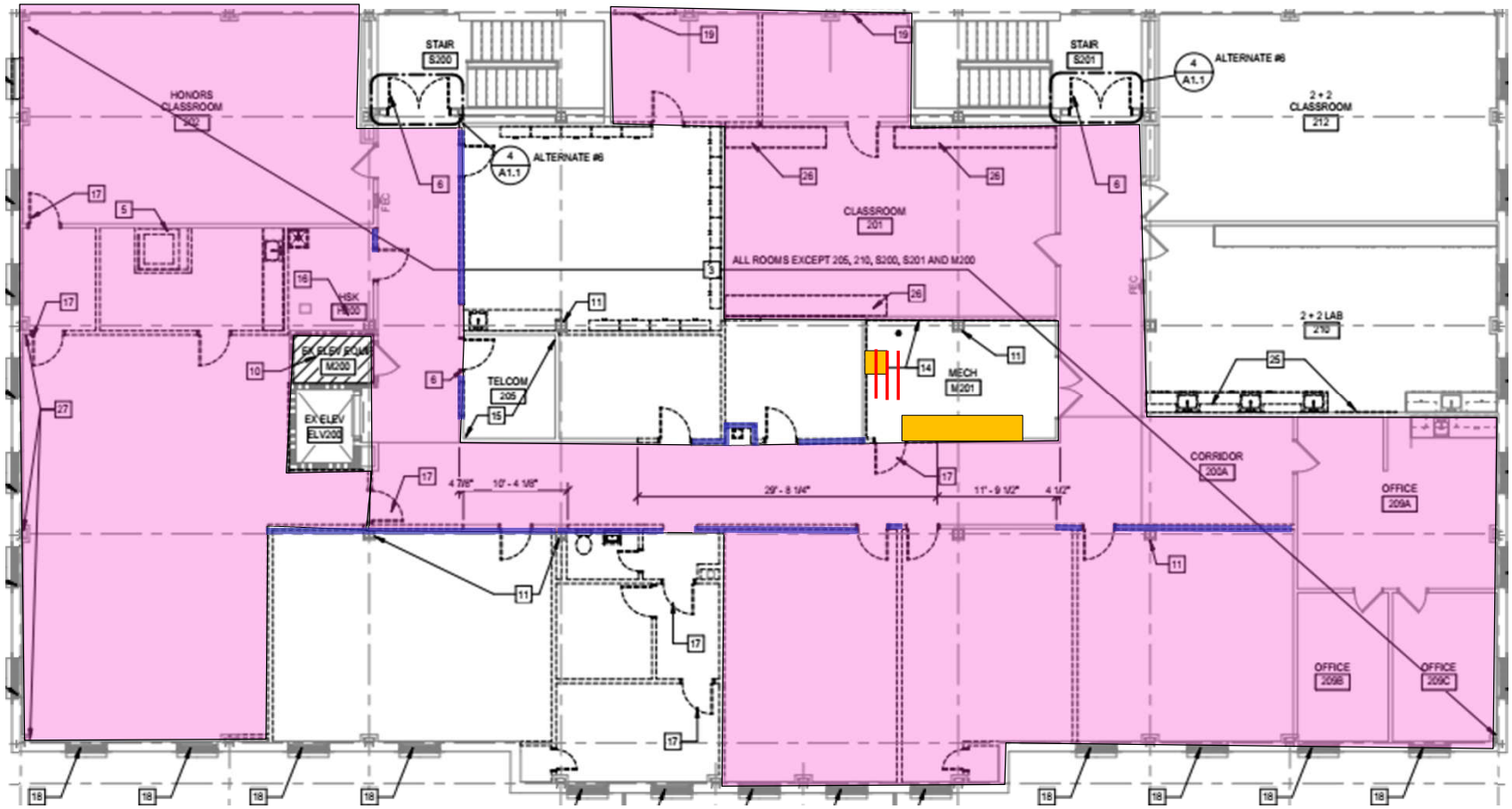


SOURCE:

GOOGLE EARTH
NOT TO SCALE

FIGURE 1
SITE LOCATION MAP

UNCW KING HALL
601 HAMILTON DRIVE
WILMINGTON, NEW HANOVER, NC
ECS PROJECT NO. 49-18273-A



LEGEND

- ACM VCT/Mastic
- ACM Vibration Dampener
- Observed ACM Black Mastic TSI
- Wall with ACM Wall Texture

N

NOTE:

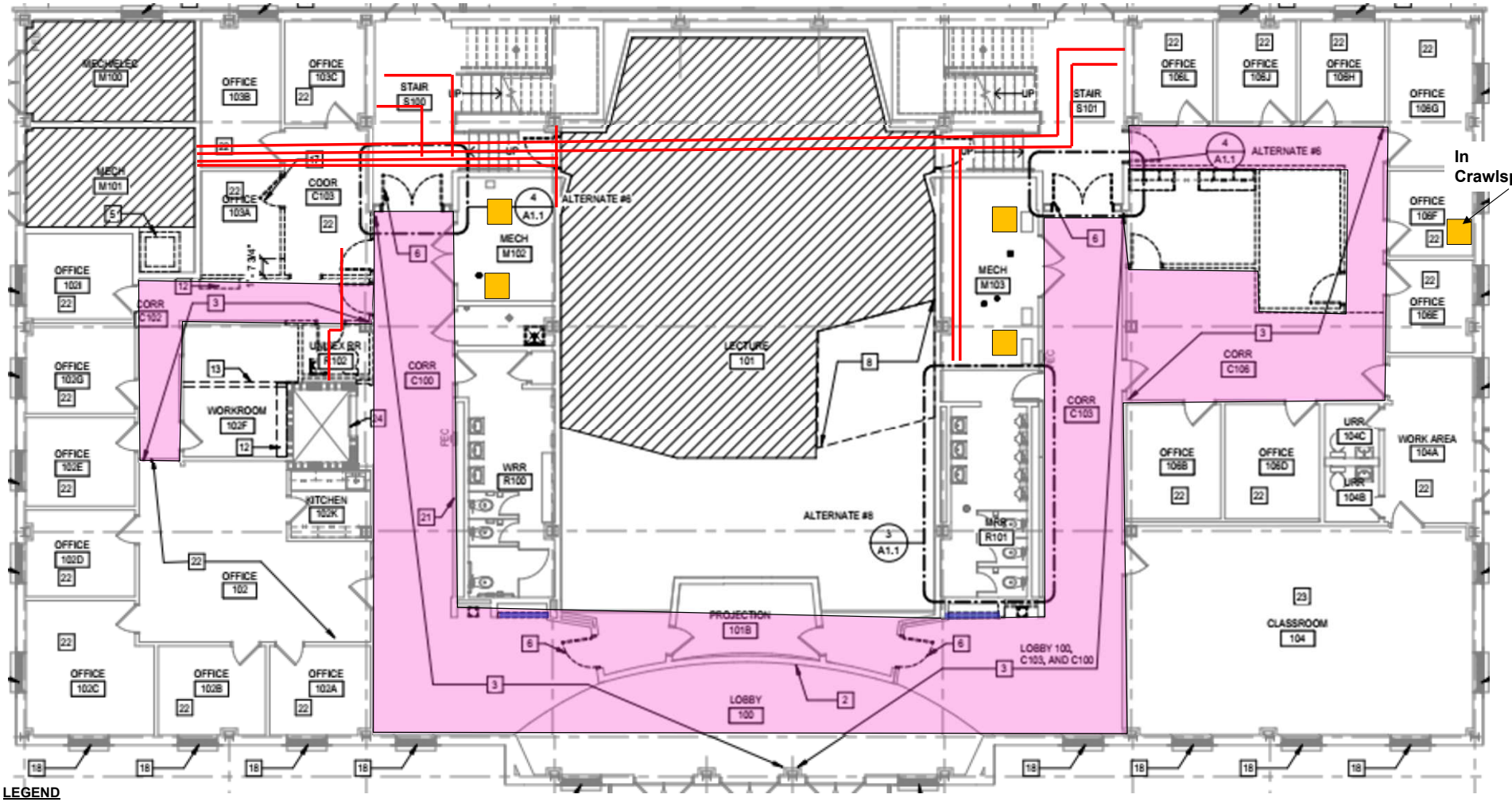
1) Contractor is responsible for removal and disposal of all ACM shown on the Drawings. The ACM shall be removed in accordance with the Asbestos Removal Plans and Specifications.
2) The boundaries, locations and quantities are approximate. Contractor shall verify the location and quantity of ACM prior to bidding work. Any discrepancies identified should be conveyed to ECS prior to bidding.

SOURCE:

MOSLEY ARCHITECTS AND ECS FIELD NOTES

NOT TO SCALE

FIGURE 2
LOCATION OF ACM TO BE REMOVED
SECOND FLOOR
UNCW KING HALL
601 HAMILTON DRIVE
WILMINGTON, NEW HANOVER, NC
ECS PROJECT NO. 49-18273-A



LEGEND

- ACM VCT/Mastic
- ACM Vibration Dampener
- Observed ACM Black Mastic TSI
- Wall with ACM Wall Texture

NOTE:

1) Contractor is responsible for removal and disposal of all ACM shown on the Drawings. The ACM shall be removed in accordance with the Asbestos Removal Plans and Specifications.
2) The boundaries, locations and quantities are approximate. Contractor shall verify the location and quantity of ACM prior to bidding work. Any discrepancies identified should be conveyed to ECS prior to bidding.

SOURCE:

MOSLEY ARCHITECTS AND ECS FIELD NOTES

NOT TO SCALE

FIGURE 3
LOCATION OF ACM TO BE REMOVED
FIRST FLOOR
UNCW KING HALL
601 HAMILTON DRIVE
WILMINGTON, NEW HANOVER, NC
ECS PROJECT NO. 49-18273-A

APPENDIX A

PREWORK ASBESTOS INSPECTION CHECKLIST

Name of State Facility: _____

Project Name: _____

Project ID Number: _____

Date of Inspection: _____ Pass: _____ Fail: _____

			YES	NO
A.	**DOCUMENTS**			
	1)	Asbestos Removal Permit/NESHAP Notification	_____	_____
	2)	Accreditation Documents for Workers & Supervisors	_____	_____
	3)	Asbestos Plans and Specifications	_____	_____
	4)	Air Monitoring Data	_____	_____
	5)	Waste Shipment Records	_____	_____
	6)	Sign-in Sheets and Bound Book for Comments	_____	_____
	7)	Calibration Record for Grade “D” Air	_____	_____
	8)	Items listed in Section 01043 of Specification	_____	_____
B.	**PPE SUPPLIES**			
	1)	Tyvek Clothing	_____	_____
	2)	Rubber Boots	_____	_____
	3)	Respirators with HEPA Filters	_____	_____
C.	**CLEAN ROOM**			
	1)	Entry Curtains	_____	_____
	2)	Emergency Phone Numbers Posted	_____	_____
	3)	First Aid Kit	_____	_____
	4)	Asbestos Signs	_____	_____
	5)	Decontamination Procedures Posted	_____	_____
	6)	Fire Extinguisher	_____	_____
D.	**SHOWER ROOM**			
	1)	Polyethylene Curtains	_____	_____
	2)	Hot/Cold Water & Operational	_____	_____
	3)	Soap & Towels	_____	_____
	4)	Waste Water Filter Pump Operational	_____	_____
	5)	Extra Five Micron Size Filters	_____	_____
	6)	Filtered Waste Water to Sanitary Sewer	_____	_____

E.	**WORK AREA**	**YES**	**NO**
1)	Removable Items Out of Area	_____	_____
2)	Non-removable Items Protected	_____	_____
3)	Critical Barriers Installed	_____	_____
4)	Polyethylene Curtains	_____	_____
5)	Polyethylene on Walls/Floors as Specified	_____	_____
6)	HVAC off	_____	_____
7)	Air Filtration Devices in Place and Operational	_____	_____
8)	Air Exhausted to Outside	_____	_____
9)	Electricity Locked and Tagged Out	_____	_____
10)	Temporary Power Installed with GFCI	_____	_____
11)	Fire Extinguishers	_____	_____
12)	Emergency and Fire Exits Marked	_____	_____
13)	Audible Alarms Operational	_____	_____
14)	Toilet Available	_____	_____

F.	**EQUIPMENT**		
1)	Safety Equipment	_____	_____
2)	HEPA Vacuums	_____	_____
3)	Waste Disposal Bags	_____	_____
4)	Airless Sprayer with Water Source	_____	_____
5)	Cleaning Equipment	_____	_____
6)	Glove Bags	_____	_____
7)	Emergency Power Generator (if required)	_____	_____
8)	Temporary Lighting	_____	_____

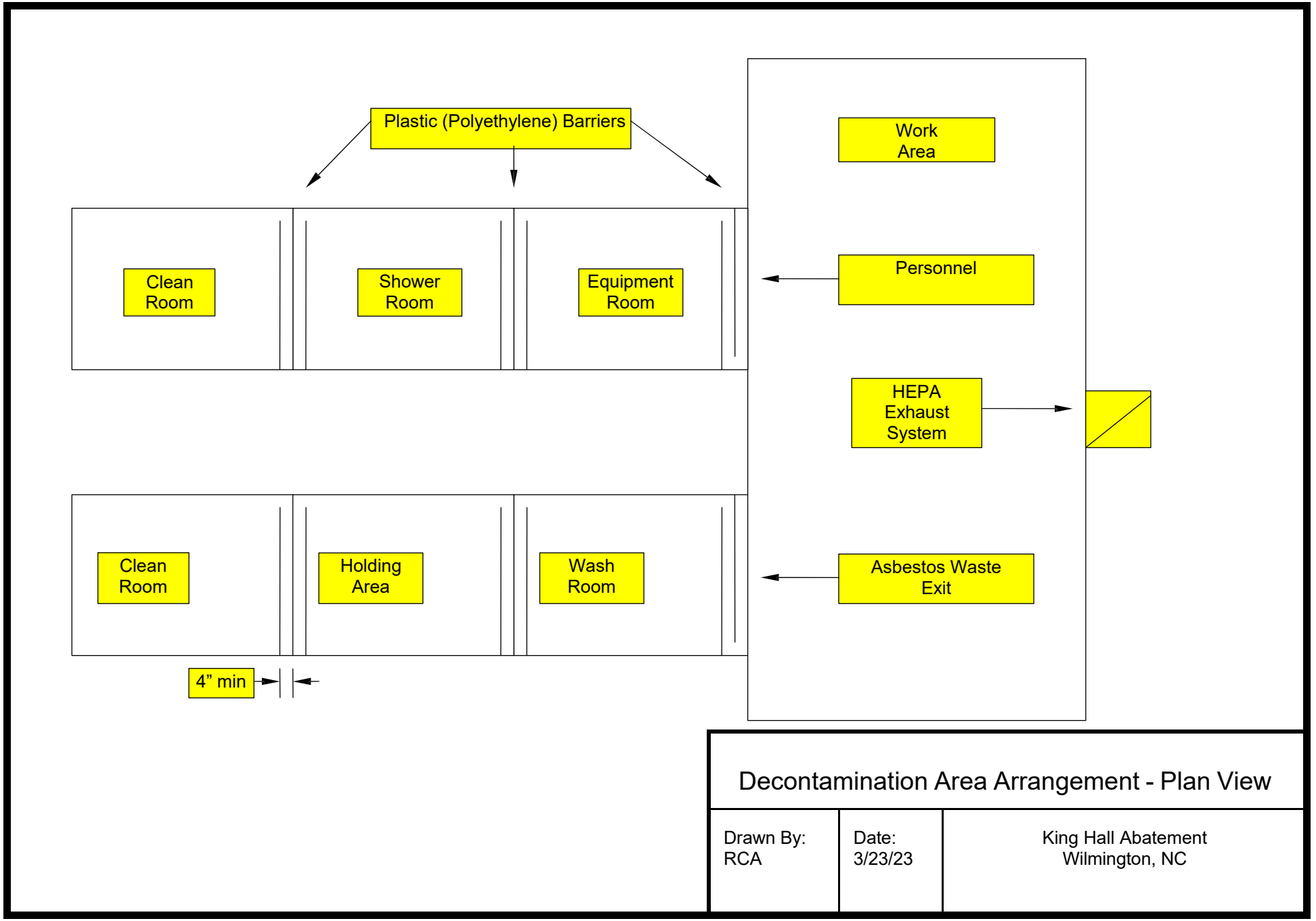
G.	**OTHER**		
1)	_____	_____	_____
2)	_____	_____	_____
3)	_____	_____	_____
4)	_____	_____	_____

_____ _____

Asbestos Design Consultant *Date*

_____ _____

Asbestos Contractor's Representative *Date*



Decontamination Area Arrangement - Plan View

Drawn By:	Date:	
RCA	3/23/23	King Hall Abatement Wilmington, NC

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

ROY COOPER • Governor
KODY H. KINSLEY • Secretary
MARK T. BENTON • Deputy Secretary for Health
SUSAN KANSANGRA • Assistant Secretary for Public Health
Division of Public Health

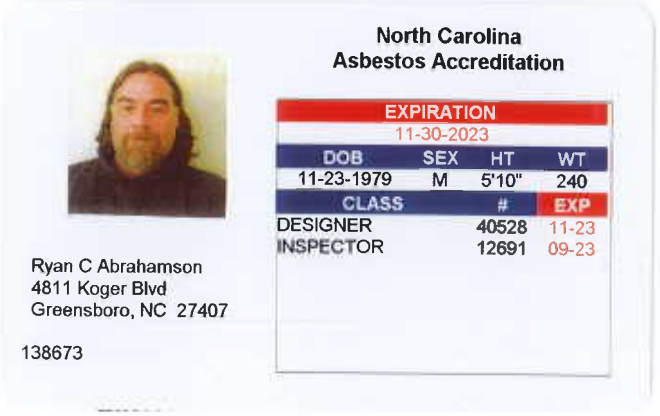
January 12, 2023

Ryan C Abrahamson
4811 Koger Blvd
Greensboro, NC 27407

Dear Mr. Abrahamson:

Based upon the review of your accreditation application, the Health Hazards Control Unit (HHCU) has determined that you have fulfilled the requirements and are eligible for asbestos accreditation as a(n) ABATEMENT PROJECT DESIGNER. Your assigned North Carolina accreditation number is 40528, which is reflected on your enclosed North Carolina Accreditation card. Please be sure to take this card with you to any asbestos work site where you are employed. The State requires that all persons conducting asbestos abatement or asbestos management activities be accredited and have their identification card on site.

Your North Carolina Abatement Project Designer accreditation will expire on NOVEMBER 30, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Abatement Project Designer after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to November 30, 2023. If you should continue to perform asbestos management activities as a(n) Abatement Project Designer without a valid North Carolina accreditation, you will be in violation of State regulations and may be cited for noncompliance.



Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

ROY COOPER • Governor

KODY H. KINSLEY • Secretary

HELEN WOLSTENHOLME • Interim Deputy Secretary for Health

MARK T. BENTON • Assistant Secretary for Public Health

Division of Public Health

June 21, 2022

Lindsey B Lucas
4634 Heritage Manor
Crestwood, KY 40014

Dear Ms. Lucas:

Based upon the review of your accreditation application, the Health Hazards Control Unit (HHCU) has determined that you have fulfilled the requirements and are eligible for asbestos accreditation as a(n) ABATEMENT PROJECT DESIGNER. Your assigned North Carolina accreditation number is 40513, which is reflected on your enclosed North Carolina Accreditation card. Please be sure to take this card with you to any asbestos work site where you are employed. The State requires that all persons conducting asbestos abatement or asbestos management activities be accredited and have their identification card on site.

Your North Carolina Abatement Project Designer accreditation will expire on JUNE 30, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Abatement Project Designer after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to June 30, 2023. If you should continue to perform asbestos management activities as a(n) Abatement Project Designer without a valid North Carolina accreditation, you will be in violation of State regulations and may be cited for noncompliance.

Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit

Lindsey B Lucas
4634 Heritage Manor
Crestwood, KY 40014

136711

North Carolina
Asbestos Accreditation

EXPIRATION			
06-30-2023			
DOB	SEX	HT	WT
11-10-1978	F	5'7"	165
CLASS		#	EXP
AIR MONITOR		80793	06-23
DESIGNER		40513	06-23
INSPECTOR		12480	06-23
MGMT PLANNER		21053	06-23

ASBESTOS AND LEAD PAINT SURVEY

UNC-WILMINGTON - KING HALL

601 HAMILTON DRIVE
WILMINGTON, NORTH CAROLINA 28403

ECS PROJECT NO. 49:18273

FOR: UNC-WILMINGTON

NOVEMBER 1, 2022

November 1, 2022

Mr. David Holsinger
UNC-Wilmington
601 South College Road
Wilmington, North Carolina 28403

ECS Project No. 49:18273

Reference: Asbestos and Lead Paint Survey, UNC-Wilmington - King Hall, 601 Hamilton Drive, Wilmington, North Carolina

Dear Mr. Holsinger:

ECS Southeast, LLP (ECS) is pleased to provide UNC-Wilmington with the results of the Asbestos and Lead Paint Survey performed at the UNC-Wilmington - King Hall. This report summarizes our observations, analytical results, findings, and recommendations related to the work performed. The work described in this report was performed by ECS in general accordance with the Scope of Services described in ECS Proposal Number 49:31775P and the terms and conditions of the agreement authorizing those services.

ECS appreciates this opportunity to provide UNC-Wilmington with our services. If we can be of further assistance to you, please do not hesitate to contact us.

Sincerely,

ECS Southeast, LLP

Tina M. Stewart, REM
Environmental Principal
tstewart@ecslimited.com
336-314-4691

Amy DeSaix, REM, CIEC
Environmental Principal
adesaix@ecslimited.com
910-686-9114

EXECUTIVE SUMMARY

The subject property consists of a two-story educational building located on the UNC Wilmington (UNCW) campus at 601 Hamilton Drive in Wilmington, New Hanover County, North Carolina. Based on the information available, the building is referred to as King Hall, contains 22,288 square feet of space, and was reportedly constructed in 1968. UNCW provided prior reports from 2002 and a spreadsheet with identified asbestos-containing materials (ACMs) including samples collected from 2018. The building consist of concrete masonry unit (CMU) block and plaster gypsum board wall finishes with floor tiles, and a drop down ceiling.

The purpose of this Asbestos and Lead Paint Survey is to evaluate if ACMs or lead-containing paint (LCP) may be present within portions of the buildings to be renovated which may require special handling and/or disposal if removed during construction activities. Reportedly, the proposed renovations include new carpet, paint, restrooms, ADA upgrades, window replacement, suite alterations including moving walls. Therefore, the survey was performed on accessible areas of the interior and exterior windows and excludes the remainder of the exterior of the building and roofing system(s).

Based on the laboratory analysis of the bulk samples collected during the survey, asbestos was identified to be in the building materials sampled. The ACMs identified included the following:

- Vibration Dampener;
- Black tar on white HVAC wrap;
- Various floor tiles and mastics;
- Black mastic on 6" pipes;
- White wall texture;
- Black residual mastic; and,
- Sink coating.

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous sampling areas including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory.

ECS was provided previous asbestos survey reports that included the identification of ACMs in the following materials:

- Cloth vibration dampener in mechanical closets;
- Mudded insulation on the steam and hot water pipes throughout the building;
- Insulation located inside the boiler flue;
- Silver/black roof flashing;
- 12"x12" white with gray and black specs floor tile;
- Black mastic beneath carpet;
- 12"x12" cream with white and gray flecks floor tile;
- 12"x12" off-white with gray streak floor tile;
- 12"x12" cream with tan and gray streak floor tile;
- 12"x12" gray/black floor tile; and,
- 12"x12" white with black dots floor tile.

Based on the laboratory analysis of the paint chip samples collected during the survey, lead was identified in several of the paint samples that included white, black, and gray paint.

Recommendations regarding the removal and disposal of the ACMs, and LCPs identified by ECS can be found in Section 5.0 of this report.

This Executive Summary is an integral part of the report. ECS recommends that the report be read in its entirety.

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TABLE OF APPENDICES

1.0 SITE DESCRIPTION

The subject property consists of a two-story educational building located on the UNC Wilmington (UNCW) campus at 601 Hamilton Drive in Wilmington, New Hanover County, North Carolina. Based on the information available, the building is referred to as King Hall, contains 22,288 square feet of space, and was reportedly constructed in 1968. UNCW provided prior reports from 2002 and a spreadsheet with identified asbestos-containing materials (ACMs) including samples collected from 2018. The building consist of concrete masonry unit (CMU) block and plaster gypsum board wall finishes with floor tiles, and a drop down ceiling.

2.0 PURPOSE

The purpose of this Asbestos and Lead Paint Survey is to evaluate if ACMs or lead-containing paint (LCP) may be present within portions of the buildings to be renovated which may require special handling and/or disposal if removed during construction activities. Reportedly, the proposed renovations include new carpet, paint, restrooms, ADA upgrades, window replacement, suite alterations including moving walls. Therefore, the survey was performed on accessible areas of the interior and exterior windows and excludes the remainder of the exterior of the building and roofing system(s).

The identification of ACMs may require trained labor, regulated work practices, and special disposal. The identification of LCP or other lead hazards may require disclosure to contractors and monitoring of lead exposure.

3.0 METHODOLOGY

ECS performed the authorized Scope of Services in general accordance with our proposal, standard industry practice(s) and methods specified by regulation(s) for the identification and confirmation of ACMs and LCPs. Prior reports indicated the following materials contained asbestos:

- Cloth Vibration Dampener in mechanical closets;
- Mudded Insulation on the steam and hot water pipes throughout the building;
- Insulation located inside the Boiler Flue;
- Silver/Black Roof Flashing;
- 12"x12" White with Gray and Black Specs Floor Tile;
- Black Mastic beneath carpet;
- 12"x12" Cream with White and Gray Flecks Floor Tile;
- 12"x12" Off-white with Gary Streak Floor Tile;
- 12"x12" Cream with Tan and Gray Streak Floor Tile;
- 12"x12" Grayish/Black Floor Tile; and,
- 12"x12" White with Black Dots Floor Tile.

Additionally the reports found the following lead-containing paints (LCPs):

- Interior Window Sills; and,
- Interior and Exterior Window Mullions.

It should be noted that ECS was unable to access the auditorium; however, prior reports indicate ACM tile and mastic within the auditorium.

3.1 Asbestos-Containing Materials

The minorly destructive asbestos survey was performed on August 29 and September 15, 2022 by Jennifer Turner and Amy DeSaix (NC License #12107), asbestos inspectors who have received EPA accredited training and is licensed by North Carolina. Samples of suspect ACMs were collected utilizing hand tools and placed into individual, labeled plastic bags. Unique bulk suspect ACM samples were submitted to Eurofins, CEI in Cary, North Carolina for analysis via Polarized Light Microscopy (PLM) in accordance with current EPA-600 methodology. Materials consisting of additional layers were analyzed separately. Eurofins, CEI is listed as an accredited laboratory by the National Voluntary Laboratory Accreditation Plan (NVLAP) managed by the National Institute of Standards and Technology (NIST) for bulk sample analysis by currently approved EPA methodology by PLM.

During the survey, ECS attempted to identify suspect ACMs in readily accessible areas. However, due to the destructive means required to identify some materials, certain areas were deemed inaccessible (i.e. behind walls or sub grade materials) and were not surveyed for suspect ACMs. Unidentified suspect ACMs may be located in these and/or other inaccessible areas.

Samples were collected in general accordance with EPA Standard 40 CFR 763 Subpart E, Asbestos Hazard Emergency Response Act (AHERA) and OSHA Standard 29 CFR 1926.1101 Inspection Protocol. Multiple samples of each unique material were submitted. Samples were analyzed using “Positive Stop” methodology. If one sample of a homogeneous material is reported to contain asbestos, the remaining samples of that material are not analyzed. EPA regulations stipulate that if one sample contains asbestos the entire quantity of that material contains asbestos, regardless of additional analysis.

3.2 Lead in Paint and Surface Coatings

The lead paint survey was performed by a North Carolina licensed Lead Inspector using a X-Ray Fluorescence (XRF) Spectrometer and paint chip sampling to identify lead concentrations in painted and glazed surfaces. Paint chip samples were collected utilizing hand tools and placed into individual, labeled plastic bags. Unique sample identifications were given to each sample and samples were submitted to Eurofins, CEI in Cary, North Carolina for analysis via Flame Atomic Absorption Spectrophotometry..

The survey was conducted utilizing the U.S. EPA definition of lead-based paint (LBP). Under this definition, painted surfaces which contain lead in concentrations equal to or greater than 1.0 milligrams per square centimeter ($\geq$ 1.0 mg/cm^2) using an XRF or 0.5% concentration by weight are classified as coated with LBP. Paints with detectable concentrations of lead are considered LCPs. Additionally, fixtures or components that are manufactured with a factory applied glazing (i.e., sinks, toilets, ceramic tiles, etc.) are tested as these factory-applied finishes often contain lead. Activities which disturb LCPs and glazing (while not LBPs by the U.S. EPA definition) are regulated by OSHA (29 CFR 1926.62).

Because the current or proposed use of the property is not residential or child-occupied, the scope of the survey was not conducted in accordance with HUD Chapter 7 requirements. This representative survey included walls, windows, doors, and miscellaneous components.

4.0 RESULTS

The following is a summary of laboratory results, findings and observations.

4.1 Asbestos-Containing Materials

In total, 94 bulk samples from 49 homogeneous areas were submitted to the laboratory of which 70 layers were analyzed. An ACM is defined as any material containing more than one percent (>1%) asbestos as determined using the method specified in Appendix E, Subpart E, 40 CFR Part 763, Section 1, PLM. Materials are categorized by the U.S. EPA in the following categories:

- Friable ACMs are defined as any ACM that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure. Non-friable ACMs are defined as any ACM that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.
- Category I non-friable ACM are listed as following: packings, gaskets, resilient floor coverings, and asphalt roofing products containing more than one percent (>1%) asbestos.
- Category II non-friable ACM are listed as any material, excluding Category I non-friable ACM, containing more than one percent (>1%) asbestos.

Regulated ACMs (RACMs) are friable ACMs or non-friable ACMs that will be or has been subjected to sanding, grinding, cutting, or abrading or has crumbled, been pulverized, or reduced to powder in the course of renovation and/or demolition operations.

Eurofins, CEI submitted a signed final laboratory report to ECS on September 7 and 22, 2022. Seventeen of the bulk samples submitted for analysis were reported to contain asbestos in detectable concentrations. These materials are summarized below. A complete list of the sampled materials submitted for analysis and sample locations are located in the Appendix of this report. Additional details regarding the overall locations of the materials identified as asbestos-containing are provided further in the report. Photographs of collected samples are also located in the Appendix of this report.

Summary of Asbestos-Containing Materials Identified

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
12-1	Mechanical Room 102, 103, and 201 and Crawlspace	White Vibration Dampener	35% Chrysotile	Friable	7 Vibration Dampeners, one of which is 20 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
13-1,2	Observed in Mechanical Room 103; Possibly located in other mechanical rooms	White HVAC sealant with Black Tar on HVAC Equipment	5% Chrysotile	Category II Non-Friable	20 square feet
18-1,2	Room 106-H	Cream Gray Floor Tile and associated Black Mastic	Floor Tile (FT): 2% Chrysotile Mastic: 3% Chrysotile	Category I Non-Friable	130 square feet
26-1,2	First Floor Ceiling into 2nd Floor Mech. Room	Black Mastic on 6" Pipes	5% Chrysotile	Category II Non-Friable	Unknown
27-1,2	Janitorial Room H200	White Wall Texture	2% Chrysotile	Friable	90 square feet
31-1,2	Room 211, Observed in Rooms 211A, 210, C200A, 208, 207, and 206	White Floor Tile	FT: 2% Chrysotile Mastic: None Detected (ND)	Category I Non-Friable	2,850 square feet
34-1	Room 209	Black Residual Mastic	3% Chrysotile	Category I Non-Friable	334 square feet
35-1,2	Room 208	Tan Floor Tile and associated Black Mastic	FT: 2% Chrysotile Mastic- 3% Chrysotile	Category I Non-Friable	450 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
36-1	Room 203, 203A, 203B, and in Second Floor Hallway by Room 203 Door and Elevator	Yellow/Black Mastic associated with Light Gray Floor Tile with Gray Streaks	FT: ND Mastic: 5% Chrysotile	Category I Non-Friable	1,250 square feet
37-1	Second Floor Hallway and Room 201A	Gray Floor Tile with Black Streaks and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	750 square feet
40-1	Room 201E	White Floor Tile under Gray Carpet and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	160 square feet
41-1	Room 201	White Sink Undercoating	3% Chrysotile	Category II Non-Friable	10 square feet
42-1	First Floor Hallway	Cream Floor Tile with Tan Streaks	FT: 2% Chrysotile	Category I Non-Friable	2,500 square feet
43-1	Room 104	White Floor Tile with Gray Streaks	FT (Tan): 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	270 square feet
44-1	Room 104	Olive Floor Tile and associated Black Mastic	FT: 2% Chrysotile Mastic: 5% Chrysotile	Category I Non-Friable	270 square feet

Sample Number	Location	Material Description	Analytical Results	Category	Estimated Quantity
48-1,2	Room 104A	Yellow/Black Mastic associated with White Floor Tile with Multi-color Specs	FT: ND Mastic: 3% Chrysotile	Category I Non-Friable	160 square feet
49-1,2,3,4,5,6,7	Interior Hallway and Room H200	White/ Off-white Wall Texture	2% Chrysotile	Friable	2,500 square feet
Assumed	Throughout	Mudded Elbows	Previously Sampled	Friable	Observed 20

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous sampling areas including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory.

It should be noted that the boiler had been removed along with the previously identified ACM boiler flue insulation.

Due to the non-destructive nature of the assessment, unless asbestos abatement documents are present, ACM floor tile mastic should be assumed present throughout.

4.2 Suspect or Assumed Asbestos-Containing Materials

Due to the inaccessibility or the destructive means that asbestos sampling requires, additional suspect ACMs may remain within the building hidden behind inaccessible areas that include, but are not limited to, sub-grade walls, structural members, topping slabs, sub-grade sealants, flooring located below underlayments, areas behind exterior walls, pipe trenches, and subsurface utilities, etc. These areas were deemed inaccessible and were not assessed.

If these materials are discovered during construction activities, they should be presumed to contain asbestos and be treated as ACMs or be sampled immediately upon discovery and prior to disturbance for asbestos content by a certified asbestos inspector in accordance with 29 CFR 1926.1101.

Based upon our past experience in the identification of ACMs in similarly constructed buildings, the following additional suspect ACMs may also be located in inaccessible areas of the structure:

- Underground Piping;
- Vapor Barrier on Exterior Structure of Foundation;
- Fire Doors;
- Pipe Insulation within Wall Chases; and,

- Mastic associated mirror and boards adhered to the wall.

4.3 Lead in Paint and Surface Coatings

Paint and surface coatings which contain detectable concentrations of lead considered LCP. Since OSHA has no specific action level for lead in paint, all paint on the site found to have a measurable concentration of lead should be assumed to be lead-containing. Work performed which may disturb LCP is regulated under OSHA as referenced under 29 CFR 1926.62. A total of 49 readings were collected during the survey, including calibration readings. Seven paint chip samples were collected and analyzed. Paint and other surface coatings which are defined by applicable regulation as lead-based paints are summarized in the table below and photographs of lead-based paint identified are located in the Appendix.

Lead-based paint is defined by the U.S. EPA and North Carolina as any paint or other surface coatings that contain lead equal to or in excess of 1.0 mg/cm^2 (XRF) or 0.5% by weight (paint chip).

The following types of materials were found to contain detectable concentrations of lead.

Summary of XRF Lead-Containing Paints

Location	Color	Substrate	Component
Exterior	White	Wood	Porch Overhang
Exterior	White	Wood	Porch Trim
Exterior	White	Metal	Door
Back Right Starirwell	White	CMU	Wall
Womens Restroom	Off-white	Ceramic	Tile
Interior	White	Wood	Window Sill
Halfmoon Window of Entrance	White	Wood	Window Casing
Front Office	Beige	Metal	Door Casing
Back Left Stairwell	Light Blue	CMU	Wall
2nd Floor Hallway	Tan	Metal	Door Casing
Exterior	White	Wood	Window Pannel
Exterior	White	Wood	Window Sill
Exterior	White	Wood	Window Casing

Summary of Paint Chip Lead-Containing Paint Results

Sample ID	Location	Color	Substrate	Component	Analytical Results
LBP01	Mechanical Room	White	Metal	Door	0.19%
LBP02	Mechanical Room	Gray	Concrete	Floor	0.0056%
LBP05	Exterior	Black	Metal	Stair Railing	0.033%
LBP06	Exterior	White	Wood	Window Sill	0.062%
LBP07	Exterior	White	Wood	Window Casing	0.19%

5.0 RECOMMENDATIONS AND REGULATORY REQUIREMENTS

Based on our understanding of the purpose of the Asbestos and Lead Paint Survey, the results of laboratory analysis, and our findings and observations, ECS presents the following recommendations.

5.1 Asbestos-Containing Materials

Several materials were identified as asbestos-containing as noted above. ECS recommends where a material type has been identified as asbestos-containing that other materials with similar color, texture, age and size throughout the building's interior and exterior be assumed to contain asbestos. Please refer to Section 4.1 for a complete list of building materials that were reported positive for asbestos and to Section 4.2 for materials that were assumed to contain asbestos.

A trace amount of asbestos (≤1%) was detected in the bulk samples of three homogeneous samples including white/gray insulation in the boiler flu, white caulking on drywall to brick on first floor, and white exterior window glazing (Samples 3-1,-2, 23-1,-2, and 47-1,-2) analyzed by the laboratory. Although materials that contain trace amounts of asbestos are not subject to U.S. EPA or North Carolina regulations for the handling and disposal of asbestos, OSHA still regulates any work which will disturb materials identified with trace amounts of asbestos (reference the November 24, 2003 OSHA Interpretation document - Compliance Requirements For Renovation Work Involving Materials Containing Less Than 1% Asbestos). Therefore, any Contractors disturbing these materials will need to comply with components of 29 CFR 1926.1101, as detailed in the 2003 OSHA Interpretation document.

An asbestos abatement design is required for each individually permitted removal of more than 3,000 square feet, 1,500 linear feet. or 656 cubic feet of regulated ACMs conducted in public areas. Based on quantities of ACMs identified, an asbestos abatement design is required to delineate and quantify known and suspect ACMs in the building and to outline proper procedures for the abatement. This will help protect the owner's liability in better defining the scope of work and contractors' roles and responsibilities in the abatement process and holding the contractor accountable for the performance of the project. The specification typically defines the Contractor's scope of work

and outline requirements and procedures that must be followed for the project. The intent of the specification is to give performance requirements for the Contractor so that the project can be completed safely and in compliance with applicable federal and state regulations. Typically, the specification document serves as part of the site owner's contract with the contractor.

If ACMs are to be removed, it is recommended that an industrial hygienist monitor the project. This involves collecting air samples from within and outside abatement work areas to monitor the asbestos abatement contractor's work practices over the course of the project. The industrial hygienist should evaluate if the asbestos abatement work is in accordance with project specifications, U.S. EPA regulation 40 CFR Part 61-National Emission Standards for Hazardous Air Pollutants Subpart M: National Emission Standard for Asbestos, and U.S. Occupational Safety and Health Administration (OSHA) regulation 29 CFR 1926.1101 – Asbestos in Construction. The industrial hygienist should assess each work area to monitor the removal of ACMs. Only after the industrial hygienist has determined the identified ACMs have been removed should final clearance air samples be collected (if necessary).

Suspect ACMs not observed due to inaccessibility or not sampled due to the destructive means that sampling would require may also be encountered during construction activities. At the time of the survey, only limited destructive means were used to locate or sample suspect ACMs; therefore, additional suspect ACMs may remain within inaccessible areas that include, but are not limited to, [sub-grade walls, structural members, topping slabs, exterior areas, sub-grade sealants, flooring located below underlayments, vapor barriers, pipe trenches and other subsurface utilities, etc.] If additional suspect ACMs are uncovered which were not accessible during this survey, it is recommended that these materials either be assumed to contain asbestos or be sampled prior to disturbance upon discovery for asbestos content by an asbestos inspector in accordance with 29 CFR 1926.1101.

5.2 Lead in Paint and Surface Coatings

Based on the findings of the lead survey, detectable concentrations of lead were identified on some paints and surface coatings. The presence of lead is a concern primarily when conditions exist where it may be inhaled or ingested. Regardless of the analytical results of a material, all painted and/or glazed surfaces may still contain concentrations of lead in the paint, which when disturbed, may generate lead dust greater than the Permissible Exposure Limit (PEL) of 50 micrograms per cubic meter (ug/m3) as an 8-hour Time Weighted Average (TWA) established by the OSHA "Lead Exposure in Construction Rule (29 CFR 1926.62)."

The OSHA standard gives no guidance on acceptable levels of lead in paint at which no exposure to airborne lead (above the action level) would be expected. Rather, OSHA defines airborne concentrations, and references specific types of work practices and operations from which a lead hazard may be generated (reference 29 CFR 1926.62, section d). Environmental and personnel monitoring should be conducted during any removal/demolition process (as appropriate) to verify that actual personal exposures are below the PEL of 50 $\mu g/m^3$ as an 8-hour TWA. Under OSHA requirements, the contractor performing renovation work will be required to conduct this monitoring and follow applicable requirements under 29 CFR 1926.62 if disturbing LCP.

6.0 LIMITATIONS

The conclusions and recommendations presented within this report are based upon a reasonable level of assessment within normal bounds and standards of professional practice for a site in this particular geographic setting. ECS is not responsible or liable for the discovery and elimination of hazards that may potentially cause damage, accidents, or injuries.

The observations, conclusions, and recommendations pertaining to environmental conditions at the subject site are necessarily limited to conditions observed, and/or materials reviewed at the time this study was undertaken. No warranty, expressed or implied, is made with regard to the conclusions and recommendations presented within this report. This report is provided for the exclusive use of the client. This report is not intended to be used or relied upon in connection with other projects or by other unidentified third parties without the written consent of ECS and the client.

Our recommendations are in part based on federal, state, and local regulations and guidelines. ECS does not assume the responsibility of the person(s) in charge of the site, or otherwise undertake responsibility for reporting to any local, state, or federal public agencies, any conditions at the site that may present a potential danger to public health, safety, or the environment. Under this scope of services, ECS assumes no responsibility regarding any response actions initiated as a result of these findings. General compliance with regulations and response actions are the sole responsibility of the Client and should be conducted in accordance with local, state, and/or federal requirements.

During this study, samples were submitted for analysis at an accredited laboratory via polarized light microscopy. As with any similar survey of this nature, actual conditions exist only at the precise locations from which samples were collected. Certain inferences are based on the results of this sampling and related testing to form a professional opinion of conditions in areas beyond those from which the samples were collected. No warranty, expressed or implied, is made.

Appendix I: Figures

Figure 1

Site Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Source: Google Earth

Not to Scale

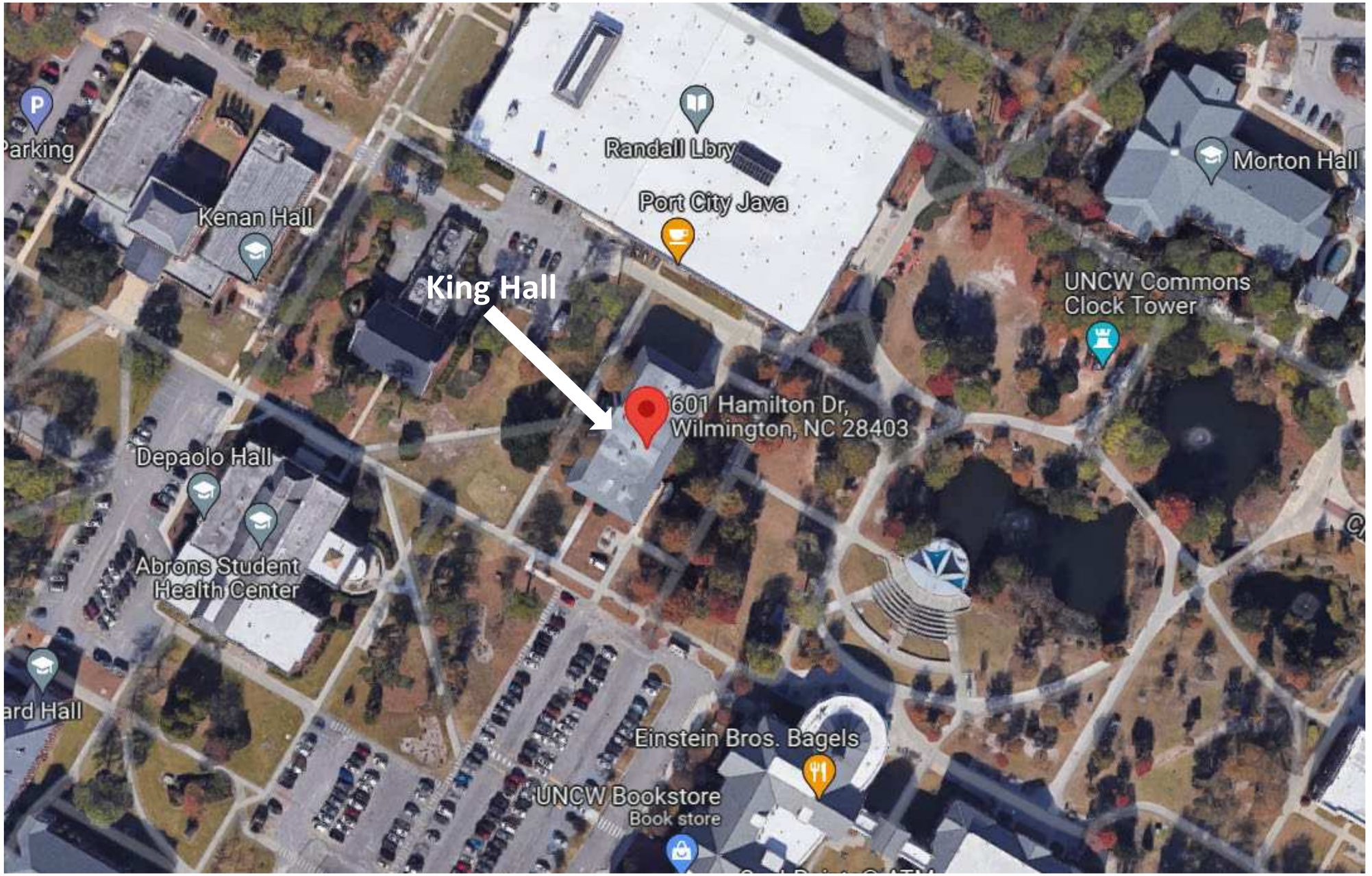


Figure 2 – First Floor
Suspect Asbestos Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1	Sample Number
●	Non-ACM Sample Location
▼	ACM Sample Location
■	Trace Asbestos (<1%)

Notes

Not to Scale

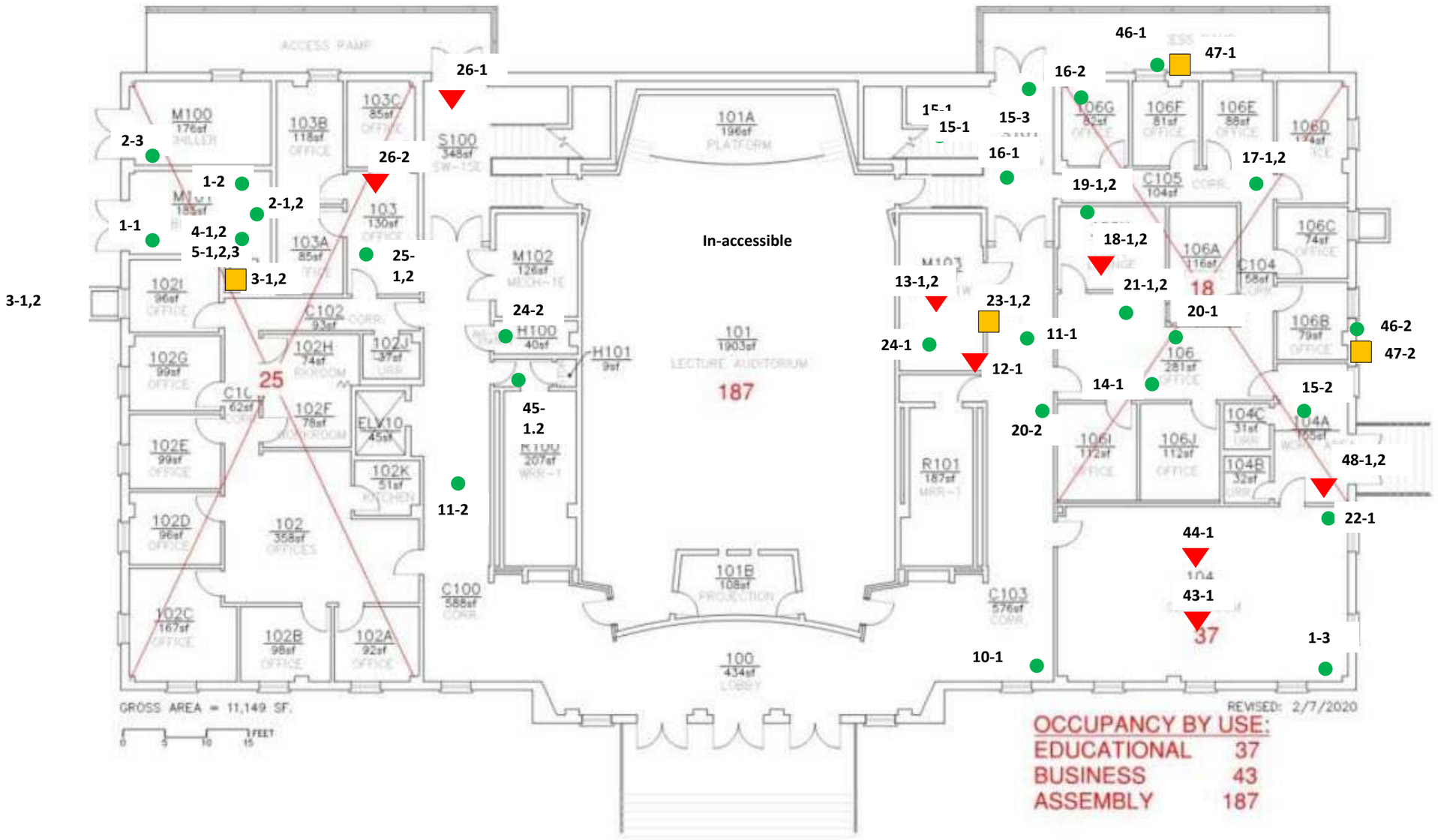


Figure 3 – Second Floor
Suspect Asbestos Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1	Sample Number
●	Non-ACM Sample Location
▼	ACM Sample Location

Notes

Not to scale

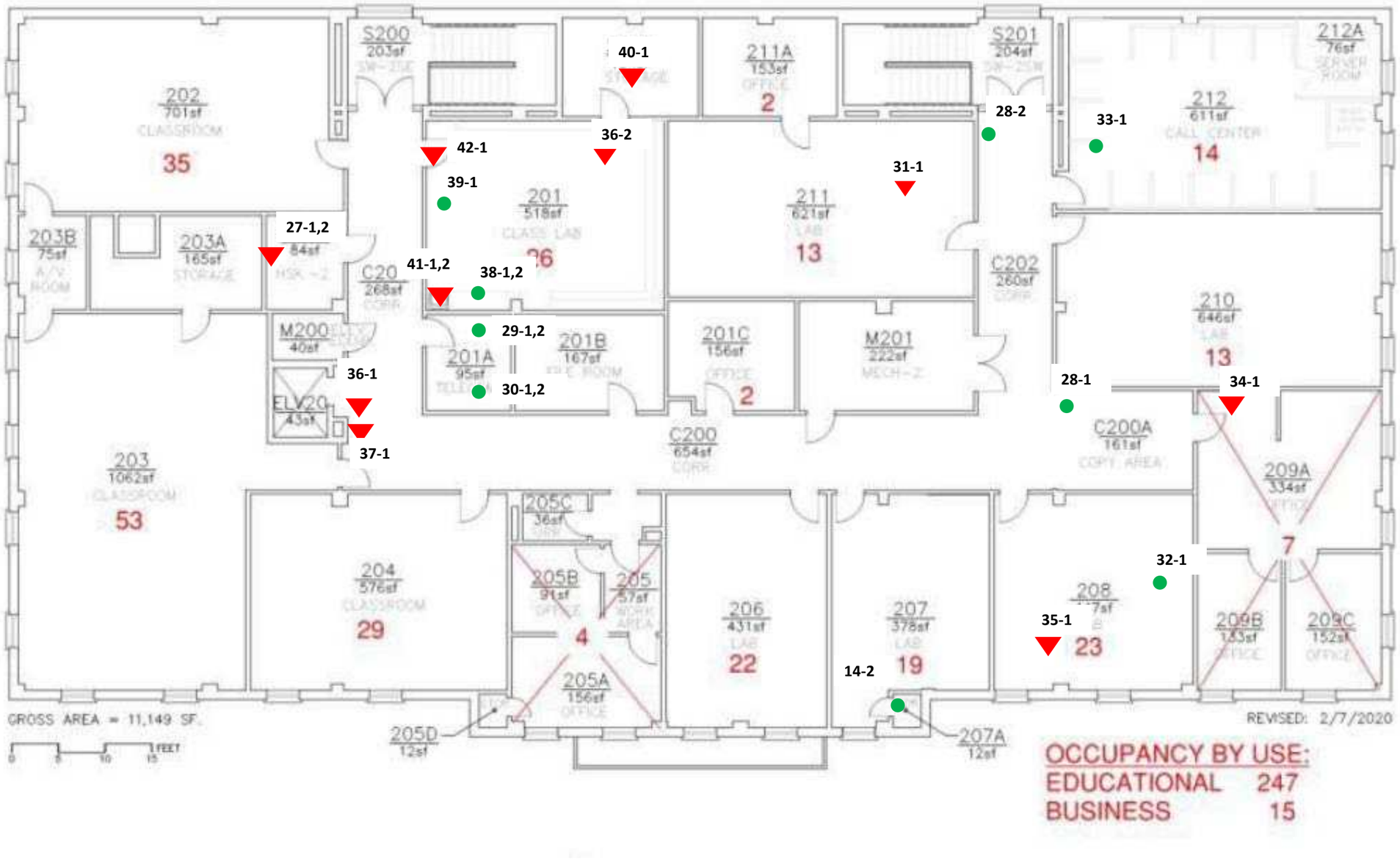


Figure 4 – First Floor
Paint Chip Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

LBP01	Sample Number
◆	Lead Not Detected
★	Lead-Containing Paint

Notes

Not to Scale

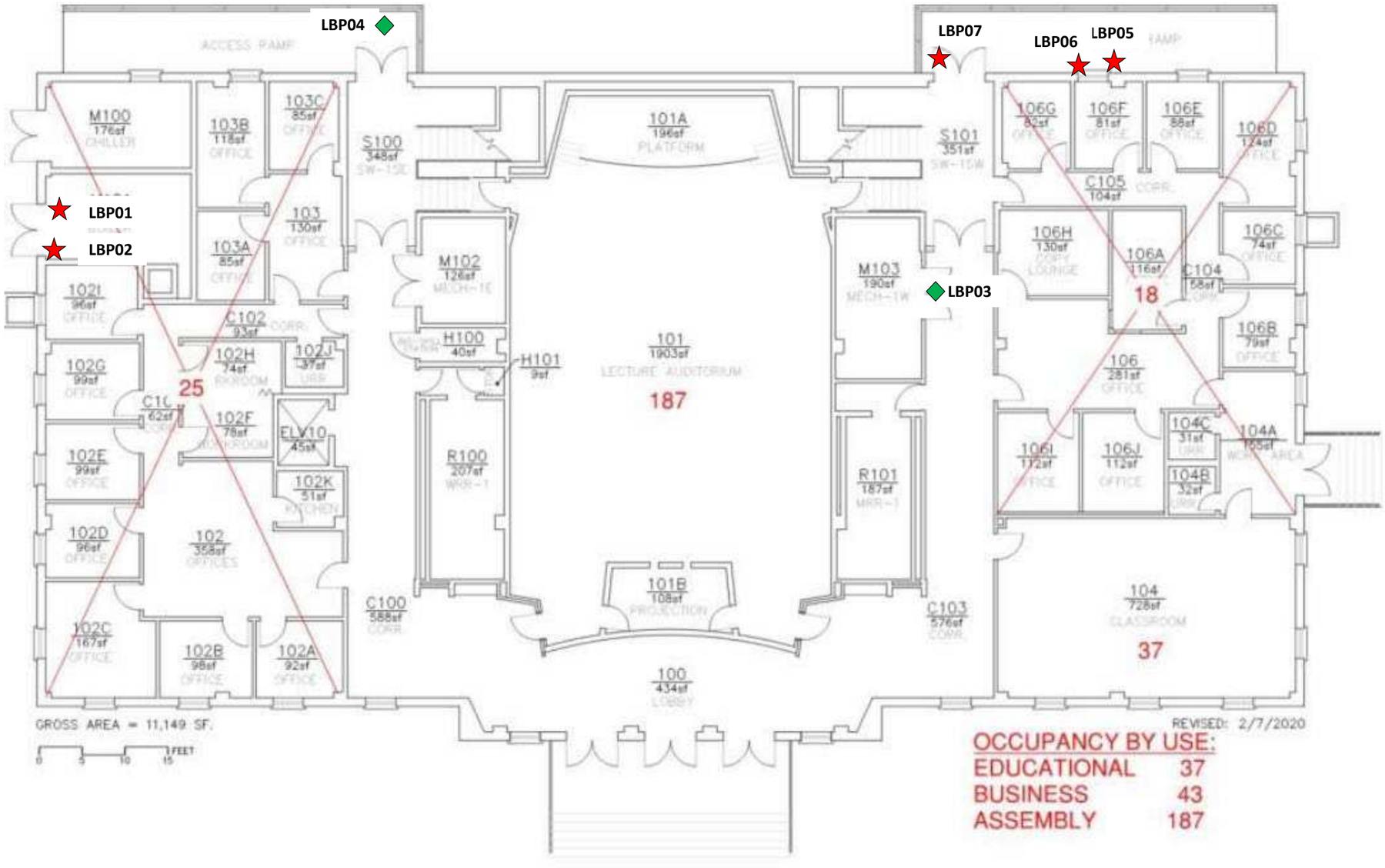


Figure 5 – Second Floor
Paint Chip Sample Location Map

UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

1-1	Sample Number
◆	Lead Not Detected
★	Lead-Containing Paint

Notes

Not to Scale

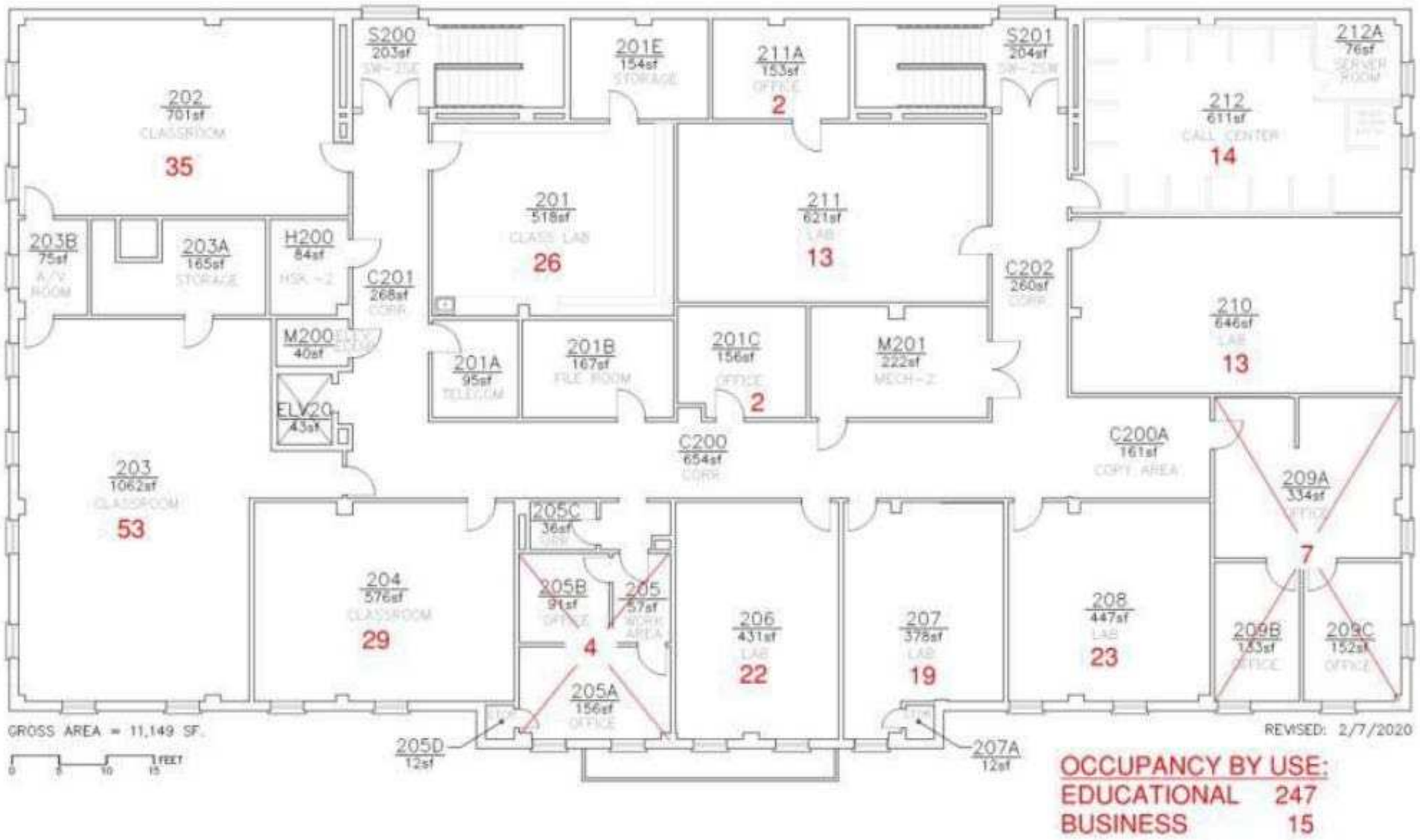


Figure 6 – First Floor
Asbestos Location Map

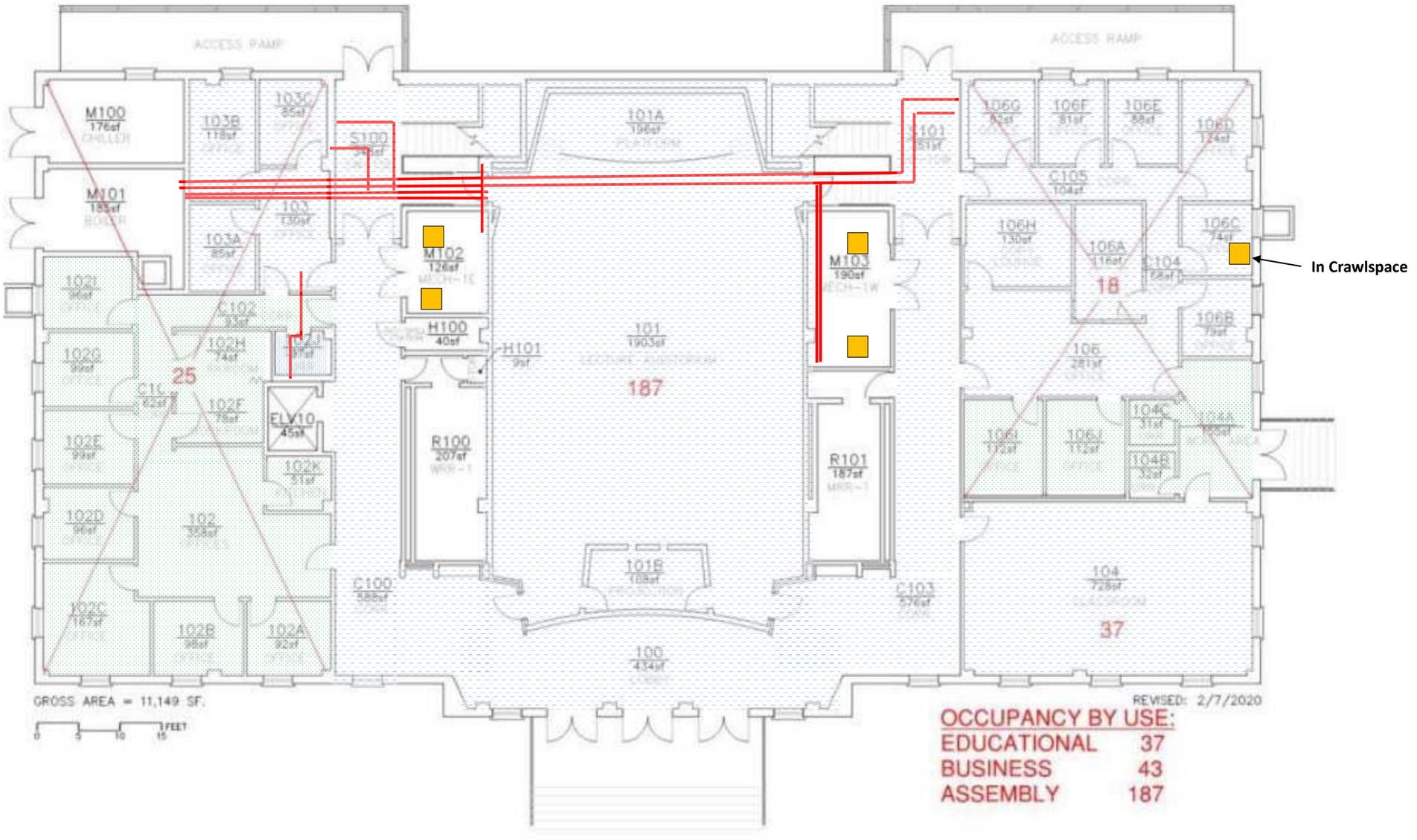
UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

- ACM Vibration Dampener
- ACM Black Mastic TSI
- ACM FT and Mastic
- ACM Black Mastic

Notes

Not to Scale



In Crawlspace

Figure 7 – Second Floor
Asbestos Location Map

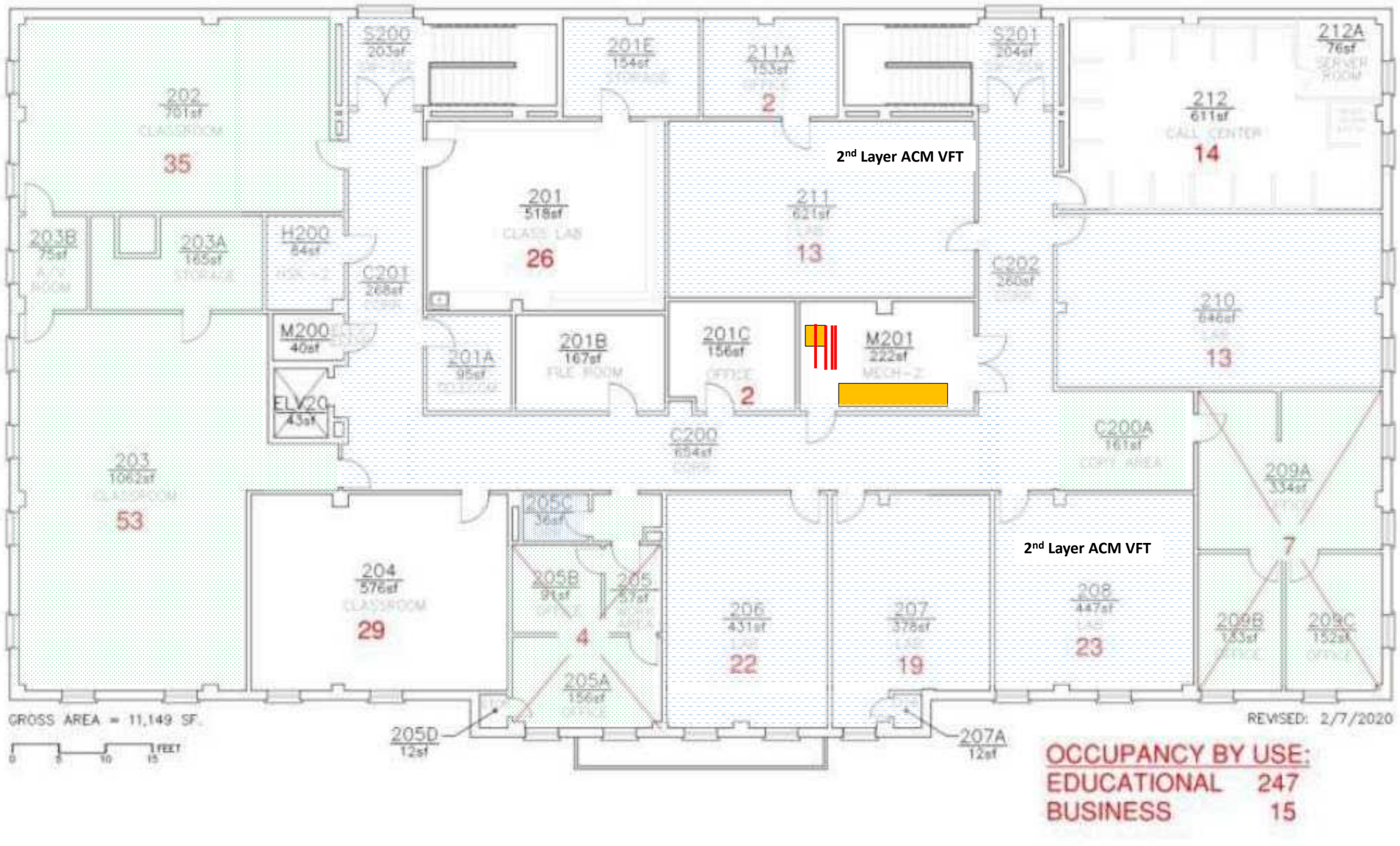
UNCW King Hall
601 Hamilton Drive
Wilmington, North Carolina
ECS Project No. 49-18273

Legend

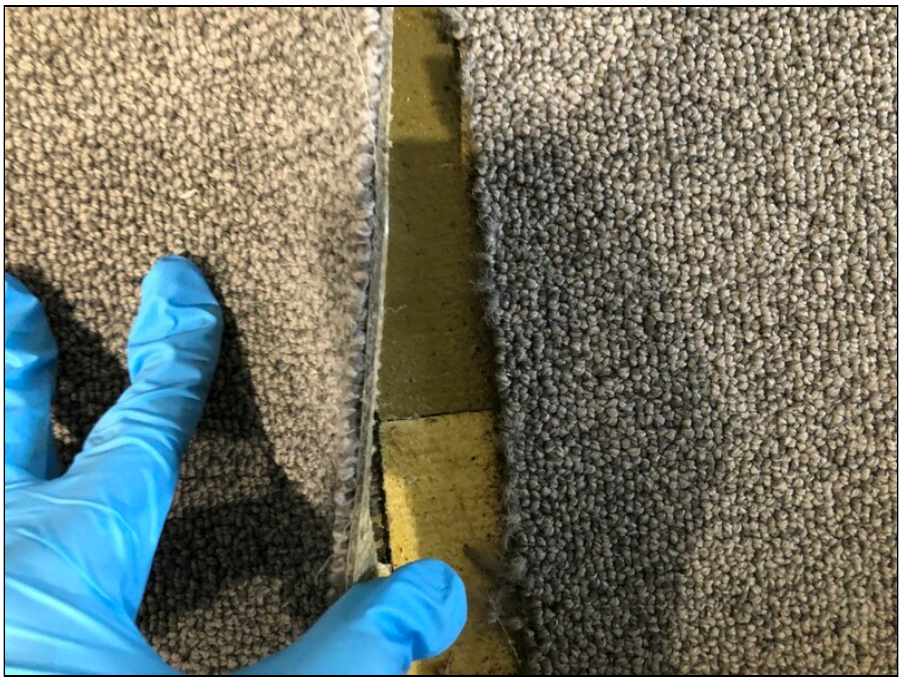
- ACM Vibration Dampener
- ACM Black Mastic TSI
- ACM FT and Mastic
- ACM Black Mastic

Notes

Not to scale



Appendix II: Site Photographs

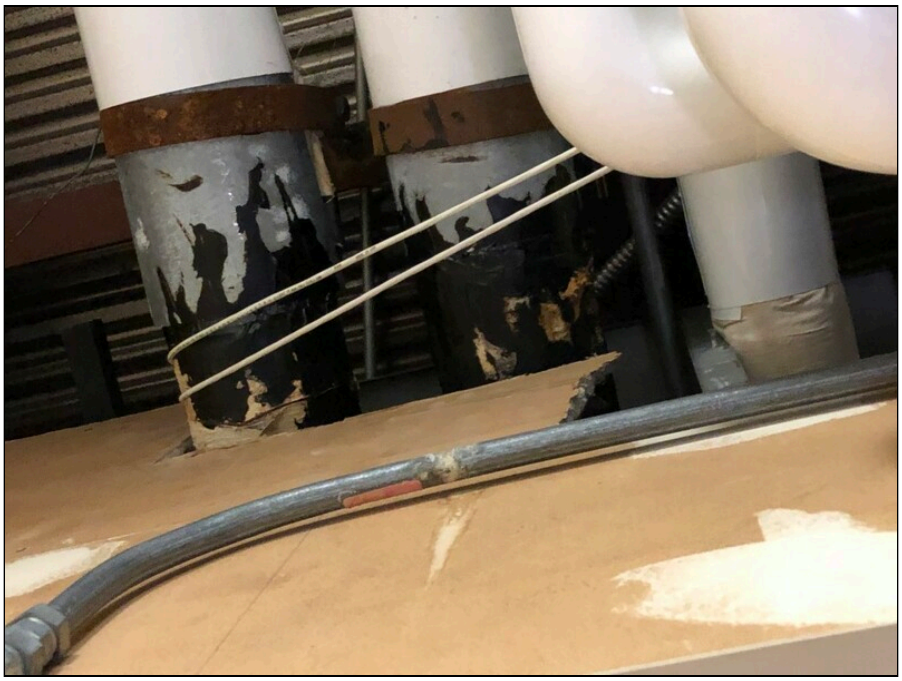


1 - View of Carpeting

2 - View of Carpeting, Black Mastic, Black Tile, and Yellow Mastic

3 - View of Black Mastic Under Carpet

4 - View of TSI and Pipe Elbows



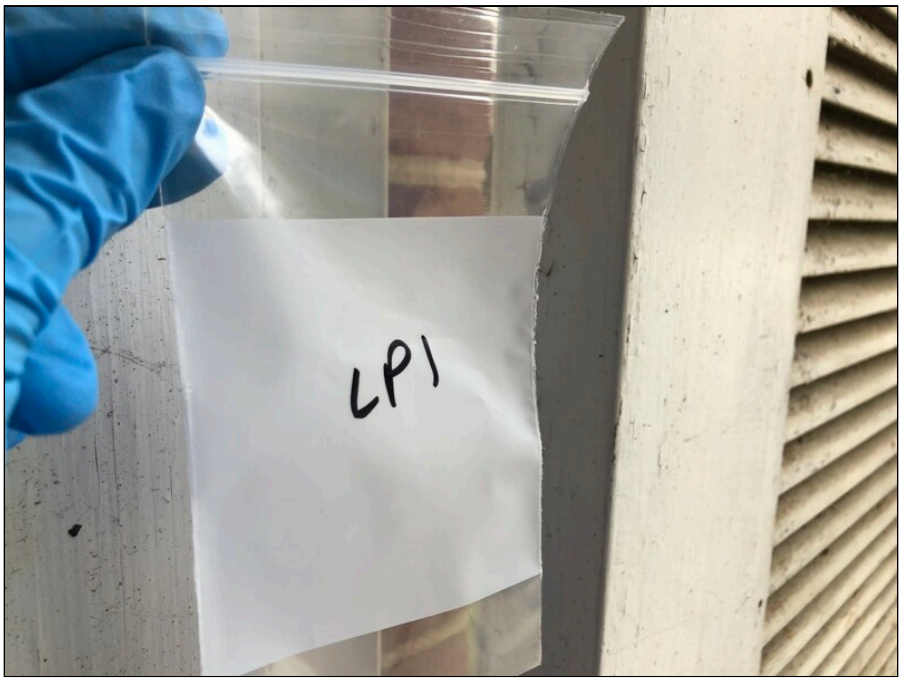
5 - View of TSI, Ceiling Tiles, and Black Caulk

6 - View of Degraded TSI

7 - View of Gray Mastic on Duct Work

8 - View of HVAC Vibration Dampener

9 - View of Layered Tiles over Assumed ACM Black Mastic



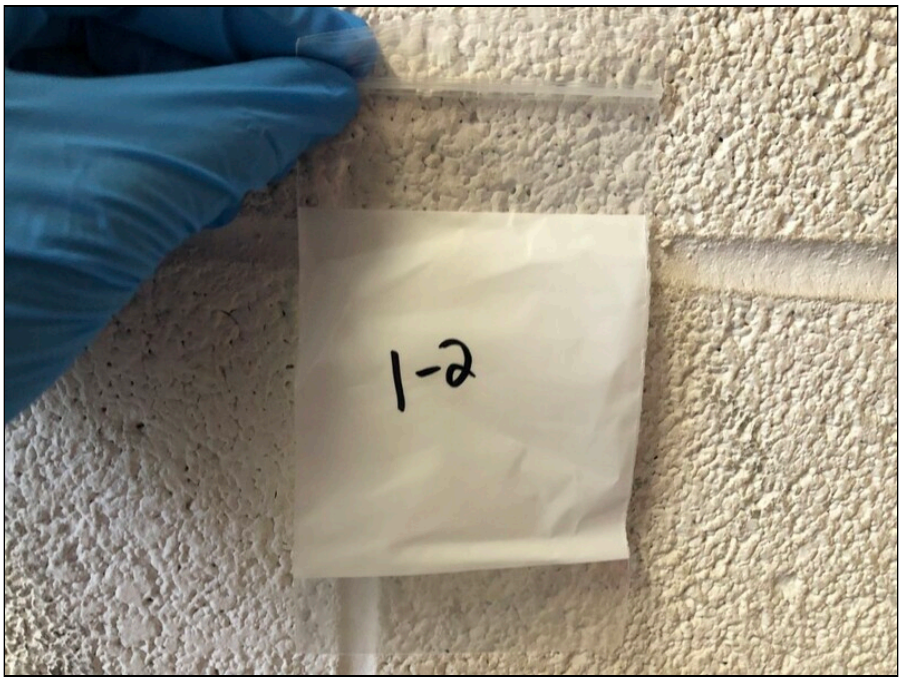
10 - View of paint chip Sample LBP01, lead-containing

11 - View of paint chip Sample LBP02, lead-containing

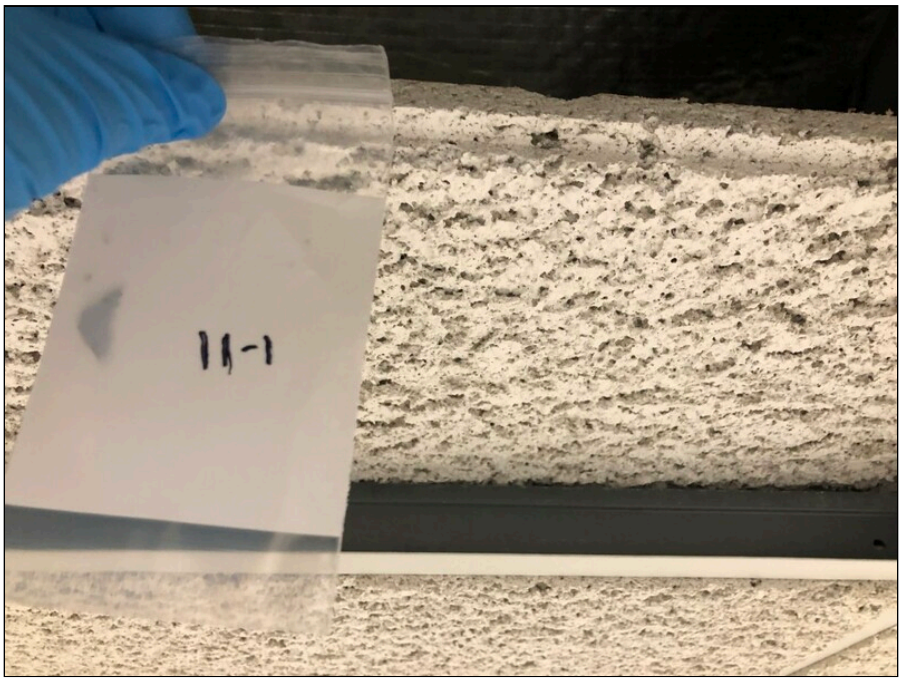
12 - View of paint chip Sample LBP03, lead paint not detected

13 - View of Lead Paint (Sample LBP04), lead paint not detected

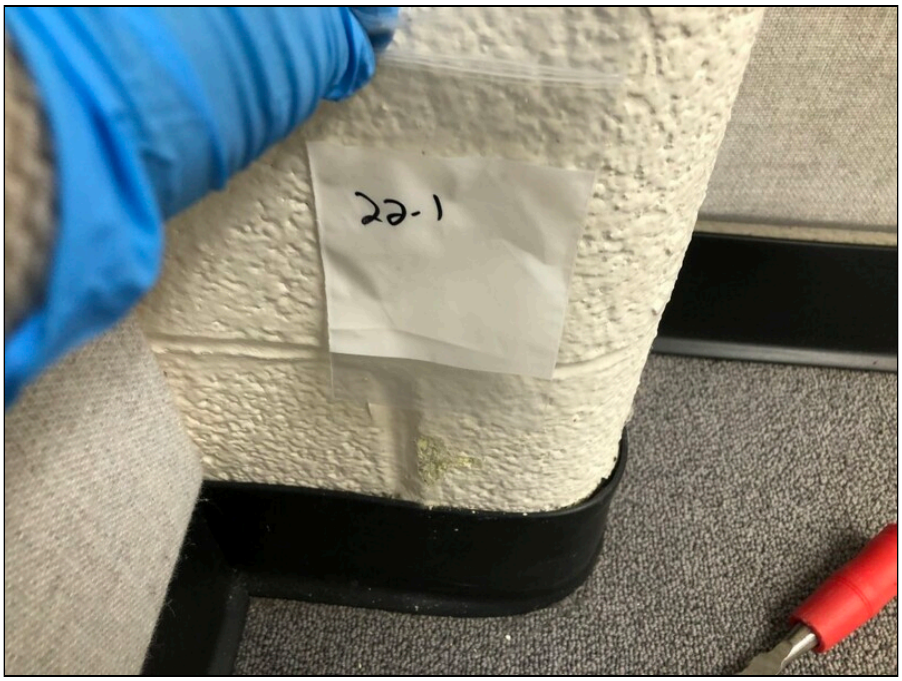
14 - View of paint chip Sample LBP06, lead-containing



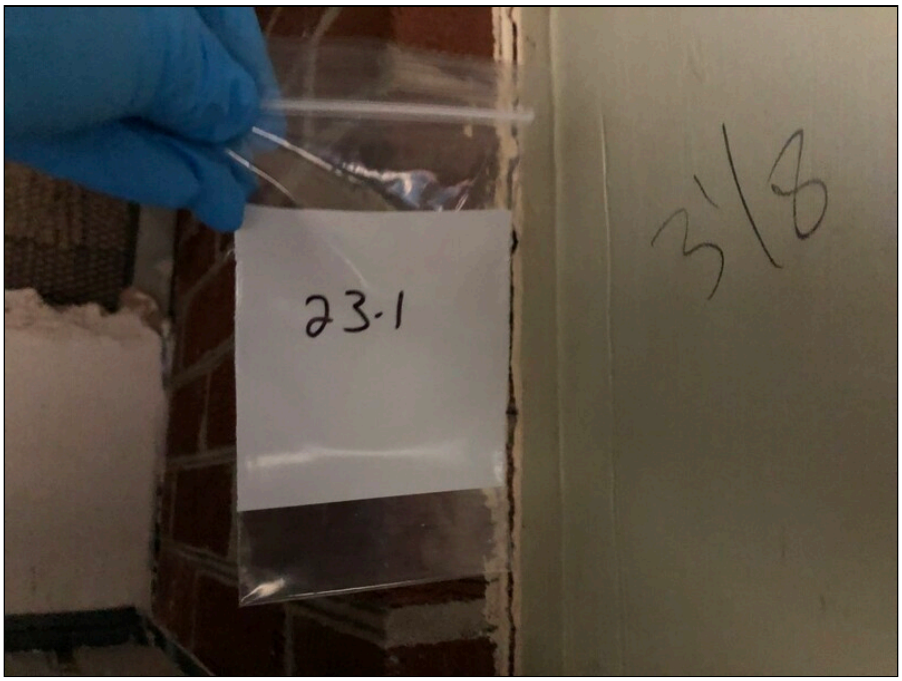
15 - View of Homogenous Area One (Samples 1-1,2,3)



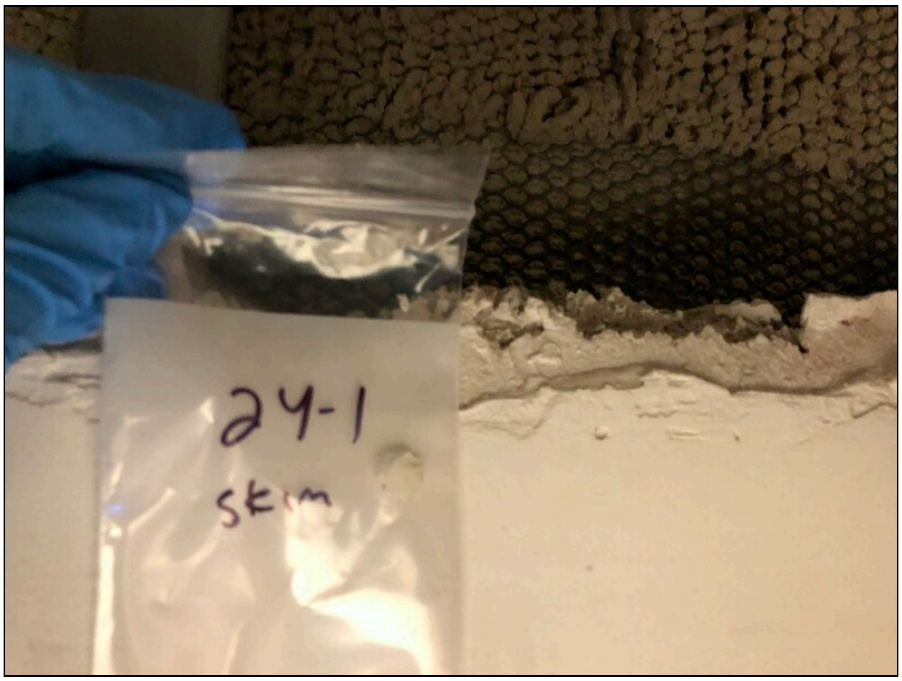
16 - View of Homogenous Area 11 (Samples 11-1,2)



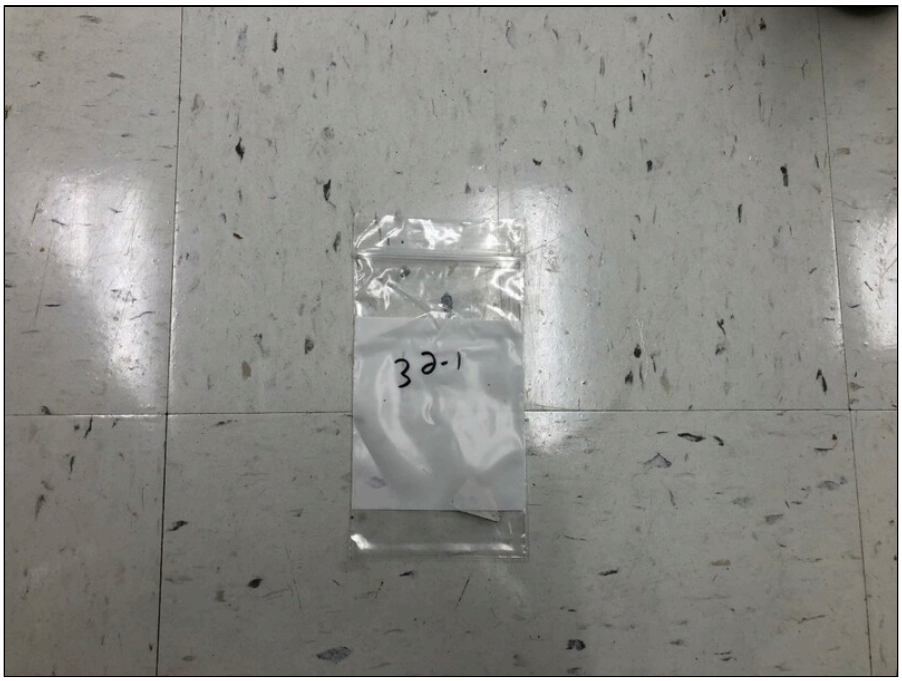
17 - View of Homogenous Area 22 (Sample 22-1)



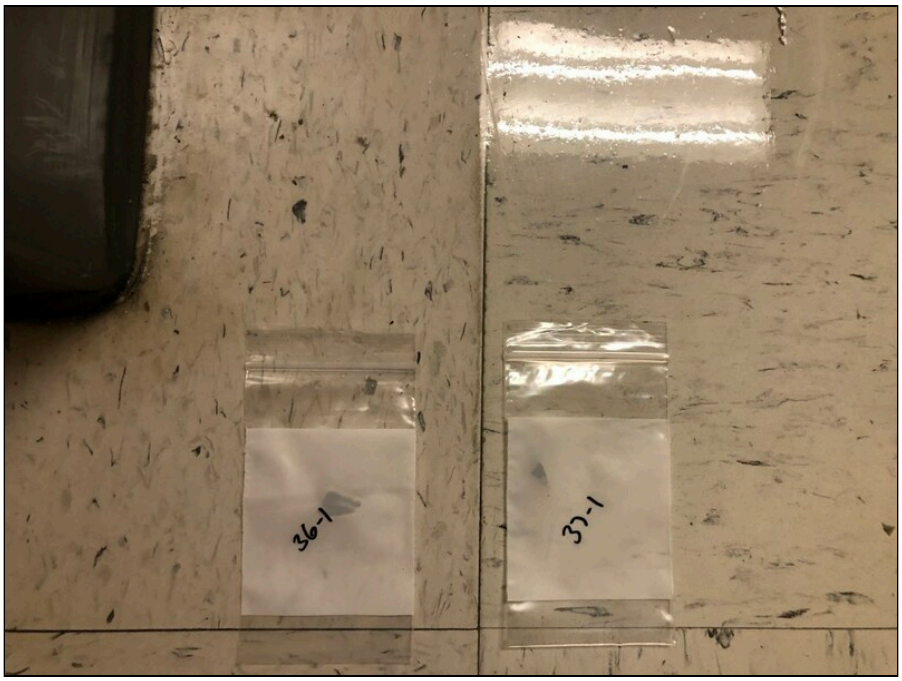
18 - View of Homogenous Area 23 (Samples 23-1,2)



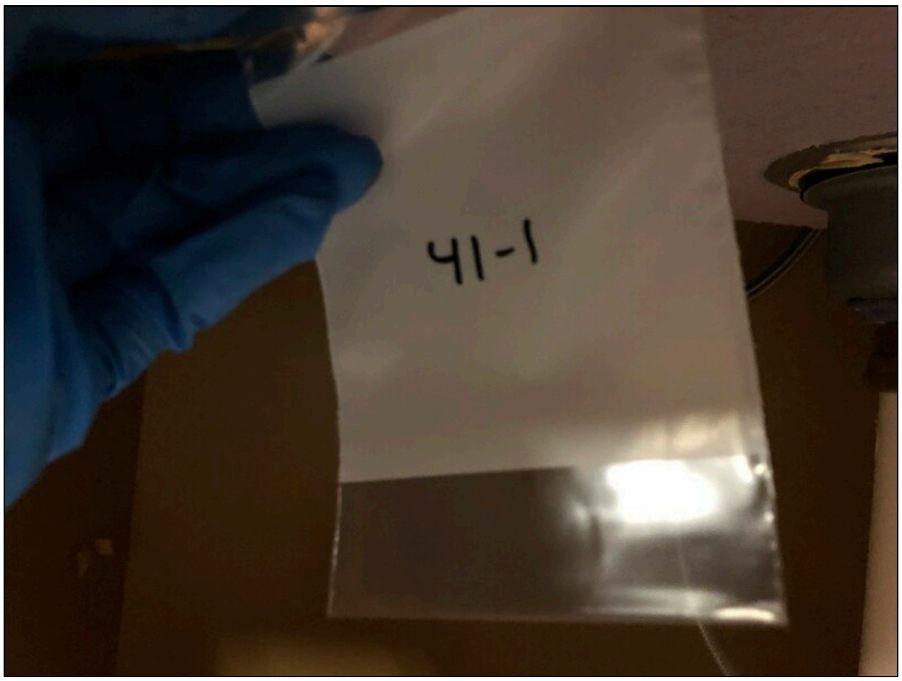
19 - View of Homogenous Area 24 (Samples 24-1,2)



20 - View of Homogenous Area 32 (Samples 32-1)



21 - View of Homogenous Areas 36 and 37



22 - View of Homogenous Area 41 (Samples 41-1,2)

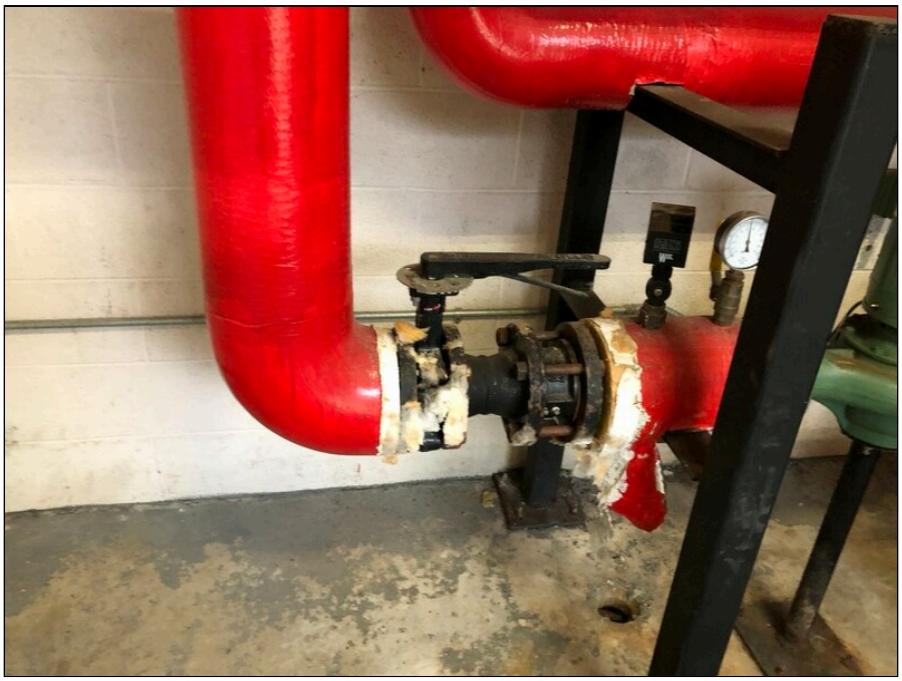
23 - View of Homogenous Area 42 (Samples 42-1)

24 - View of Homogenous Area 45 (Samples 45-1,2)

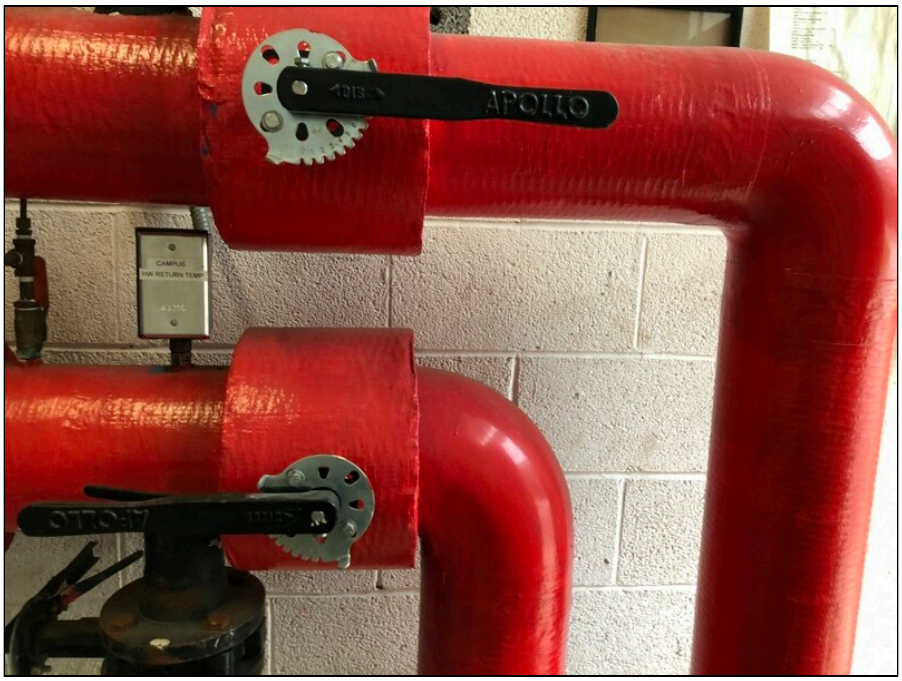
25 - IMG 8199 (Medium)

26 - View of TSI

27 - IMG 8198 (Medium)



28 - IMG 8197 (Medium)



29 - IMG 8196 (Medium)

Appendix III: Asbestos Bulk Sample Results

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September 7, 2022

ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

CLIENT PROJECT: UNCW King Hall, 49:18273
CEI LAB CODE: B2210933

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on September 1, 2022. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

ECS Southeast, LLP

CLIENT PROJECT: UNCW King Hall, 49:18273

LAB CODE: B2210933

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 09/07/22

TOTAL SAMPLES ANALYZED: 81

SAMPLES >1% ASBESTOS: 22

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
1-1		B2210933.01	White	Cmu Wall Texture	None Detected
1-2		B2210933.02	White	Cmu Wall Texture	None Detected
1-3		B2210933.03	White	Cmu Wall Texture	None Detected
2-1	Layer 1	B2210933.04	Red,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.04	Yellow	Insulation	None Detected
2-2	Layer 1	B2210933.05	White,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.05	Yellow	Insulation	None Detected
2-3	Layer 1	B2210933.06	Blue,Silver	Pipe Wrap	None Detected
	Layer 2	B2210933.06	Yellow	Insulation	None Detected
3-1		B2210933.07	White,Gray	Insulation	Amosite <1%
3-2		B2210933.08	White,Gray	Insulation	Amosite <1%
4-1		B2210933.09	Red	Brick	None Detected
4-2		B2210933.10	Red	Brick	None Detected
5-1		B2210933.11	Gray	Liner	None Detected
5-2		B2210933.12	Gray	Liner	None Detected
5-3		B2210933.13	Gray	Liner	None Detected
6-1	Layer 1	B2210933.14	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.14	Yellow	Insulation	None Detected
6-2	Layer 1	B2210933.15	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.15	Yellow	Insulation	None Detected
6-3	Layer 1	B2210933.16	Brown,Black	Pipe Wrap	None Detected
	Layer 2	B2210933.16	Yellow	Insulation	None Detected
7-1		B2210933.17	Gray	Hvac Sealant	None Detected
7-2		B2210933.18	Gray	Hvac Sealant	None Detected
8-1		B2210933.19	Black	Vibration Dampener	None Detected
8-2		B2210933.20	Black	Vibration Dampener	None Detected
9-1		B2210933.21	Black,Brown	Foundation Wp	None Detected
9-2		B2210933.22	Black,Brown	Foundation Wp	None Detected
10-1		B2210933.23A	Brown,Black	Covebase	None Detected
		B2210933.23B	Brown	Mastic	None Detected
11-1		B2210933.24	White	Textured Ceiling Tile	None Detected

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
11-2		B2210933.25	White	Textured Ceiling Tile	None Detected
12-1		B2210933.26	White	Vibration Dampener	Chrysotile 35%
13-1	Layer 1	B2210933.27	White	Hvac Sealant	None Detected
	Layer 2	B2210933.27	Black	Tar	Chrysotile 5%
13-2		B2210933.28		Sample Not Analyzed per COC	
14-1		B2210933.29	White,Beige	Drywall/Joint Compound	None Detected
14-2		B2210933.30	White	Drywall/Joint Compound	None Detected
15-1	Layer 1	B2210933.31	White	Pipe Wrap	None Detected
	Layer 2	B2210933.31	Yellow	Insulation	None Detected
15-2	Layer 1	B2210933.32	White	Pipe Wrap	None Detected
	Layer 2	B2210933.32	Yellow	Insulation	None Detected
15-3		B2210933.33	Gray,White	Pipe Wrap	None Detected
16-1		B2210933.34	White	Ceiling Tile	None Detected
16-2		B2210933.35	White	Ceiling Tile	None Detected
17-1		B2210933.36	Gray	Leveling Compound	None Detected
17-2		B2210933.37	Gray	Leveling Compound	None Detected
18-1		B2210933.38A	Cream Gray, Tan	Floor Tile	Chrysotile 2%
		B2210933.38B	Black	Mastic	Chrysotile 3%
18-2		B2210933.39A		Sample Not Analyzed per COC	
		B2210933.39B		Sample Not Analyzed per COC	
19-1		B2210933.40	Black	Sink Undercoating	None Detected
19-2		B2210933.41	Black	Sink Undercoating	None Detected
20-1		B2210933.42A	Cream,Brown	Covebase	None Detected
		B2210933.42B	Yellow,Beige	Mastic	None Detected
20-2		B2210933.43A	Cream,Brown	Covebase	None Detected
		B2210933.43B	Yellow,Beige	Mastic	None Detected
21-1		B2210933.44	Yellow	HVAC Mastic	None Detected
21-2		B2210933.45	Yellow	HVAC Mastic	None Detected
22-1		B2210933.46	White	Cmu Block Fill	None Detected
23-1		B2210933.47	White	Wall Caulk	Chrysotile <1%

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
23-2		B2210933.48	White	Wall Caulk	Chrysotile <1%
24-1	Layer 1	B2210933.49	White	Plaster Skim Coat	None Detected
	Layer 2	B2210933.49	Gray	Plaster Base Coat	None Detected
24-2	Layer 1	B2210933.50	White	Plaster Skim Coat	None Detected
	Layer 2	B2210933.50	Gray	Plaster Base Coat	None Detected
25-1		B2210933.51	White	Ceiling Tile	None Detected
25-2		B2210933.52	White	Ceiling Tile	None Detected
26-1		B2210933.53	Black	Mastic	Chrysotile 5%
26-2		B2210933.54		Sample Not Analyzed per COC	
27-1		B2210933.55	White	Wall Texture	Chrysotile 2%
27-2		B2210933.56		Sample Not Analyzed per COC	
28-1		B2210933.57A	Brown	Cove Base	None Detected
		B2210933.57B	Yellow	Mastic	None Detected
28-2		B2210933.58A	Brown	Cove Base	None Detected
		B2210933.58b	Yellow	Mastic	None Detected
29-1		B2210933.59	Red	Firestop	None Detected
29-2		B2210933.60	Red	Firestop	None Detected
30-1		B2210933.61	Pink	Firestop	None Detected
30-2		B2210933.62	Pink	Firestop	None Detected
31-1	Layer 1	B2210933.63A	Yellow	Mastic	None Detected
	Layer 2	B2210933.63A	White	Floor Tile	Chrysotile 2%
		B2210933.63B	Black,Yellow	Mastic	None Detected
32-1		B2210933.64	White,Black	Floor Tile	None Detected
33-1		B2210933.65A	Blue	Floor Tile	None Detected
		B2210933.65B	Yellow	Mastic	None Detected
34-1		B2210933.66	Black	Residual Mastic	Chrysotile 3%
35-1		B2210933.67A	Tan	Floor Tile	Chrysotile 2%
		B2210933.67B	Black	Mastic	Chrysotile 3%
35-2		B2210933.68A		Sample Not Analyzed per COC	
		B2210933.68B		Sample Not Analyzed per COC	
36-1		B2210933.69A	Gray	Floor Tile	None Detected

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Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2210933**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
		B2210933.69B	Yellow,Black	Mastic	Chrysotile 5%
37-1		B2210933.70A	Gray	Floor Tile	Chrysotile 2%
		B2210933.70B	Black	Mastic	Chrysotile 5%
38-1		B2210933.71A	Gray,White	Floor Tile	None Detected
		B2210933.71B	Yellow	Mastic	None Detected
38-2		B2210933.72A	Gray,White	Floor Tile	None Detected
		B2210933.72B	Yellow	Mastic	None Detected
39-1		B2210933.73A	Tan	Floor Tile	None Detected
		B2210933.73B	Yellow	Mastic	None Detected
40-1		B2210933.74A	White	Floor Tile	Chrysotile 2%
		B2210933.74B	Black	Mastic	Chrysotile 5%
41-1		B2210933.75	White	Sink Undercoating	Chrysotile 3%
41-2		B2210933.76		Sample Not Analyzed per COC	
42-1		B2210933.77	Tan	Floor Tile	Chrysotile 2%
43-1		B2210933.78A	Tan	Floor Tile	Chrysotile 2%
		B2210933.78B	Black	Mastic	Chrysotile 5%
44-1		B2210933.79A	Olive	Floor Tile	Chrysotile 2%
		B2210933.79B	Black	Mastic	Chrysotile 5%
45-1		B2210933.80	Gray	Thin Set	None Detected
45-2		B2210933.81	Gray	Thin Set	None Detected
46-1		B2210933.82	White	Ext Window Caulk	None Detected
46-2		B2210933.83	White	Ext Window Caulk	None Detected
47-1		B2210933.84	White	Ext Window Glazing	Chrysotile <1%
47-2		B2210933.85	White	Ext Window Glazing	None Detected
48-1		B2210933.86A	White,Multicolor	Floor Tile	None Detected
		B2210933.86B	Yellow,Black	Mastic	Chrysotile 3%
48-2		B2210933.87A	White,Multicolor	Floor Tile	None Detected
		B2210933.87B		Sample Not Analyzed per COC	

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
1-1 B2210933.01	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
1-2 B2210933.02	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
1-3 B2210933.03	Cmu Wall Texture	Heterogeneous White Non-fibrous Bound			60% 35% 5%	Binder Calc Carb Silicates	None Detected
2-1 Layer 1 B2210933.04	Pipe Wrap	Heterogeneous Red,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.04	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
2-2 Layer 1 B2210933.05	Pipe Wrap	Heterogeneous White,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.05	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
2-3 Layer 1 B2210933.06	Pipe Wrap	Heterogeneous Blue,Silver Fibrous Bound	60%	Cellulose	35% 5%	Metal Foil Paint	None Detected
Layer 2 B2210933.06	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
3-1 B2210933.07	Insulation	Homogeneous White,Gray Fibrous Loosely Bound	15%	Fiberglass	83% 2%	Binder Paint	<1% Amosite
Sample appears to be insulation. No caulking present.							
3-2 B2210933.08	Insulation	Homogeneous White,Gray Fibrous Loosely Bound	15%	Fiberglass	83% 2%	Binder Paint	<1% Amosite
Sample appears to be insulation. No caulking present.							
4-1 B2210933.09	Brick	Homogeneous Red Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
4-2 B2210933.10	Brick	Homogeneous Red Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
5-1 B2210933.11	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
5-2 B2210933.12	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
5-3 B2210933.13	Liner	Homogeneous Gray Non-fibrous Tightly Bound			70% 30%	Silicates Binder	None Detected
6-1 Layer 1 B2210933.14	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected
Layer 2 B2210933.14	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
6-2 Layer 1 B2210933.15	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected
Layer 2 B2210933.15	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
6-3 Layer 1 B2210933.16	Pipe Wrap	Homogeneous Brown,Black Fibrous Bound	60%	Cellulose	20% 20%	Metal Foil Tar	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2210933.16	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
7-1 B2210933.17	Hvac Sealant	Homogeneous Gray Non-fibrous Bound			100%	Mastic	None Detected
7-2 B2210933.18	Hvac Sealant	Homogeneous Gray Non-fibrous Bound			100%	Mastic	None Detected
8-1 B2210933.19	Vibration Dampener	Homogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
8-2 B2210933.20	Vibration Dampener	Homogeneous Black Fibrous Bound	70%	Cellulose	30%	Tar	None Detected
9-1 B2210933.21	Foundation Wp	Heterogeneous Black,Brown Fibrous Bound	90%	Cellulose	10%	Tar	None Detected
9-2 B2210933.22	Foundation Wp	Heterogeneous Black,Brown Fibrous Bound	90%	Cellulose	10%	Tar	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
10-1 B2210933.23A	Covebase	Homogeneous Brown,Black Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.23B	Mastic	Homogeneous Brown Non-fibrous Bound			100%	Mastic	None Detected
11-1 B2210933.24	Textured Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	15% 5%	Fiberglass Cellulose	5% 75%	Metal Foil Binder	None Detected
11-2 B2210933.25	Textured Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	15% 5%	Fiberglass Cellulose	5% 75%	Metal Foil Binder	None Detected
12-1 B2210933.26	Vibration Dampener	Homogeneous White Fibrous Bound	20%	Cellulose	45%	Binder	**35% Chrysotile**
13-1 Layer 1 B2210933.27	Hvac Sealant	Homogeneous White Non-fibrous Bound			100%	Mastic	None Detected
Layer 2 B2210933.27	Tar	Homogeneous Black Non-fibrous Bound			95%	Tar	**5% Chrysotile**
13-2 B2210933.28	Sample Not Analyzed per COC						

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
14-1 B2210933.29	Drywall/Joint Compound	Heterogeneous White,Beige Fibrous Bound	15%	Cellulose	75% 10%	Gypsum Calc Carb	None Detected
14-2 B2210933.30	Drywall/Joint Compound	Heterogeneous White Fibrous Bound	15%	Cellulose	75% 10%	Gypsum Calc Carb	None Detected
15-1 Layer 1 B2210933.31	Pipe Wrap	Homogeneous White Fibrous Bound	100%	Cellulose			None Detected
Layer 2 B2210933.31	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
15-2 Layer 1 B2210933.32	Pipe Wrap	Homogeneous White Fibrous Bound	100%	Cellulose			None Detected
Layer 2 B2210933.32	Insulation	Homogeneous Yellow Fibrous Loose	100%	Fiberglass			None Detected
15-3 B2210933.33	Pipe Wrap	Heterogeneous Gray,White Fibrous Bound	80%	Cellulose	10% 10%	Metal Foil Binder	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
16-1 B2210933.34	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
16-2 B2210933.35	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
17-1 B2210933.36	Leveling Compound	Homogeneous Gray Non-fibrous Bound	3%	Cellulose	97%	Binder	None Detected
17-2 B2210933.37	Leveling Compound	Homogeneous Gray Non-fibrous Bound	3%	Cellulose	97%	Binder	None Detected
18-1 B2210933.38A	Floor Tile	Homogeneous Cream Gray,Tan Non-fibrous Tightly Bound			98%	Vinyl	**2% Chrysotile**
B2210933.38B	Mastic	Homogeneous Black Non-fibrous Bound			97%	Mastic	**3% Chrysotile**
18-2 B2210933.39A	Sample Not Analyzed per COC						
B2210933.39B	Sample Not Analyzed per COC						

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
19-1 B2210933.40	Sink Undercoating	Homogeneous Black Non-fibrous Bound	<1%	Cellulose	90% 10%	Tar Binder	None Detected
19-2 B2210933.41	Sink Undercoating	Homogeneous Black Non-fibrous Bound	<1%	Cellulose	90% 10%	Tar Binder	None Detected
20-1 B2210933.42A	Covebase	Homogeneous Cream,Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.42B	Mastic	Homogeneous Yellow,Beige Non-fibrous Bound			100%	Mastic	None Detected
20-2 B2210933.43A	Covebase	Homogeneous Cream,Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.43B	Mastic	Homogeneous Yellow,Beige Non-fibrous Bound			100%	Mastic	None Detected
21-1 B2210933.44	HVAC Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
21-2 B2210933.45	HVAC Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
22-1 B2210933.46	Cmu Block Fill	Homogeneous White Non-fibrous Bound		60% 40%	Binder Paint	None Detected
23-1 B2210933.47	Wall Caulk	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	<1% Chrysotile
23-2 B2210933.48	Wall Caulk	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	<1% Chrysotile
24-1 Layer 1 B2210933.49	Plaster Skim Coat	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	None Detected
Layer 2 B2210933.49	Plaster Base Coat	Homogeneous Gray Non-fibrous Bound		75% 25%	Silicates Binder	None Detected
24-2 Layer 1 B2210933.50	Plaster Skim Coat	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	None Detected

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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
Layer 2 B2210933.50	Plaster Base Coat	Homogeneous Gray Non-fibrous Bound			75% 25%	Silicates Binder	None Detected
25-1 B2210933.51	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
25-2 B2210933.52	Ceiling Tile	Heterogeneous White Fibrous Loosely Bound	60% 20%	Cellulose Fiberglass	15% 5%	Perlite Binder	None Detected
26-1 B2210933.53	Mastic	Homogeneous Black Non-fibrous Bound			95%	Mastic	**5% Chrysotile**
26-2 B2210933.54	Sample Not Analyzed per COC						
27-1 B2210933.55	Wall Texture	Heterogeneous White Non-fibrous Bound			58% 35% 5%	Binder Calc Carb Paint	**2% Chrysotile**
27-2 B2210933.56	Sample Not Analyzed per COC						
28-1 B2210933.57A	Cove Base	Homogeneous Brown Non-fibrous Bound			100%	Vinyl	None Detected

ASBESTOS BULK ANALYSIS

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
B2210933.57B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
28-2 B2210933.58A	Cove Base	Homogeneous Brown Non-fibrous Bound			100%	Vinyl	None Detected
B2210933.58b	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
29-1 B2210933.59	Firestop	Homogeneous Red Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
29-2 B2210933.60	Firestop	Homogeneous Red Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
30-1 B2210933.61	Firestop	Homogeneous Pink Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected
30-2 B2210933.62	Firestop	Homogeneous Pink Non-fibrous Bound	2%	Cellulose	98%	Caulk	None Detected

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
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ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous		Non-Fibrous		ASBESTOS %
31-1 Layer 1 B2210933.63A	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
Layer 2 B2210933.63A	Floor Tile	Homogeneous White Non-fibrous Tightly Bound			98%	Vinyl	**2% Chrysotile**
B2210933.63B	Mastic	Homogeneous Black,Yellow Non-fibrous Bound	2%	Cellulose	98%	Mastic	None Detected
32-1 B2210933.64	Floor Tile	Homogeneous White,Black Non-fibrous Tightly Bound			100%	Vinyl	None Detected
33-1 B2210933.65A	Floor Tile	Homogeneous Blue Non-fibrous Tightly Bound			100%	Vinyl	None Detected
B2210933.65B	Mastic	Homogeneous Yellow Non-fibrous Bound			100%	Mastic	None Detected
34-1 B2210933.66	Residual Mastic	Homogeneous Black Non-fibrous Bound			97%	Mastic	**3% Chrysotile**

ASBESTOS BULK ANALYSIS

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Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
35-1 B2210933.67A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound		98%	Vinyl	**2% Chrysotile**
B2210933.67B	Mastic	Homogeneous Black Non-fibrous Bound		97%	Mastic	**3% Chrysotile**
35-2 B2210933.68A	Sample Not Analyzed per COC					
B2210933.68B	Sample Not Analyzed per COC					
36-1 B2210933.69A	Floor Tile	Homogeneous Gray Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.69B	Mastic	Homogeneous Yellow,Black Non-fibrous Bound		95%	Mastic	**5% Chrysotile**
37-1 B2210933.70A	Floor Tile	Homogeneous Gray Non-fibrous Tightly Bound		98%	Vinyl	**2% Chrysotile**
B2210933.70B	Mastic	Homogeneous Black Non-fibrous Bound		95%	Mastic	**5% Chrysotile**

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ASBESTOS BULK ANALYSIS

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Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
38-1 B2210933.71A	Floor Tile	Homogeneous Gray,White Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.71B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
38-2 B2210933.72A	Floor Tile	Homogeneous Gray,White Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.72B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
39-1 B2210933.73A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.73B	Mastic	Homogeneous Yellow Non-fibrous Bound		100%	Mastic	None Detected
40-1 B2210933.74A	Floor Tile	Homogeneous White Non-fibrous Tightly Bound		98%	Vinyl	**2% Chrysotile**

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ASBESTOS BULK ANALYSIS

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Lab Code: B2210933
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Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous	ASBESTOS %
B2210933.74B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile
41-1 B2210933.75	Sink Undercoating	Homogeneous White Fibrous Bound	97%	Binder	3% Chrysotile
41-2 B2210933.76	Sample Not Analyzed per COC				
42-1 B2210933.77	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
43-1 B2210933.78A	Floor Tile	Homogeneous Tan Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
B2210933.78B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile
44-1 B2210933.79A	Floor Tile	Homogeneous Olive Non-fibrous Tightly Bound	98%	Vinyl	2% Chrysotile
B2210933.79B	Mastic	Homogeneous Black Non-fibrous Bound	95%	Mastic	5% Chrysotile

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
45-1 B2210933.80	Thin Set	Homogeneous Gray Non-fibrous Bound		75% 25%	Silicates Binder	None Detected
45-2 B2210933.81	Thin Set	Homogeneous Gray Non-fibrous Bound		75% 25%	Silicates Binder	None Detected
46-1 B2210933.82	Ext Window Caulk	Homogeneous White Non-fibrous Bound		100%	Caulk	None Detected
46-2 B2210933.83	Ext Window Caulk	Homogeneous White Non-fibrous Bound		100%	Caulk	None Detected
47-1 B2210933.84	Ext Window Glazing	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	<1% Chrysotile
47-2 B2210933.85	Ext Window Glazing	Homogeneous White Non-fibrous Bound		80% 20%	Binder Calc Carb	None Detected
48-1 B2210933.86A	Floor Tile	Homogeneous White,Multicolor Non-fibrous Tightly Bound		100%	Vinyl	None Detected

ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2210933
Date Received: 09-01-22
Date Analyzed: 09-07-22
Date Reported: 09-07-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
B2210933.86B	Mastic	Homogeneous Yellow,Black Non-fibrous Bound		97%	Mastic	3% Chrysotile
Unable to separate mastics for analysis.						
48-2 B2210933.87A	Floor Tile	Homogeneous White,Multicolor Non-fibrous Tightly Bound		100%	Vinyl	None Detected
B2210933.87B	Sample Not Analyzed per COC					

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LEGEND: Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

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Information provided by customer includes customer sample ID and sample description.

ANALYST: Ryan Steele

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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September 22, 2022

ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

CLIENT PROJECT: UNCW King Hall, 49:18273
CEI LAB CODE: B2212107

Dear Customer:

Enclosed are asbestos analysis results for PLM Bulk samples received at our laboratory on September 19, 2022. The samples were analyzed for asbestos using polarizing light microscopy (PLM) per the EPA 600 Method.

Sample results containing >1% asbestos are considered asbestos-containing materials (ACMs) per EPA regulatory requirements. The detection limit for the EPA 600 Method is <1% asbestos by weight as determined by visual estimation.

Thank you for your business and we look forward to continuing good relations.

Kind Regards,

Tianbao Bai, Ph.D., CIH
Laboratory Director

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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ASBESTOS ANALYTICAL REPORT
By: Polarized Light Microscopy

Prepared for

ECS Southeast, LLP

CLIENT PROJECT: UNCW King Hall, 49:18273

LAB CODE: B2212107

TEST METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORT DATE: 09/22/22

TOTAL SAMPLES ANALYZED: 7

SAMPLES >1% ASBESTOS: 1

730 SE Maynard Road • Cary, NC 27511 • 919.481.1413

Asbestos Report Summary

By: POLARIZING LIGHT MICROSCOPY

PROJECT: UNCW King Hall, 49:18273 **LAB CODE: B2212107**

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

Client ID	Layer	Lab ID	Color	Sample Description	ASBESTOS %
49-1		B2212107.01	White	Wall Texture	None Detected
49-2		B2212107.02	White,Green	Wall Texture	None Detected
49-3		B2212107.03	White,Off-white	Wall Texture	Chrysotile 2%
49-4		B2212107.04	White,Green	Paint	None Detected
49-5		B2212107.05	White,Blue	Wall Texture	None Detected
49-6		B2212107.06	White	Wall Texture	None Detected
49-7		B2212107.07	White,Blue	Wall Texture	None Detected

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ASBESTOS BULK ANALYSIS

By: POLARIZING LIGHT MICROSCOPY

Client: ECS Southeast, LLP
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: B2212107
Date Received: 09-19-22
Date Analyzed: 09-22-22
Date Reported: 09-22-22

Project: UNCW King Hall, 49:18273

ASBESTOS BULK PLM, EPA 600 METHOD

Client ID / Lab ID	Lab Description	Lab Attributes	NON-ASBESTOS COMPONENTS Fibrous	Non-Fibrous		ASBESTOS %
49-1 B2212107.01	Wall Texture	Heterogeneous White Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected
49-2 B2212107.02	Wall Texture	Heterogeneous White,Green Non-fibrous Bound		60% 35% 5%	Binder Calc Carb Paint	None Detected
49-3 B2212107.03	Wall Texture	Heterogeneous White,Off-white Non-fibrous Bound		58% 35% 5%	Binder Calc Carb Paint	2% Chrysotile
49-4 B2212107.04 No wall texture present.	Paint	Heterogeneous White,Green Non-fibrous Bound		100%	Paint	None Detected
49-5 B2212107.05	Wall Texture	Heterogeneous White,Blue Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected
49-6 B2212107.06	Wall Texture	Heterogeneous White Non-fibrous Bound		60% 35% 5%	Binder Calc Carb Paint	None Detected
49-7 B2212107.07	Wall Texture	Heterogeneous White,Blue Non-fibrous Bound		60% 35% 5%	Binder Silicates Paint	None Detected

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LEGEND:
Non-Anth = Non-Asbestiform Anthophyllite
Non-Trem = Non-Asbestiform Tremolite
Calc Carb = Calcium Carbonate

METHOD: EPA 600 / R93 / 116 and EPA 600 / M4-82 / 020

REPORTING LIMIT: <1% by visual estimation

REPORTING LIMIT FOR POINT COUNTS: 0.25% by 400 Points or 0.1% by 1,000 Points

REGULATORY LIMIT: >1% by weight

Due to the limitations of the EPA 600 method, nonfriable organically bound materials (NOBs) such as vinyl floor tiles can be difficult to analyze via polarized light microscopy (PLM). EPA recommends that all NOBs analyzed by PLM, and found not to contain asbestos, be further analyzed by Transmission Electron Microscopy (TEM). Please note that PLM analysis of dust and soil samples for asbestos is not covered under NVLAP accreditation. *Estimated measurement of uncertainty is available on request.*

This report relates only to the samples tested or analyzed and may not be reproduced, except in full, without written approval by Eurofins CEI. Eurofins CEI makes no warranty representation regarding the accuracy of client submitted information in preparing and presenting analytical results. Interpretation of the analytical results is the sole responsibility of the client. Samples were received in acceptable condition unless otherwise noted. This report may not be used by the client to claim product endorsement by NVLAP or any other agency of the U.S. Government.

Information provided by customer includes customer sample ID and sample description.

ANALYST: Jacob Morgan

APPROVED BY: Tianbao Bai, Ph.D., CIH
Laboratory Director

Scott Minyard

NVLAP® TESTING
NVLAP LAB CODE 101768-0

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CHAIN OF CUSTODY

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	B2210933
CEI Lab I.D. Range:	

(87)

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Jennifer Turner
Company: ECS Southeast	Email / Tel: Jturner1@ecslimited.com 910-599-6285
Address: 6714 Netherlands Dr.	Project Name: UNCW King Hall
Wilmington, NC 28405	Project ID#: 49:18273
Email: Jturner1@ecslimited.com	PO #: 49:18273
Tel: 910-599-6285 Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☒	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600		☐	☐	☐	☐	☐
PLM BULK	CARB 435		☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD		☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16			☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD			☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD		☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

Positive STOP per HA Except DW/JCT Plastics / Textures

Please Call w/ Questions 910-599-6285

☒ Accept Samples

☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
	8-30-22 5:30PM	BF	9/1 10:20

Samples will be disposed of 30 days after analysis

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast	Job Contact:
Project Name: UNCW King Hall	
Project ID #: 49: 18273	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
1-1, 2, 3	CMU Wall Texture	HA1	PLM [X]	TEM [ ]
2-1, 2, 3	Mech Rm Pipe Wrap	HA2	PLM [ ]	TEM [ ]
3-1, 2	Boiler Flu Stack White Caulking	HA3	PLM [ ]	TEM [ ]
4-1, 2	Boiler Flu Stack Brick	HA4	PLM [ ]	TEM [ ]
5-1, 2, 3	Boiler Flu Stack Liner	HA5	PLM [ ]	TEM [ ]
6-1, 2, 3	Crawl Space 3" Pipe Wrap	HA6	PLM [ ]	TEM [ ]
7-1, 2	Gray HVAC Sealant	HA7	PLM [ ]	TEM [ ]
8-1, 2	Crawl Space 1st Fl Vibration Dampener	HA8	PLM [ ]	TEM [ ]
9-1, 2	Crawl Space Blk Foundation WP	HA9	PLM [ ]	TEM [ ]
23 → 10-1	Brn Covebase w/ Mastics	HA10	PLM [ ]	TEM [ ]
11-1, 2	2' x 2' White Textured Ceiling Tile	HA11	PLM [ ]	TEM [ ]
12-1	HVAC Vibration Dampener	HA12	PLM [ ]	TEM [ ]
13-1, 2	White HVAC Sealant	HA13	PLM [ ]	TEM [ ]
14-1, 2	Drywall / Joint Compound	HA14	PLM [ ]	TEM [ ]
15-1, 2, 3	2" Pipe Wrap	HA15	PLM [ ]	TEM [ ]
16-1, 2	2' x 2' White Pinhole CT	HA16	PLM [ ]	TEM [ ]
17-1, 2	Gray leveling Compound	HA17	PLM [ ]	TEM [ ]
18-1, 2	12" x 12" ~~Beige~~ Cream w/	HA18	PLM [ ]	TEM [ ]
	Gray + Tan Mottling FT		PLM [ ]	TEM [ ]
19-1, 2	Blk Sink Undercoating	HA19	PLM [ ]	TEM [ ]
20-1, 2	Cream Covebase w/ Yel Mastic	HA20	PLM [ ]	TEM [ ]
21-1, 2	Yellow HVAC Mastic	HA21	PLM [ ]	TEM [ ]
22-1	CMU Block Fill	HA22	PLM [ ]	TEM [ ]
24 → 23-1, 2	Wall Caulk	HA23	PLM [ ]	TEM [ ]
24-1, 2	Plaster Wall System	HA24	PLM [ ]	TEM [ ]
25-1, 2	2' x 4' White Pinhole CT	HA25	PLM [ ]	TEM [ ]
26-1, 2	Black Mastic on 6" Pipe	HA26	PLM [ ]	TEM [ ]
27-1, 2	Wall Texture 2nd Fl	HA27	PLM [ ]	TEM [ ]

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company:	Job Contact:
Project Name:	
Project ID #:	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST	
28-1,2	Brn CB w/ Yellow Mastic	HA28	PLM ☒	TEM ☐
29-1,2	Red Firestop	HA29	PLM ☐	TEM ☐
30-1,2	Pink Firestop	HA30	PLM ☐	TEM ☐
31-1	Unknow FT under 12x12 White w/ BK	HA31	PLM ☐	TEM ☐
~~32-1~~	spots FT + Blk / Yellow Mastic		PLM ☐	TEM ☐
32-1	12" x12" White w/ Black	HA32	PLM ☐	TEM ☐
-	Specs FT		PLM ☐	TEM ☐
33-1	12x12 Lt Blue FT w/ Yellow	HA33	PLM ☐	TEM ☐
	Mastic		PLM ☐	TEM ☐
34-1	Residual Black Mastic	HA34	PLM ☐	TEM ☐
35-1,2	Unknow Tan FT w/ Black Mas	HA35	PLM ☐	TEM ☐
36-1	12" x12" Gray FT w/ Gray/Blk Streaks	HA36	PLM ☐	TEM ☐
37-1	12" x12" White FT w/ Blk Streak	HA37	PLM ☐	TEM ☐
38-1,2	12" x12" Gray FT w/ white streaks	HA38	PLM ☐	TEM ☐
39-1	12" x12" Tan FT under	HA39	PLM ☐	TEM ☐
	12" x12" Gray FT		PLM ☐	TEM ☐
40-1	White FT under Carpet	HA40	PLM ☐	TEM ☐
41-1,2	White Sink Under Coating	HA41	PLM ☐	TEM ☐
42-1	12x12 Cream w/ Tan Streaks	HA42	PLM ☐	TEM ☐
~~43-1~~	FT 1st FL		PLM ☐	TEM ☐
43-1	12x12 white w/ Gray Streaks	~~HA43~~	PLM ☐	TEM ☐
	FT		PLM ☐	TEM ☐
44-1	12x12 olive FT	HA44	PLM ☐	TEM ☐
45-1,2	Gray Thin Set Under Ceramic	HA45	PLM ☐	TEM ☐
46-1,2	Gray Ext Window Caulk	HA46	PLM ☐	TEM ☐
47-1,2	Gray Ext Window Glazing	HA47	PLM ☐	TEM ☐
48-1,2	12x12 white w/ Multi-Color	HA48	PLM ☐	TEM ☐
	Specs FT		PLM ☐	TEM ☐

,70

,87

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CHAIN OF CUSTODY

7

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	B2212107
CEI Lab I.D. Range:	

COMPANY INFORMATION	PROJECT INFORMATION
CEI CLIENT #:	Job Contact: Jenn Turner
Company: ECS Southeast	Email / Tel: 910-599-6285 jturner1@ecslimited.com
Address: 6714 Netherlands Drive	Project Name: UNCW King Hall
Wilmington, NC 28405	Project ID#: 49:18273
Email: jturner1@ecslimited.com	PO #: 49:18273
Tel: 910-599-6285 Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

ASBESTOS	METHOD	TURN AROUND TIME					
		4 HR	8 HR	1 DAY	2 DAY	3 DAY	5 DAY
PLM BULK	EPA 600	☐	☐	☐	☐	☒	☐
PLM POINT COUNT (400)	EPA 600	☐	☐	☐	☐	☐	☐
PLM POINT COUNT (1000)	EPA 600	☐	☐	☐	☐	☐	☐
PLM GRAV w POINT COUNT	EPA 600	[redacted]	☐	☐	☐	☐	☐
PLM BULK	CARB 435	[redacted]	☐	☐	☐	☐	☐
PCM AIR	NIOSH 7400	☐	☐	☐	☐	☐	☐
TEM AIR	EPA AHERA	☐	☐	☐	☐	☐	☐
TEM AIR	NIOSH 7402	☐	☐	☐	☐	☐	☐
TEM AIR (PCME)	ISO 10312	☐	☐	☐	☐	☐	☐
TEM AIR	ASTM 6281-15	☐	☐	☐	☐	☐	☐
TEM BULK	CHATFIELD	[redacted]	☐	☐	☐	☐	☐
TEM DUST WIPE	ASTM D6480-05 (2010)	☐	☐	☐	☐	☐	☐
TEM DUST MICROVAC	ASTM D5755-09 (2014)	☐	☐	☐	☐	☐	☐
TEM SOIL	ASTM D7521-16	[redacted]		☐	☐	☐	☐
TEM VERMICULITE	CINCINNATI METHOD	[redacted]		☐	☐	☐	☐
TEM QUALITTATIVE	IN-HOUSE METHOD	[redacted]	☐	☐	☐	☐	☐
OTHER:		☐	☐	☐	☐	☐	☐

REMARKS / SPECIAL INSTRUCTIONS:

No Positive Stop

☒ Accept Samples
☐ Reject Samples

Relinquished By:	Date/Time	Received By:	Date/Time
Jennifer Turner	9115122 5:00 PM	BF	9/19 930

Samples will be disposed of 30 days after analysis

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast	Job Contact:
Project Name: UNCW King Hall	
Project ID #: 49:18273	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/ AREA	TEST			
49-1	Wall texture - 1st Fl by MechRm	HA 1	PLM	[X]	TEM	[ ]
↓ -2	↓ 1st FL Hallway	↓	PLM	↓	TEM	[ ]
-3	1st FL Front Hall		PLM		TEM	[ ]
-4	1st FL Hall by Office		PLM		TEM	[ ]
-5	2nd FL by Electric Panel		PLM		TEM	[ ]
-6	2nd FL Front Hallway		PLM		TEM	[ ]
-7	2nd FL Inner Hallway		PLM		TEM	[ ]
			PLM	[ ]	TEM	[ ]
			PLM	[ ]	TEM	[ ]
			PLM	[ ]	TEM	[ ]
			PLM	[ ]	TEM	[ ]
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			PLM	[ ]	TEM	[ ]
			PLM	[ ]	TEM	[ ]

Version: CCOC.01.18.2/2.LD

Appendix IV: Lead Laboratory Analytical Results

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Eurofins CEI
730 SE Maynard Road
Cary, NC 27511
TEL: 866-481-1412
TEL: 919-481-1413
FAX: 919-481-1442

LABORATORY REPORT
LEAD IN PAINT

Client: **ECS Southeast, LLP**
6714 Netherlands Drive
Wilmington, NC 28405

Lab Code: C220783
Received: 09-01-22
Analyzed: 09-07-22
Reported: 09-07-22

Project: UNCW King Hall, 49:18273

METHOD: EPA SW846 7000B

CLIENT ID	LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT
LBP01	CA4105	1900	**0.19**
LBP02	CA4106	56	**0.0056**
LBP03	CA4107	<39	**<0.0039**
LBP04	CA4108	<35	**<0.0035**
LBP05	CA4109	330	**0.033**
LBP06	CA4110	620	**0.062**
LBP07	CA4111	1900	**0.19**
Sample contains substrate, potentially affecting results			

Eurofins CEI
730 SE Maynard Road
Cary, NC 27511

TEL: 866-481-1412
TEL: 919-481-1413
FAX: 919-481-1442

Project: UNCW King Hall, 49:18273

Lab Code: C220783

METHOD: EPA SW846 7000B

CLIENT ID	LAB ID	PPM (µg/g)	CONCENTRATION % BY WEIGHT

Reviewed By:

Tianbao Bai, Ph.D.
Laboratory Director

This method has been validated for sample weights of 0.020g or greater. When samples with a weight of less than that are analyzed those results fall outside of the scope of accreditations.
*** The analysis of composite wipe samples as a single samples is not included under AIHA accreditation.**

Minimum reporting limit is 10 µg total lead. Sample results denoted with a “less than” (<) sign contain less than 10.0 µg total lead, based on a 40ml sample volume.

Lead samples are not analyzed by Eurofins CEI Lead samples are submitted to an AIHA ELLAP accredited laboratory for lead analysis of soil, dust, paint, and TCLP samples.
Laboratory results represent the analysis of samples as submitted by the client. Information regarding sample location, description, area, volume, etc., was provided by the client. Unless notified in writing to return samples, Eurofins CEI discards client samples after 30 days. This report shall not be reproduced, except in full, without the written consent of Eurofins CEI.

Information provided by customer includes customer sample ID, location, volume and area as well as date and time of sampling.

REGULATORY LIMITS

OSHA Standard: No safe limit.
Consumer Products Safety Standard: Greater than 0.009% lead by weight.
Federal Lead Standard / HUD: 0.5% lead by weight.

LEGEND

µg = microgram
ml = milliliter
ppm = parts per million
Pb = lead
g = grams
wt = weight

End of Report

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CHAIN OF CUSTODY

730 SE Maynard Road, Cary, NC 27511
Tel: 866-481-1412; Fax: 919-481-1442

LAB USE ONLY:	
CEI Lab Code:	C220783
CEI Lab I.D. Range:	CA4105-CA4111

(7)

COMPANY INFORMATION		PROJECT INFORMATION
CEI CLIENT #:		Job Contact: Jenn Turner
Company: ECS Southeast, LLP		Email / Tel: 910-599-6285
Address: 6714 Netherlands Drive		Project Name: UNCW Kenyon Hall
Wilmington, NC 28405		ID# 49:18273
Email: JTurner1@ECSLimited.com		PO #: 49:18273
Tel: 910-686-9114	Fax:	STATE SAMPLES COLLECTED IN: NC

IF TAT IS NOT MARKED STANDARD 3 DAY TAT APPLIES.

Analyte	METHOD	TURN AROUND TIME					
		4 HR**	8 HR**	1 DAY**	2 DAY	3 DAY	5 DAY
LEAD PAINT	EPA SW846 7000B				☐	☒	☐
LEAD WIPE	EPA SW846 7000B				☐	☐	☐
LEAD SOIL	EPA SW846 7000B				☐	☐	☐
LEAD AIR	EPA SW846 7000B				☐	☐	☐
LEAD TCLP	EPA SW846 7000B				☐	☐	☐
RCRA 8 METALS	EPA SW846 7000B				☐	☐	☐
RCRA 8 TCLP	EPA SW846 7000B				☐	☐	☐
OTHER:					☐	☐	☐

TAT IS NOT AVAILABLE. LEAD SAMPLES ARE SUBCONTRACTED FOR ANALYSIS TO AN ELLAP ACCREDITED LAB.

REMARKS:			BMB Accept Samples ☐ Reject Samples
Relinquished By:	**Date/Time**	**Received By:**	**Date/Time**
[signature]	8-30-22 5:30PM	BF	9/1 10:20

Samples will be disposed of 30 days after analysis

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SAMPLING FORM

COMPANY CONTACT INFORMATION	
Company: ECS Southeast LLP	Job Contact:
Project Name: UNCW Kenan Hall	
Project ID #: 49 18273	Tel:

SAMPLE ID#	DESCRIPTION / LOCATION	VOLUME/AREA	COMMENTS
LBP01	Mech RM Metal Door/White	1" x 1"	
LBP02	Mech RM Floor / Grey		
LBP03	Metal Door Frame / Wh. tc		
LBP04	CMU @ in Class RM / Wh. tc		
LBP05	Stair Railing / Blk		
LBP06	Ext Window Sill / Wh. tc		
LBP07	Ext Window Casing / Wh. tc		

Appendix V: XRF Lead-Based Paint Readings

XRF shot number	XRF reading	Color	Substrate	Component	Location	Side
1	0.2	White	Wood	Porch Overhang	Exterior	A
2	0.3	White	Wood	Porch Trim	Exterior	A
3	0.4	White	Metal	Door Casing	Exterior	A
4	0.2	White	CMU	Wall	Back Right Stairwell	B
5	-0.3	Black	Metal	Stair Stinger	Back Right Stairwell	D
6	-0.1	Black	Metal	Stiar Riser	Back Right Stairwell	D
7	-0.1	Beige	Metal	Door Casing	1st Floor Hallway	C
8	-0.1	Beige	Metal	Door Casing	1st Floor Hallway	B
9	0.2	Off-White	Ceramic	Tile	Womens Restroom	C
10	0.0	White	Wood	Window Casing	Interior	C
11	0.2	White	Wood	Window Sill	Interior	C
12	-0.3	Light Blue	Gypsum	Wall	By Front Entrance	C
13	0.4	White	Wood	Window Casing	Halfmoon Entrance Wndc	C
14	-0.1	White	Gypsum	Wall	By Front Office	D
15	-0.2	White	Plaster	Wall Texture	By Womens Restroom	B
16	0.1	Beige	Metal	Door Casing	Front Office	D
17	-0.2	Light Blue	Gypsum	Wall	By Womens Restroom	B
18	0.2	Light Blue	CMU	Wall	Back Left Stairwell	D
19	0.0	White	Metal	Door Casing	Mechanical Room	B
20	-0.2	White	Gypsum	Wall	Back Left Stairwell	B
21	-0.1	White	Wood	Windown Sill	2nd Floor Interior	A
22	0.0	Gray	Metal	Eletrical Pannel	2nd Floor Hallway	D
23	-0.1	White	Metal	Door Casing	2nd Floor Hallway	B
24	0.1	Tan	Metal	Door Casing	2nd Floor Hallway	C
25	-0.2	Light Blue	Plaster	Wall Texture	2nd Floor Hallway	C
26	-0.3	White	Plaster	Wall Texture	2nd Floor Hallway	D
27	0.0	Gray	Metal	Radiator	2nd Floor Stairwell	B
28	0.0	White	Wood	Wood Casing	Exterior	A
29	0.2	White	Wood	Window Pannel	Exterior	A
30	0.5	White	Wood	Window Sill	Exterior	A
31	0.3	White	Wood	Window Casing	Exterior	A

Appendix VI: Certifications/ Licenses

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

ROY COOPER • Governor

KODY H. KINSLEY • Secretary

HELEN WOLSTENHOLME • Interim Deputy Secretary for Health

MARK T. BENTON • Assistant Secretary for Public Health

Division of Public Health

June 20, 2022

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

Dear Ms. Desaix:

Based upon the review of your accreditation application, the Health Hazards Control Unit (HHCU) has determined that you have fulfilled the requirements and are eligible for asbestos accreditation as a(n) ABATEMENT PROJECT DESIGNER. Your assigned North Carolina accreditation number is 40530, which is reflected on your enclosed North Carolina Accreditation card. Please be sure to take this card with you to any asbestos work site where you are employed. The State requires that all persons conducting asbestos abatement or asbestos management activities be accredited and have their identification card on site.

Your North Carolina Abatement Project Designer accreditation will expire on MAY 31, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Abatement Project Designer after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to May 31, 2023. If you should continue to perform asbestos management activities as a(n) Abatement Project Designer without a valid North Carolina accreditation, you will be in violation of State regulations and may be cited for noncompliance.

Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

136671

North Carolina
Asbestos Accreditation

EXPIRATION			
05-31-2023			
DOB	SEX	HT	WT
07-19-1977	F	5'4"	140
CLASS		#	EXP
DESIGNER		40530	05-23
INSPECTOR		12107	03-23

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

ROY COOPER • Governor

KODY H. KINSLEY • Secretary

HELEN WOLSTENHOLME • Interim Deputy Secretary for Health

MARK T. BENTON • Assistant Secretary for Public Health

Division of Public Health

August 15, 2022

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

Dear Ms. Desaix:

The Health Hazards Control Unit (HHCU) has determined that you have fulfilled the application requirements and are eligible for lead certification as a(n) INSPECTOR. Your assigned Inspector certification number is 110230, which is reflected on your enclosed North Carolina Lead Certification card. The State requires that all persons conducting regulated lead-based paint activities be certified and have their identification card on-site.

A "Lead-Based Paint Activity Summary" shall be submitted to the HHCU by the certified inspector or risk assessor within 45 days of each inspection, risk assessment, or lead hazard screen conducted. The information shall be submitted on a form provided or approved by the Program, per 10A NCAC 41C .0807(b), Lead-Based Paint Hazard Management Program Rules.

Accredited refresher training must be completed at least every 24 months from the date of the last accredited training course **AND** within twelve months prior to applying for certification. The HHCU strongly recommends that individuals note the date of certification expiration and ensure all refresher training meets the above requirements.

Your North Carolina Inspector certification will expire on AUGUST 31, 2023. It is NOT the policy of the HHCU to issue renewal notices. If you wish to continue working as a(n) Inspector after this expiration date, you must successfully complete the required training and submit a completed application to this office prior to August 31, 2023. If you should perform lead-based paint activities as a(n) Inspector without a valid North Carolina certification, you will be in violation of State regulations and may be cited for noncompliance.

If you have any questions, please contact our office at (919) 707-5954.

NORTH CAROLINA
LEAD CERTIFICATION

Amy C Desaix
7424 Ern Way
Wilmington, NC 28411

DOB	SEX	HT	WT
07-19-1977	F	5'4"	145

DISCIPLINE	#	LAST COURSE	EXPIRATION
INSPECTOR	110230	INS 08-02-2022	08-31-2023

Sincerely,

Ed Norman
Program Manager
Health Hazards Control Unit

LOCATION: 5505 Six Forks Road, Building 1, Raleigh, NC 27609
MAILING ADDRESS: 1912 Mail Service Center, Raleigh, NC 27699-1912
www.ncdhhs.gov . TEL: 919-707-5950 . FAX: 919-870-4808

Appendix VII: Previous Reports

2242.02
B-3

ENGINEERING CONSULTING SERVICES, LTD.
Geotechnical • Construction Materials • Environmental

August 20, 2003

Mr. Rick Wash
Wash Hatem Nelson Architects
330 West Tenth Street
Charlotte, North Carolina 28202

Reference: Report of Lead-Based Paint Survey
University of North Carolina Wilmington
King Hall
Wilmington, North Carolina
ECS, Ltd. Project G-8042

Dear Mr. Wash:

Engineering Consulting Services, Ltd. (ECS) has completed a lead-based paint survey at the above referenced property. The purpose of the testing was to determine the presence and general location of lead-based paint (LBP) on the interior and exterior of the building prior to planned renovation activities. This report contains the testing procedures and our conclusions and recommendations.

PROJECT INFORMATION

We understand that renovations are planned for King Hall located on the campus of the North Carolina Wilmington (UNCW) in Wilmington, North Carolina. King Hall is a two-story, 22,000 square foot building brick building that was constructed in the 1960s. The building contains a lecture auditorium, classrooms, offices, and laboratories. The building has brick and wood exterior walls and a pitched roof with shingles. Interior finishes in the building consist of drywall and masonry block walls; ceiling tile ceilings; and terrazzo, carpet, tile or linoleum floors over a concrete slab.

1.0 LEAD - BASED PAINT (LBP) TESTING

1.1 Lead-Based Paint Survey Procedures

The building was reportedly constructed in the 1960s. The Consumer Products Safety Commission banned the use of LBP in 1978. Therefore, there is the potential that lead-based paint may have been used in the facility. Lead-based paint testing was performed on July 22, 2003 by Mr. Shawn Tucker (NC Lead Inspector/Risk Assessor #120049) of ECS. The survey began by randomly selecting painted surfaces in the different areas of the building (storage areas, restrooms, offices, common areas, exterior areas, etc.) and exterior painted areas of the building. Typical test areas included walls, ceilings, doors, door frames, interior trim, columns, exterior walls, and handrails, gutters, etc. Lead testing was performed based on planned renovations to the building as communicated to us by Mr. Greg Walker with UNCW.

1.2 Lead-Based Paint Test Procedures

The sampling was performed using a calibrated Scitec Spectrum Analyzer (X-Ray Fluorescence Lead-Based Paint Analyzer). An XRF screen reading was taken at each test location. The Department of Housing and Urban Development (HUD) and the State of North Carolina defines a lead-based paint as having "a lead content of 1.0 mg/cm^2 of painted surface". Approximately 94 test locations were analyzed in the building using the XRF. The results of the lead based paint survey using the XRF are presented in Table 2 - Summary of Lead Survey.

1.3 Lead-Based Paint Results

Lead in excess of EPA and State of North Carolina levels was detected in window sills and interior and exterior window mullions of the building.

1.4 Lead-Based Paint Conclusions and Recommendations

The lead-based paint can be maintained and monitored as part of an operations and maintenance program. It appears that lead-based paint is confined to older painted surfaces of the building. There are several options for managing lead-based paint during renovations to the facility. The most practical method for dealing with lead-based paint is to remove (in whole components) and dispose of the building components that contain lead-based paint (windows, etc.) and replace them with new components that do not contain lead-based paint. This option can increase building material costs on a renovation project, but it eliminates the majority of the lead-based paint at the facility. If lead-based paint will be disturbed (sanded, scraped), you must follow applicable EPA, State of North Carolina and OSHA lead-based paint guidelines when working with, handling and disposing of lead-based paint. In addition, subcontractors (such as painting contractors) must be informed of the location of lead-based paint prior to disturbing it. In most cases it is recommended that lead abatement contractors remove loose flakes and prepare the surface prior to repainting.

1.5 Qualifications of Lead-Based Paint Survey

This report summarizes our evaluation of the conditions observed at the site. The findings prepared by ECS are based upon testing performed in the facility. Additional lead-based paint may exist (undetected) in other areas due to their inaccessibility or due to the limited nature of our testing. Our recommendations are based on the guidelines presented in EPA, State of North Carolina or OSHA lead-based paint regulations.

2.0 CLOSING

ECS appreciates the opportunity to provide our environmental services for this project. We can assist you with preparing lead removal plans and specifications, holding pre-bid meetings, and air monitoring and clearance testing. If you have questions or need additional information, please contact us at (336) 856-7150.

Respectfully,

ENGINEERING CONSULTING SERVICES, LTD.

Shawn M Tucker, REM
Project Scientist

Brian E. Maas, REM, CMR
Principal Scientist

Attachments: Table 1 - Summary of Lead Survey
Drawing 1 - Lead Sample Locations - 1st Floor
Drawing 2 - Lead Sample Locations - 2nd Floor

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
1	Exterior Door	West Entrance	White	Wood	Fair	0.23	0.18
2	Exterior Door Frame	West Entrance	White	Metal	Fair	0.15	--
3	Exterior Handrail	West Entrance	Black	Metal	Fair	0.10	--
4	Exterior Handrail	West Entrance	Black	Metal	Fair	0.47	0.31
5	Exterior Door	Northeast Entrance	White	Wood	Fair	0.30	-0.10
6	Exterior Door Frame	Northeast Entrance	White	Metal	Fair	0.02	--
7	Exterior Window Sill	Northeast Entrance	White	Metal	Fair	0.23	0.16
8	Exterior Window Mullion	Northeast Entrance	White	Metal	Fair	**6.12**	0.59
9	Exterior Window Mullion	Southeast Entrance	White	Metal	Fair	**5.65**	0.94
10	Exterior Window Sill	Southeast Entrance	White	Metal	Fair	0.58	0.10
11	Exterior Handrail	South Entrance	Black	Metal	Fair	0.03	--
12	Gutter	South Side of Building	Brown	Metal	Fair	0.31	--
13	Exterior Door	South Entrance	White	Wood	Fair	-0.15	0.04
14	Exterior Door Frame	South Entrance	White	Metal	Fair	-0.08	--
15	Handrail	North Side	Yellow	Metal	Fair	0.16	--
16	Gutter	North Side	Brown	Metal	Fair	0.25	--
17	Piping	Boiler Room	Green	Metal	Fair	0.28	--
18	Piping	Boiler Room	Blue	Metal	Fair	0.39	--
19	Piping	Boiler Room	Red	Metal	Fair	0.06	--
20	Piping	Boiler Room	Gray	Metal	Fair	0.19	--
21	Wall	Boiler Room	White	Masonry	Fair	0.29	0.34
22	Door	Boiler Room	White	Metal	Fair	0.33	--
23	Door Frame	Boiler Room	White	Metal	Fair	0.44	--
24	Wall	Lobby	Green	Concrete	Good	0.11	0.32
25	Wall	Exterior of Room 104	White	Drywall	Good	-0.16	0.17

K & L Values are in mg/cm^2
A result greater than 1.0 mg/cm^2 is considered lead-based paint
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
26	Wall	Across from Room 104	Tan	Ceramic Tile	Good	0.54	-0.98
27	Baseboard	Across from Room 104	Tan	Ceramic Tile	Good	0.06	0.29
28	Wall	Outside of Room 106	White	Drywall	Good	-0.23	0.48
29	Wall	Outside of Room 106G	White	Masonry Block	Good	-0.42	-0.14
30	Window Sill	Lobby, Near Room 104	White	Wood	Good	-0.26	-0.00
31	Window Frame	Lobby, Near Room 104	White	Wood	Good	0.28	0.38
32	Wall	Outside of Women's Restroom	White	Drywall	Good	-0.33	--
33	Door	Northeast Entrance	White	Wood	Good	0.08	0.15
34	Door Frame	Northeast Entrance	White	Metal	Good	-0.06	0.30
35	Wall Panel	Outside of Room 102	Green	Wood	Good	0.25	--
36	Wall	Room 102	White	Drywall	Good	0.12	0.40
37	Wall	Near Room 103A	White	Drywall	Good	-0.08	0.43
38	Wall	Room 103	White	Masonry Block	Good	-0.03	0.30
39	Wall	Near Room 102G	White	Drywall	Good	0.26	0.62
40	Door	Room 102I	Stain	Wood	Good	0.03	0.09
41	Door Frame	Room 102I	White	Metal	Good	-0.04	--
42	Window	Room 102C	Stain	Wood	Good	0.09	0.23
43	Window Sill	Room 102C	Stain	Wood	Good	-0.22	0.12
44	Door Frame	Room 102K	White	Metal	Good	-0.35	--
45	Door	Room 102K	Stain	Wood	Good	-0.08	-0.09
46	Baseboard	Women's Room	Green	Ceramic Tile	Good	0.30	-0.62
47	Floor	Women's Room	Green	Ceramic Tile	Good	0.00	0.18
48	Baseboard	Lobby	Tan	Ceramic Tile	Good	0.68	-1.01
49	Wall	Room 208	White	Masonry Block	Good	0.01	-0.30
50	Wall	Room 208	White	Drywall	Good	-0.12	0.18

K & L Values are in mg/cm^2
A result greater than 1.0 mg/cm^2 is considered lead-based paint
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
51	Window Mullion	Room 208	White	Wood	Good	0.26	0.40
52	Window Sill	Room 208	White	Wood	Good	**2.49**	0.46
53	Window Sill	Room 208	White	Wood	Good	0.05	0.05
54	Window Mullion	Room 208	White	Wood	Good	**8.22**	0.91
55	Wall	2nd Floor, Mechanical Room	Gray	Drywall	Fair	0.21	0.18
56	Wall	Room 104	White	Masonry Block	Good	0.11	0.20
57	Window Mullion	Room 104	White	Wood	Good	**6.66**	0.94
58	Window Sill	Room 104	White	Wood	Good	-0.04	0.04
59	Window Mullion	Near Room 104	White	Wood	Good	**7.44**	0.55
60	Door	Room 106D	Stain	Wood	Good	-0.13	0.20
61	Door Frame	Room 106D	Stain	Wood	Good	0.19	0.30
62	Wall	Room 106 Hall	White	Drywall	Good	0.12	0.29
63	Door	Room 106	Stain	Wood	Good	0.32	0.11
64	Door Frame	Room 106	White	Metal	Good	-0.22	--
65	Window Mullion	Room 106	White	Wood	Good	**8.35**	0.89
66	Window Sill	Room 106	White	Wood	Good	-0.10	0.14
67	Wall	Room 106 Hall	White	Masonry Block	Good	-0.14	0.11
68	Wall	Auditorium	Gray	Masonry Block	Good	0.12	0.35
69	Wall	Auditorium	Gray	Masonry Block	Good	0.05	0.05
70	Stringer	South Stairwell	Black	Metal	Good	0.21	--
71	Riser	South Stairwell	Black	Metal	Good	-0.07	--
72	Newel Post	South Stairwell	Black	Metal	Good	0.17	--
73	Radiator	South Stairwell	Gray	Metal	Good	0.63	--
74	Window Mullion	South Stairwell	White	Wood	Good	**1.01**	0.27
75	Window Frame	South Stairwell	White	Wood	Good	0.07	0.28

K & L Values are in mg/cm^2
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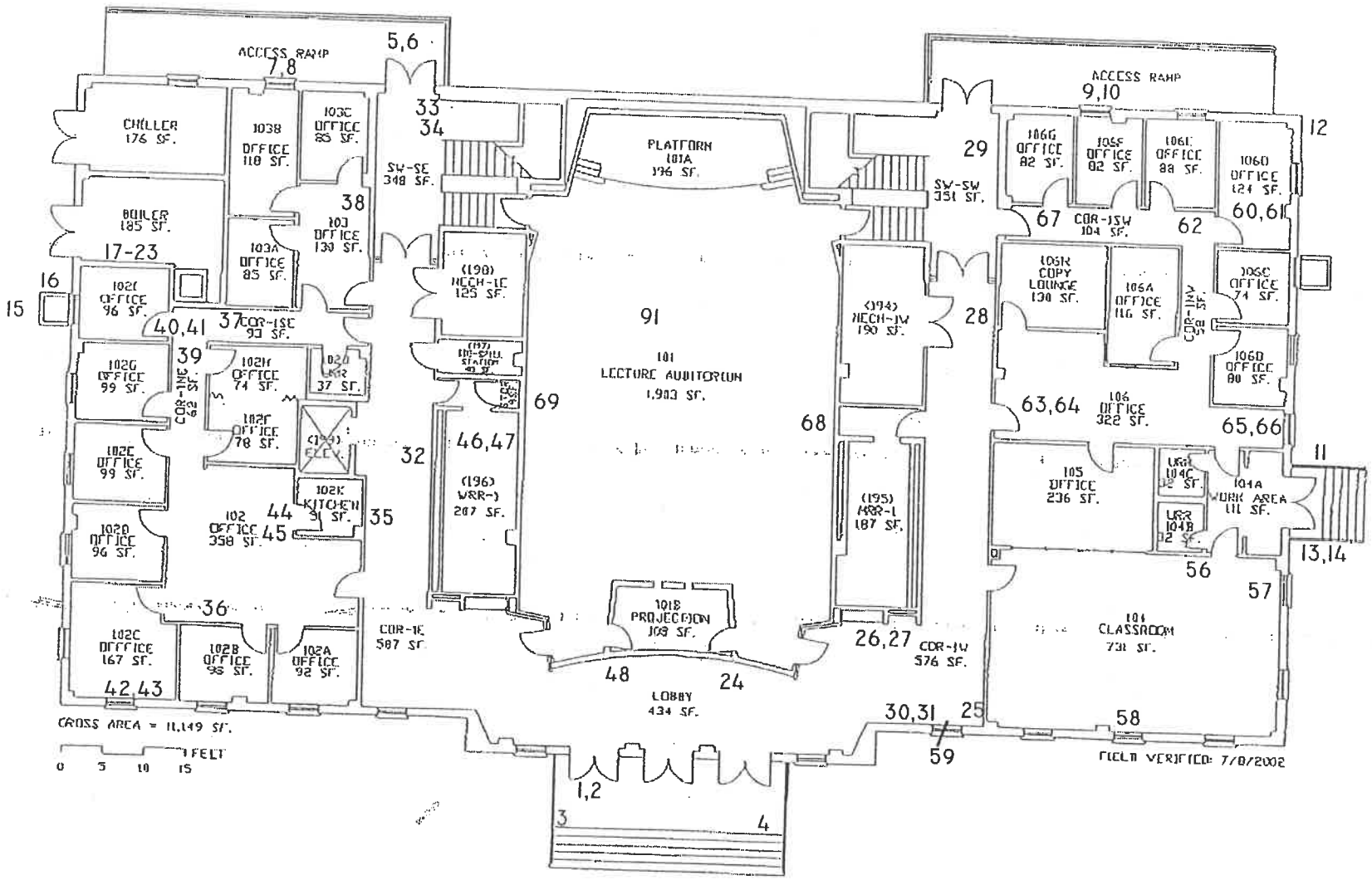
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present

Table 1
Summary of Lead Survey
UNCW - King Hall
Wilmington, North Carolina
ECS, Ltd. Project No. G-8042

Sample No.	Component	Location	Color	Substrate	Condition	K	L
76	Wall	Room 212	White	Drywall	Good	-0.04	0.37
77	Window Mullion	Room 212	White	Wood	Good	**10.27**	**1.17**
78	Window Sill	Room 212	White	Wood	Good	0.11	0.06
79	Door	Room 211	Stain	Wood	Good	-0.13	0.17
80	Door Frame	Room 211	White	Steel	Good	0.15	--
81	Wall	Room 211	White	Drywall	Good	-0.04	0.09
82	Window Mullion	Room 209E	White	Wood	Good	**6.00**	0.63
83	Window Sill	Room 209E	White	Wood	Good	0.03	0.17
84	Wall	Room 209E	White	Masonry Block	Good	0.27	0.29
85	Cabinet	Room 209, Breakroom	White	Wood	Good	-0.23	-0.08
86	Wall	Room 206	Blue	Drywall	Good	0.13	0.35
87	Door Frame	Room 206	Blue	Steel	Good	-0.14	--
88	Window Mullion	Room 206	White	Wood	Good	**7.31**	0.87
89	Window Sill	Room 206	White	Wood	Good	0.01	0.04
90	Wall	Room 203	White	Drywall	Good	0.00	0.15
91	Wall	Room 203, Kitchen	Yellow	Drywall	Good	0.14	0.21
92	Door	2nd Floor, Elevator	Tan	Steel	Good	0.11	--
93	Door Frame	2nd Floor, Elevator	Tan	Steel	Good	0.20	--
94	Cabinet	Room 201	Stain	Wood	Good	-0.05	0.23

K & L Values are in mg/cm^2
A result greater than 1.0 mg/cm^2 is considered lead-based paint
Steel/Metal substrates do not yield an L value
Bold indicates lead paint is present



KING HALL FIRST FLOOR PLAN

NOT TO SCALE

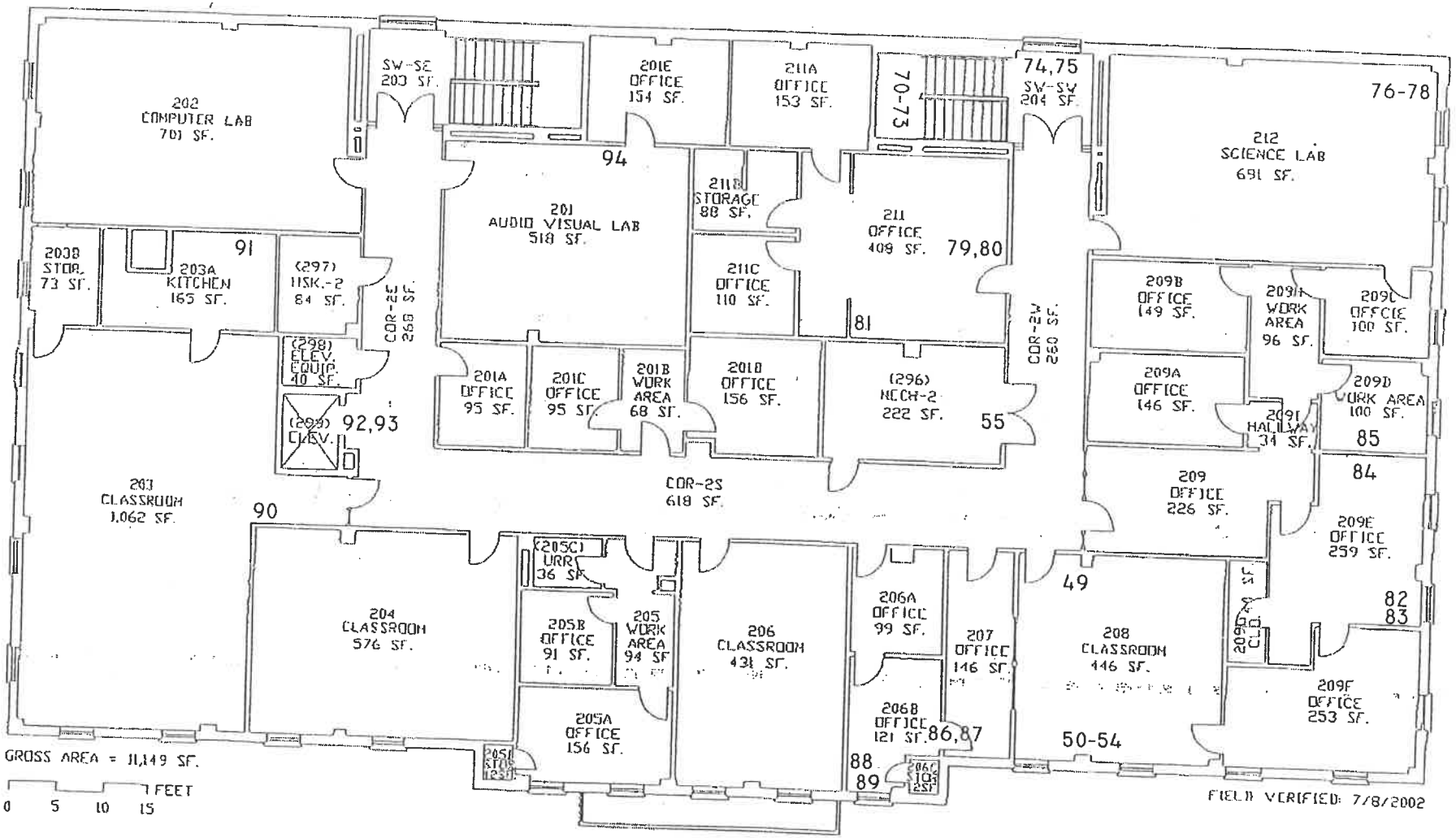
REFERENCE:
SITE PLAN PROVIDED BY
WASH HATEM NELSON AND
ASSOCIATES

ECS LTD
ENGINEERING
CONSULTING
SERVICES, LTD

FIGURE 2
LEAD SAMPLE LOCATIONS

UNCW
KING HALL–1ST FLOOR
WILMINGTON, NORTH CAROLINA

DRAWN BY/DATE:	CHECKED BY/DATE:	PROJECT NO.
TAC/08–05–03		G–8042



51 KING HALL SECOND FLOOR PLAN

NOT TO SCALE

REFERENCE:
SITE PLAN PROVIDED BY
WASH HATEM NELSON AND
ASSOCIATES

ECS LTD
ENGINEERING
CONSULTING
SERVICES, LTD

FIGURE 3
LEAD SAMPLE LOCATIONS

UNCW
KING HALL–2ND FLOOR
WILMINGTON, NORTH CAROLINA

DRAWN BY/DATE:	CHECKED BY/DATE:	PROJECT NO.
TAC/08-05-03		G-8042

S&ME

April 15, 2002

Lee Nichols Architecture
301 East Ninth Street, Suite 110
Charlotte, North Carolina 28202

ATTENTION: Mr. Garry Neavitt

Reference: **ASBESTOS SURVEY**
King Hall
University of North Carolina - Wilmington
Wilmington, North Carolina
S&ME Project No. 1355-02-251

Dear Mr. Neavitt:

S&ME, Inc. (S&ME) is pleased to provide you with the results of an asbestos survey of King Hall classroom building at the University of North Carolina Wilmington (UNCW). On March 28, 2002 Jonathan Borntrager and Chris Hamblet of S&ME, Inc. (S&ME) visited the site in Wilmington, North Carolina to perform the fieldwork associated with the asbestos survey. The roof, building exterior and interior were included in the scope of work. This assessment was performed according to our Proposal No. 1355-10244-01, dated June 12, 2001 and is needed for the renovation plans that are being designed for the building.

BACKGROUND INFORMATION

King Hall is presently in use and houses classrooms, offices and an auditorium. The building is a two-story structure, approximately 23,000 square feet in size. It is a masonry structure with metal support beams that are not insulated. The perimeter walls and interior load bearing walls are concrete block covered with plaster. The non-load bearing walls are drywall construction. The floors throughout the building are concrete and are covered with various selections of floor tiles or carpet. Suspended ceiling tiles are located throughout the building, creating an open air-plenum for the ventilation system.

S&ME, Inc.
3118 Spring Forest Road
Raleigh, North Carolina 27616

Mailing address:
P.O. Box 58069
Raleigh, North Carolina 27658-8069

(919) 872-2660
(919) 790-9827 fax
www.smeinc.com

All accessible areas of the building were included in the asbestos survey. However, surveys performed by S&ME for suspect asbestos-containing materials (ACM's) are limited to materials that are reasonably accessible. Suspect materials hidden in pipe chases, under a layer of flooring, behind walls and mechanical equipment, above solid ceilings or encased in columns should be assumed to contain asbestos if the inspector was not able to collect a sample of these materials. Further sampling may be needed to confirm the presence or absence of asbestos if a hidden suspect material becomes accessible during the renovation operations.

FINDINGS

During the asbestos survey, a total of 55 samples were collected for analysis, represent 25 types of suspect materials. Types of materials sampled include floor coverings, ceiling tiles, plaster, drywall components, textured wall covering, thermal system insulation and roofing materials.

Samples of suspect materials were placed in containers for transportation to S&ME's analytical laboratory in Charlotte, North Carolina. The samples were analyzed using polarized light microscopy (PLM) coupled with dispersion staining. This technique identifies asbestos fibers based on six unique optical and morphological characteristics: morphology, color, refractive index, extinction angle, signs of elongation, and dispersion staining colors. Refer to the appendix for a table displaying the results of the samples collected. Asbestos content is estimated and expressed as a percent of the total sample. Analytical forms can also be found in the appendix.

The United States Environmental Protection Agency (USEPA) considers a material to be asbestos containing if the asbestos content is greater than 1% by weight/volume. Asbestos material can be classified as friable or non-friable. A friable material can be easily crushed when dry with moderate hand pressure. Friable materials are more susceptible to damage and may potentially release fibers more readily than non-friable materials.

The following materials tested positive for the presence of asbestos.

Friable Asbestos-Containing Materials

- (KHK) A cloth vibration damper located in the second floor mechanical room contains 20% to 55% chrysotile asbestos. The damper is approximately three inches wide and 80 feet long (~20 square feet). It is installed in a large air-handling unit that occupies most of the room. This damper is in good condition.

- (KHW-KHP-KHO) The mud type insulation used on the steam and hot water pipes (2", 3" and 4" diameter pipes) throughout the building contain 2% amosite asbestos. The outer wrap on the 4" pipe fittings contains as much as 4% chrysotile asbestos. These pipe fitting insulations were found to be in good to fair condition. The inspector's noted approximately 22 2"-fittings, 46 3"-fittings, and 26 4"-fittings during the survey. However, additional fittings insulated with ACM may be located above the suspended ceiling tiles or in pipe chases.

- (KHY) In addition, the boiler flue located in the boiler room is insulated with a thermal system insulation that contains 15% amosite asbestos and 2% chrysotile asbestos. There is approximately 50 cubic feet of the insulation and it is in good condition.

Non-friable Asbestos-Containing Materials

- (KHB) A sample of the silver and black roof flashing was found to contain 2% chrysotile asbestos. This material is located around the 12 roof risers (approximately 12 square feet) that penetrate the field of the roof and is in good condition.

- Most of the floor tiles and mastics located throughout the building were found to contain 2% to 4% chrysotile asbestos. Following is a list of the positive floor tiles, which were all found to be in good condition:

(KHG)	1' x 1' white with gray and black specks	7,000 square feet
(KHI)	black mastic beneath carpet	300 square feet
(KHJ)	1' x 1' cream with white and gray flecks	27 square feet
(KHQ)	1' x 1' off-white with gray streaks	4,000 square feet
(KHR)	1' x 1' cream with gray and tan streaks	145 square feet
(KHS)	1' x 1' grayish black tiles	370 square feet
(KHU)	1' x 1' white with black dots	2,200 square feet

RECOMMENDATIONS

For building renovation, the asbestos-containing materials are required to be removed if they are friable and will be disturbed or if the material is nonfriable and the renovation operations will render

the material to be a "Regulated Asbestos-Containing Material (RACM)". RACM is (a) friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by forces expected to act on the material during demolition or renovation operations. These criteria are outlined in the "Asbestos/NESHAP Regulated Asbestos-Containing Materials Guidance, EPA 340/1-90-018".

It is probable that the thermal system insulations, vibration damper, roof flashing, floor tiles and mastics could be disturbed during the renovation to the building and should be carefully considered. Materials that will be disturbed will need to be properly removed before the renovations continue. The ACM should be removed in accordance with USEPA National Emission Standards for Hazardous Air Pollutants (NESHAP) Asbestos Regulations (40 CFR 61, Subpart M) and/or the approved state or local requirements equivalent to this regulation. It is required that a North Carolina Licensed Asbestos Abatement Contractor be used to properly remove and dispose of the ACM, because friable materials are involved.

CLOSING

We appreciate the opportunity to provide environmental services to Lee Nichols Architecture. If you have any questions, please call our office at (919) 872-2660.

Sincerely,
S&ME, Inc.

Beth Roberts
Project Professional

C. Mike Cashio, CIH
IH Department Manager

Enclosures
S:\Environ\2002 Jobs\1355-02-251 UNCW King Hall\1355-02-251-Report-SR.doc

TABLES

TABLE 1A
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHA	MISC-NF-I Roof flashing - black	Roof - perimeter flashing	KHA-01	Roof - ND Insulation - ND	Good	N/A
			KHA-02	Roof - ND Insulation - ND		
KHB	MISC-NF-I Roof flashing - silver and black	Roof - around penetrations	KHB-03	ND	Good	~ 12 square feet (12 risers)
			KHB-04	2% Chrysotile		
KHC	MISC-NF-I Roof felt and shingles	Roof - field	KHC-05	ND	Good	N/A
			KHC-06	ND		
KHD	MISC-F Drywall components	Wall partitions in the classrooms and offices	KHD-07	ND	Good	N/A
			KHD-08	<1% Chrysotile		
KHE	SURF-F Plaster	Walls partitions in the restrooms, auditorium, chiller room and boiler room	KHE-09	Smooth Coat - ND Plaster - ND	Good	N/A
			KHE-32	ND		
KHF	MISC-F Suspended ceiling tiles - 2' x 2' with fissures & pinholes	Offices and classrooms throughout most of the building and the back part of the auditorium	KHF-10	ND	Good	N/A
			KHF-45	ND		
KHG	MISC-NF-I Floor tiles - 1' x 1' white with gray and black specks	Flooring used throughout most of the second floor	KHG-11	Tile - 2% chrysotile Mastic - 3% chrysotile	Good	~ 7,000 square feet
			KHG-12	Tile - 2% chrysotile Mastic - 4% chrysotile		
			KHG-21	Tile - 2% chrysotile Mastic 1 - 3% chrysotile Mastic 2 - ND		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1B
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHH	MISC-F Suspended ceiling tiles - 2' x2' white textured tiles	Lobby and corridor around the auditorium on 1st floor and the main corridor on the 2nd floor	KHH-13	ND	Good	N/A
			KHH-38	ND		
KHI	MISC-NF-I Black Mastic - Beneath carpet and atop concrete in 206 Offices	Beneath the carpet in the 205 offices	KHI-14	2% chrysotile	Good	~ 300 square feet
			KHI-15	2% chrysotile		
KHJ	MISC-NF-I Floor tiles - 1' x 1' cream with white and gray flecks	205 Offices Restroom	KHJ-16	Tile - ND Mastic - 2% chrysotile	Good	~ 27 square feet
			KHJ-48	Tile - ND Mastic - <1% chrysotile		
KHK	MISC-F Cloth vibration damper	Mechanical Room - 2nd Floor	KHK-17	55% chrysotile	Good	~ 20 square feet
			KHK-18	20% chrysotile		
KHL	MISC-F Suspended ceiling tiles - 2' x 4' white with fissures and pinholes	Mechanical Room - 2nd Floor	KHL-19	ND	Fair	N/A
			KHL-28	ND		
KHM	MISC - F Suspended ceiling tiles - 2' x 4' white textured tiles	206 and 207 offices	KHM-20	ND	Good	N/A
			KHM-22	ND		
KHN	MISC-NF-I Floor tile - 1' x 1 dark gray with black & white spots	Corridor outside of the Dean's office on the 2nd floor	KHN-23	ND	Good	N/A
			KHN-24	ND		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1C
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHO	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical equipment rooms, chiller room, boiler room and above plenum on 3" pipes	KHO-25	Wrap - ND Insulation - 2% amosite	Good	~ 46 fittings (visible)
			KHO-26	Wrap - ND Insulation - 2% amosite		
			KHO-27	Insulation - 2% amosite		
KHP	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical equipment rooms, chiller room, boiler room and above plenum on 4" pipes	KHP-29	Wrap 1 - ND Wrap 2 - 4% chrysotile Insulation - 2% amosite	Good	~ 26 fittings (visible)
			KHP-30	Wrap 1 - ND Wrap 2 - 3% chrysotile Insulation - <1% amosite		
			KHP-31	Wrap 1 - ND Insulation - 2% amosite		
			KHP-53	Wrap - ND Insulation - 2% amosite		
KHQ	MISC-NF-I Floor tiles - 1' x 1' off-white with gray streaks	Throughout most of the 1st floor office and classroom area.	KHQ-34	Tile - 3% chrysotile Mastic - 4% chrysotile	Good	~ 4,000 square feet
			KHQ-37	Tile - 3% chrysotile Mastic - 2% chrysotile		
			KHQ-39	Tile - 3% chrysotile Mastic - ND		
KHR	MISC-NF-I Floor tiles - 1' x 1' cream with gray and tan streaks	1st floor kitchen areas	KHR-33	Tile - 2% chrysotile Mastic - 2% chrysotile	Good	~ 145 square feet
			KHR-42	ND		
KHS	MISC-NF- I Floor tiles - 1' x 1' grayish black tiles	Classroom 104 - 1st Floor	KHS-35	Tile - 4% chrysotile Mastic - 4% chrysotile	Good	~ 370 square feet
			KHS-36	Tile - 4% chrysotile Mastic - <1% chrysotile		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

ND = None Detected
DNA = Did not analyze

SURF = Surfacing material
MISC = Miscellaneous material
TSI = Thermal system insulation

F = Friable material
NF-I = Category I non-friable material
NF-II = Category II non-friable material

TABLE 1D
ASBESTOS SAMPLE TABLE
UNCW - KING HALL
WILMINGTON, NORTH CAROLINA
S&ME PROJECT NO: 1355-02-251

HOMOGENEOUS AREA (HGA)			SAMPLE		ASSESSMENT	
Name	Description	Location	Number	Results	Condition	Approx. Amount
KHT	MISC-F Suspended ceiling tiles - 2' x 4' white with fissures and pinholes	Office supply room and adjacent offices	KHT-40	ND	Good	N/A
			KHT-41	ND		
KHU	MISC-NF-I Floor Tiles - 1' x 1' white with black dots	Auditorium and adjacent storage room	KHU-43	Tile - 3% chrysotile Mastic - 4% chrysotile	Good	~ 2,200 square feet
			KHU-44	Tile - 3% chrysotile Mastic - 4% chrysotile		
KHV	MISC-F Drywall components with a white textured finish	Corridors, east mechanical room, bio. spill room and women's bathroom foyer	KHV-46	<1% chrysotile	Good	N/A
			KHV-47	ND		
KHW	TSI-F Pipe fitting insulation (Note - pipe straight runs are insulated with fiberglass)	Mechanical areas, boiler room, chiller room and above the plenum on the 2" pipes	KHW-49	Wrap - ND Insulation - 2% amosite, <1% chrysotile	Fair	~ 22 fittings (visible)
			KHW-50	Wrap - ND Insulation - 2% amosite		
KHX	MISC-NF-II Window glazing	Window exteriors throughout the building	KHX-51	ND	Fair	N/A
			KHX-52	ND		
KHY	TSI-F Boiler flue insulation	Boiler Room - 1st Floor	KHY-54	Wrap - ND Insulation - 15% amosite, 2% chrysotile	Good	~ 50 cubic feet
			KHY-55	Wrap - ND Insulation - 15% amosite, 2% chrysotile		

Inspector: Jonathan Borntrager (NC 12085)
Sampling Date: March 28, 2002

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SURF = Surfacing material
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APPENDIX

S&ME

9751 Southern Pine Boulevard
Charlotte, NC 28273
704-523-4726 Fax 704-523-3953
NVLAP ID 102075-0

POLARIZED LIGHT MICROSCOPY
Performed by EPA 600/R-93/116 Method

Asbestos Analysis Summary

Client Name Charlotte Branch

9751 Southern Pine Blvd.
Charlotte
NC 29273

Client Job UNCW Klng Hall

Job Number 1355-02-251

Date Received 4/1/02
Date Analyzed 4/4/02

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4304A	KH-A-01	BLACK FIBROUS	ROOF	ND	10 GLASS	90 OTHER
02-4304B	KH-A-01	GREY FIBROUS	INSULATION	ND	98 CELLULOSE	2 PERLITE
02-4305A	KH-A-02	BLACK FIBROUS	ROOF	ND	10 GLASS	90 OTHER
02-4305B	KH-A-02	GREY FIBROUS	INSULATION	ND	98 CELLULOSE	2 PERLITE

Analyzed by: Jane Wasilewski

Jane Wasilewski
Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4306	KH-B-03	BLACK/SILVER FIBROUS		ND	25 SYNTHETIC <1 GLASS	75 OTHER
02-4307	KH-B-04	BLACK/SILVER FIBROUS		2 CHRYSOTILE	15 SYNTHETIC 2 GLASS	81 OTHER
02-4308	KH-C-05	BLACK FIBROUS		ND	20 GLASS	80 OTHER
02-4309	KH-C-06	BLACK FIBROUS		ND	20 GLASS	80 OTHER
02-4310	KH-D-07	TAN FIBROUS		ND	15 CELLULOSE 2 GLASS	60 GYPSUM 23 OTHER
02-4311	KH-D-08	TAN FIBROUS		<1 CHRYSOTILE	35 CELLULOSE 2 GLASS	63 GYPSUM <1 OTHER
02-4312A	KH-E-09	WHITE NONFIBROUS	SMOOTH COAT	ND		100 OTHER

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Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4312B	KH-E-09	GREY GRANULAR	PLASTER	ND		100 OTHER
02-4313	KH-F-10	GREY FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	
02-4314A	KH-G-11	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4314B	KH-G-11	BLACK FIBROUS	MASTIC	3 CHRYSOTILE		97 OTHER
02-4315A	KH-G-12	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4315B	KH-G-12	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4316	KH-H-13	SILVER/GREY FIBROUS		ND	95 MINERAL WOOL 2 CELLULOSE	3 OTHER

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Laboratory Manager

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4317	KH-I-14	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4318	KH-I-15	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4319A	KH-J-16	GREY NONFIBROUS	TILE	ND		100 OTHER
02-4319B	KH-J-16	BLACK/YW FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4320	KH-K-17	GREYS FIBROUS		55 CHRYSOTILE	45 SYNTHETIC	
02-4321	KH-K-18	GREYS FIBROUS		20 CHRYSOTILE	40 GLASS 30 SYNTHETIC	10 OTHER
02-4322	KH-L-19	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4323	KH-M-20	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4324A	KH-G-21	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4324B	KH-G-21	BLACK FIBROUS	MASTIC 1	3 CHRYSOTILE		97 OTHER
02-4324C	KH-G-21	YELLOW NONFIBROUS	MASTIC 2	ND		100 OTHER
02-4325	KH-M-22	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4326	KH-N-23	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4327	KH-N-24	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4317	KH-I-14	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4318	KH-I-15	YW/BLK NONFIBROUS		2 CHRYSOTILE		98 OTHER
02-4319A	KH-J-16	GREY NONFIBROUS	TILE	ND		100 OTHER
02-4319B	KH-J-16	BLACK/YW FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4320	KH-K-17	GREYS FIBROUS		55 CHRYSOTILE	45 SYNTHETIC	
02-4321	KH-K-18	GREYS FIBROUS		20 CHRYSOTILE	40 GLASS 30 SYNTHETIC	10 OTHER
02-4322	KH-L-19	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	

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Job Number 1355-02-251

Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4323	KH-M-20	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4324A	KH-G-21	GREY NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4324B	KH-G-21	BLACK FIBROUS	MASTIC 1	3 CHRYSOTILE		97 OTHER
02-4324C	KH-G-21	YELLOW NONFIBROUS	MASTIC 2	ND		100 OTHER
02-4325	KH-M-22	GREY FIBROUS		ND	100 MINERAL WOOL	<1 OTHER
02-4326	KH-N-23	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4327	KH-N-24	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4328A	KH-O-25	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4328B	KH-O-25	GREY FIBROUS	INSULATION	2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4329A	KH-O-26	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4329B	KH-O-26	GREY FIBROUS	INSULATION	2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4330	KH-O-27	GREY FIBROUS		2 AMOSITE	35 MINERAL WOOL	63 OTHER
02-4331	KH-L-28	TAN FIBROUS		ND	75 MINERAL WOOL 25 CELLULOSE	
02-4332A	KH-P-29	GREY FIBROUS	WRAP 1	ND	100 CELLULOSE	<1 PAINT

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4332B	KH-P-29	BLACK FIBROUS	WRAP 2	4 CHRYSOTILE	35 GLASS	61 OTHER
02-4332C	KH-P-29	GREY/YELLOW FIBROUS	INSULATION	2 AMOSITE	55 MINERAL WOOL	43 OTHER
02-4333A	KH-P-30	GREY FIBROUS	WRAP 1	ND	100 CELLULOSE	<1 PAINT
02-4333B	KH-P-30	BLACK/SILVER FIBROUS	WRAP 2	3	40 GLASS 20 CELLULOSE	37 OTHER
02-4333C	KH-P-30	GREY/YELLOW FIBROUS	INSULATION	<1 AMOSITE	75 MINERAL WOOL	25 OTHER
02-4334A	KH-P-31	BEIGE FIBROUS	WRAP	ND	100 CELLULOSE	
02-4334B	KH-P-31	GREY/YELLOW FIBROUS	INSULATION	2 AMOSITE	55 MINERAL WOOL	43 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4335	KH-E-32	WHITE NONFIBROUS		ND		100 OTHER
02-4336A	KH-R-33	TAN NONFIBROUS	TILE	2 CHRYSOTILE		98 OTHER
02-4336B	KH-R-33	BLACK FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4337A	KH-Q-34	GREY NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4337B	KH-Q-34	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4338A	KH-S-35	GREY NONFIBROUS	TILE	4 CHRYSOTILE		96 OTHER
02-4338B	KH-S-35	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4339A	KH-S-36	GREY NONFIBROUS	TILE	4 CHRYSOTILE		96 OTHER
02-4339B	KH-S-36	BLACK NONFIBROUS	MASTIC	<1 CHRYSOTILE		100 OTHER
02-4340A	KH-Q-37	GREY NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4340B	KH-Q-37	BLACK FIBROUS	MASTIC	2 CHRYSOTILE		98 OTHER
02-4341	KH-H-38	GREY FIBROUS		ND	96 MINERAL WOOL 2 CELLULOSE	2 OTHER
02-4342A	KH-Q-39	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4342B	KH-Q-39	YELLOW NONFIBROUS	MASTIC	ND		100 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4343	KH-T-40	GREY FIBROUS		ND	40 MINERAL WOOL 30 CELLULOSE	30 PERLITE
02-4344	KH-T-41	GREY FIBROUS		ND	40 MINERAL WOOL 30 CELLULOSE	30 PERLITE
02-4345	KH-R-42	GREY NONFIBROUS	TILE (ONLY)	ND		100 OTHER
02-4346A	KH-U-43	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4346B	KH-U-43	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER
02-4347A	KH-U-44	BEIGE NONFIBROUS	TILE	3 CHRYSOTILE		97 OTHER
02-4347B	KH-U-44	BLACK FIBROUS	MASTIC	4 CHRYSOTILE		96 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4348	KH-F-45	GREY FIBROUS		ND	80 MINERAL WOOL 20 CELLULOSE	<1 PERLITE
02-4349	KH-V-46	TAN FIBROUS		<1 CHRYSOTILE	25 CELLULOSE	75 OTHER
02-4350	KH-V-47	TAN FIBROUS		ND	75 CELLULOSE <1 GLASS	25 OTHER <1 GYPSUM
02-4351A	KH-J-48	BEIGE NONFIBROUS	TILE	ND		100 OTHER
02-4351B	KH-J-48	YW/BLK NONFIBROUS	MASTIC	<1 CHRYSOTILE		100 OTHER
02-4352A	KH-W-49	GREY FIBROUS	WRAP	ND	100 CELLULOSE	
02-4352B	KH-W-49	GREY FIBROUS	INSULATION	2 AMOSITE <1 CHRYSOTILE	40 MINERAL WOOL	58 OTHER

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4353A	KH-W-50	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4353B	KH-W-50	GREY FIBROUS	INSULATION	2 AMOSITE	40 MINERAL WOOL	58 OTHER
02-4354	KH-X-51	BEIGE NONFIBROUS		ND		100 OTHER
02-4355	KH-X-52	BEIGE NONFIBROUS		ND		100 OTHER
02-4356A	KH-P-53	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4356B	KH-P-53	GREY FIBROUS	INSULATION	2 AMOSITE	40 MINERAL WOOL	58 OTHER
02-4357A	KH-Y-54	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT

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Laboratory ID:	*Sample #:*	*Appearance*	*Comments*	*Total Asbestos %/Type*	*Non-Asbestos Fibrous %/Type*	*Non-Fibrous %/Type*
02-4357B	KH-Y-54	GREY FIBROUS	INSULATION	15 AMOSITE 2 CHRYSOTILE	5 MINERAL WOOL	78 OTHER
02-4358A	KH-Y-55	GREY FIBROUS	WRAP	ND	100 CELLULOSE	<1 PAINT
02-4358B	KH-Y-55	GREY FIBROUS	INSULATION	15 AMOSITE 2 CHRYSOTILE	5 MINERAL WOOL	78 OTHER

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the Contract documents apply to this Section.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash or ground granulated blast-furnace slag, subject to compliance with requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Fiber reinforcement.
5. Curing compounds.
6. Bonding agents.
7. Adhesives.
8. Joint-filler strips.
9. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. Preinstallation Conference: Conduct conference at Project site.

1. After submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Special inspector.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, slab joints, joint-filler strips, forms and form removal limitations, vapor-barrier installation, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed (weldable).

C. Plain-Steel Wire: ASTM A 82, galvanized.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire or plastic according to CRSI's "Manual of Standard Practice," as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. Concrete bricks are not permitted for support of reinforcing bars or welded wire fabric.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, II or I/II. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Self-Consolidating, High Range: ASTM C494, Type A and Type F.

7. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
8. Shrinkage reducing and compensating admixture: ASTM C494, Type S

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, non-dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.6 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Reglets: Fabricate reglets of not less than 0.022-inch thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Limit percentage by weight of cementitious materials, other than portland cement, in concrete as follows:
1. Fly Ash: 20 percent.
2. Ground Granulated Blast-Furnace Slag: 20 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

E. Air Content: Exposed exterior concrete shall have air-entraining admixture added at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6% within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:

F. Do not air entrain normal weight concrete for trowel-finished interior floor slabs, and do not allow entrapped air content to exceed 3 percent.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: As indicated.
2. Slump Limit: 5 inches, plus or minus 1 inch.
3. Maximum water/cement ratio:0.50.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.2 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas every 10' OC in each direction. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.3 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of reinforcement embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.4 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17 (F(L) not required at elevated slab).
    b. At slabs supporting cells, specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 24.
    c. At areas receiving a polished concrete floor finish, specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 40; and of levelness, F(L) 24.

3.5 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
    1. Coordinate sizes and locations of concrete bases with actual equipment provided

3.6 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
    1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
        a. Water.
        b. Continuous water-fog spray.
        c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
    2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped

at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.7 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions, and as indicated.
   1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.8 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching

mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd, plus one set for each additional 50 cu. yd. or fraction thereof.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143; one test at point of placement for each composite sample. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31.
    a. Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days and one set of three specimens at 28 days. Hold one specimen in reserve for 56 day test.
    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 042000
UNIT MASONRY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ACI SP-66 - ACI Detailing Manual 2004.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.

D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2022.

E. ASTM C91/C91M - Standard Specification for Masonry Cement 2023.

F. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.

G. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) 2022.

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019a, with Editorial Revision.

I. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.

J. ASTM C476 - Standard Specification for Grout for Masonry 2022.

K. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete 2019, with Editorial Revision (2022).

L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.

M. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover 2008a (Reapproved 2019).

N. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.

O. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.

P. BIA Technical Notes No. 20 - Cleaning Brickwork 2018.

Q. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.

R. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.

S. NCMA TEK 08-04A - Cleaning Concrete Masonry 2005.

T. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2022.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project site one week before starting work of this section; require attendance by all relevant installers.

1.03 SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories, for each type of masonry.

1. Provide elevations indicating steel reinforcing bar locations; provide details of reinforcing including bends and cross-sections, in accordance with ACI SP-66.
2. Provide flashing details indicating corners, end dams, and other special conditions.

C. Material Certificates and Test Reports: Provide manufacturer's certificates and test reports for the following:
   1. Mortar and Grout Mixes: Provide description and proportion of materials for each type of mortar and grout.
   2. Provide material certificates for each type of metal accessory, including reinforcing bars, joint reinforcement, veneer ties and anchors, and other indicated accessories, indicating compliance with requirements.

D. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Comply with provisions of ACI 530.1/ASCE 6/TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Source Limitations for Mortar: Provide each mortar mix from a single manufacturer, sourced through a single supplier. Each required mortar mix shall maintain consistency of each component, including cementitious materials and aggregate, to provide consistent color and texture fr all product required on the entire project. The approved mockup/sample panel shall be used to determine acceptable color and texture range.

1.05 FIELD CONDITIONS

A. Cold- and Hot-Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 BRICK UNITS

A. Existing Brick: Salvage existing brick in locations where new windows are indicated, to the greatest extent possible, for toothing in at new jambs and for new lintel work.
   1. Coordinate with Section 017000 - Execution and Closeout Requirements for cutting and patching of masonry and with Section 024100 - Demolition for salvage of existing materials.
   2. If an adequate amount of existing brick can not be salvaged and cleaned of existing mortar, the Contractor shall supplement with new brick to match existing. Coordinate with Architect to determine an acceptable color and texture match to existing.

B. Facing Brick: ASTM C216, Type FBS or FBX, Grade SW.
   1. Special Shapes: Molded units (plant-fabricated) as required by conditions indicated, unless standard units can be sawn to produce equivalent effect. Cut or sawn edges shall not be exposed in the finished work.
   2. Efflorescence: Provide brick that has been tested per ASTM C 67 and received a rating of "not effloresced."

2.02 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M.
   1. Colored Mortar: Premixed cement as required to match Architect's color sample.
   2. Available Products:
      a. Argos USA; Magnolia Masonry Cement.

b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
c. Lehigh Hanson; flamingo Colored Cement.
d. Roanoke Cement; a division of Titan America; Colored Masonry Cement.
e. York Building Products, a Stewart Company; Workrite Colored Masonry Cement.

B. Mortar Aggregate: ASTM C144.

C. Grout Aggregate: ASTM C404.

D. Water: Clean and potable.

E. Accelerating Admixture: ASTM C494/C494M, Type C; nonchloride, noncorrosive type for use in cold weather; approved by manufacturer for use in masonry mortar.

2.03 REINFORCEMENT AND ANCHORAGE

A. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B. Provide at masonry veneer walls with metal framing backup. At cavity walls with CMU backup and masonry veneer, masonry veneer anchors may be used in conjunction with standard horizontal joint reinforcing, at Contractor's option, in lieu of adjustable multiple wythe joint reinforcement.
1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
a. Size wire ties to extend at least halfway through veneer wythe, but provide not less than 5/8 inch of mortar coverage from masonry face.
3. Vertical adjustment: Not less than 3-1/2 inches.

B. Metal-to-Metal Fasteners (for Steel Studs): Self-drilling, self-tapping #10 hex screws; fabricated of either 304 stainless steel or of steel with corrosion resistant polymer coating tested to ASTM B117. Fasteners shall include integral neoprene or EPDM washer.
1. Manufacturers:
a. ELCO Construction Products; Dril-Flex with Stalgard Finish.
b. Heckmann Building Products; #668 TEK Self-Drilling Steel Stud Screw.
c. ITW Commercial Construction North America; Teks Maxiseal with Climaseal Finish, or Scots Long Life Teks (stainless steel).

2.04 FLASHINGS

A. Combination Nonasphaltic Flashing Materials - Copper:
1. Copper/Polymer Film or Fabric Flashing: 5 oz/sq ft copper sheet laminated between two sheets of polymer film. Minimum Puncture Resistance of 780 psi, when measured in accordance with ASTM E154/E154M.
a. Available Products:
1) Advanced Building Products, Inc.; Copper Sealtite 2000.
2) Hohmann & Barnard, Inc; Copper-Fabric NA.
3) STS Coatings, Inc.; Wall Guardian Copper TWF.
4) York Manufacturing, Inc; Multi-Flash 500 Series.

B. Factory-Fabricated Flashing Corners and End Dams: Stainless steel.

C. Termination Bars: One-inch wide, fabricated of 0.125-inch PVC, 0.090-inch extruded aluminum, or 0.075-inch stainless steel; compatible with membrane and adhesives.

D. Drip Edge: Copper; angled drip with hemmed edge; compatible with membrane and adhesives.

E. Flashing Sealant/Adhesive/Liquid Seam Tape: Polyether-based, 100% solids, moisture-curing elastomeric products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates; and that are compatible with asphalt-free flashing materials and air barrier materials. Traditional mastic is not acceptable.
   1. Available Products:
      a. Master Builders Solutions; MasterSeal NP150.
      b. STS Coatings; GreatSeal LT-100 Liquid Tape.
      c. York; UniverSeal US-100 Liquid Tape.

2.05 ACCESSORIES

A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.

B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations. Provide in depth matching cavity depth without gap at front or back of mesh. Fabricate approximately 10 inches high with minimum 6 inch high dovetail shape projections.
      a. Available Products:
         1) Advanced Building Products, Inc; Mortar Break DT.
         2) Heckmann Building Products; WallDefender.
         3) Hohmann & Barnard, Inc.; Mortar Trap.
         4) Mortar Net Solutions; MortarNet.
         5) Wire-Bond; Cavity Net DT (3611D).

C. Weeps/Cavity Vents:
   1. Cellular Type: Extruded propylene with honeycomb design.
      a. Color(s): To be selected by Architect from manufacturer's full range.
      b. Available Products:
         1) Advanced Building Products, Inc.; Mortar Break weep mesh.
         2) Blok-Lok Limited; Cell-Vent.
         3) CavClear/Archovations, Inc.; CavClear Weep Vent.
         4) Heckmann Building Products Inc.; No. 85 Cell Vent.
         5) Hohmann & Barnard, Inc.; Quadro-Vent.
         6) Mortar Net Solutions; WeepVent.
         7) Wire-Bond; Cell Vent.

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

2.06 LINTELS

A. Masonry Lintels: Fabricated of bond beam CMUs, with texture matching adjacent standard CMU. Provide reinforcing bars and grout in accordance with structural requirements. Provide temporary supports until cured.

B. Precast Concrete Lintels: Comply with structural requirements for concrete strength and reinforcing. Precast U-lintels fabricated in accordance with performance standards of PCI MNL-116 with 3500 psi concrete for standard lintels and 6000 psi concrete for prestressed lintels as manufactured by Cast-Crete are acceptable in lieu of rectangular section lintels.

C. Steel Lintels: Refer to Section 055000 - Metal Fabrications.

2.07 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Exterior, loadbearing and non-loadbearing, and interior, loadbearing and non-loadbearing: Type N, except as indicated above.
      a. Interior, non-loadbearing masonry may use Type O at Contractor's option.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.
   1. Use colored mortar for all veneer masonry. Separate colors shall be required for each type and color of veneer.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. For installation in cold or hot weather, comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
   1. Brick Coursing: Either two or three units with accompanying mortar joints shall equal 8 inches, based on basis-of-design brick size(s) indicated above.

C. Provide running bond for all masonry units unless otherwise indicated.

D. Tool all mortar joints slightly concave where they will be exposed, unless otherwise indicated.
   1. Provide flush joints where they will be concealed by surface-applied treatments or finishes other than paint; including but not limited to tile, wall coverings, fluid-applied or SPF air barriers, or membranes.

3.05 PLACING AND BONDING

A. Remove broken, cracked, chipped, or otherwise damaged masonry units from pallets and set aside. Do not use unless they may be field cut to remove damaged section, for installation where special shape is required to fit construction.

B. Create a consistent blend for each type of veneer masonry by mixing units from a minimum of three pallets.

C. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

D. Lay hollow masonry units with face shell bedding on head and bed joints.

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

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

1. Do not cut masonry unless it is required for certain shapes, such as rowlock sills, or unless it is unavoidable due to fitting around other construction, such as wall penetrations.
2. Cut masonry edges shall not be visible in the final work. Where special shapes are required that would expose cut edges, they shall be plant-fabricated.

H. Jack Arch: Coordinate installation with BIA Tech Note 31. Maintain uniform mortar joint widths. Cut adjacent horizontal brick that abuts keyed sets cleanly to match skewback as condition requires, and to maintain a consistent mortar joint. Match existing lintel conditions at adjacent existing windows.

1. Provide flashings and end dams at keyed sets in accordance with BIA standard.

3.06 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels.

3.07 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry and/or Metal Framing Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.09 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

1. Remove or cover protrusions or sharp edges that could puncture flashings.
2. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:

1. Anchor vertical leg of flashing into backing with a termination bar and sealant.

C. Extend metal flashings to within 1/2 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
   1. Notch and hem exterior corners of drip edges to eliminate sharp, exposed cut metal edges at locations below 6' - 0" above grade.

D. Support flexible flashings across gaps and openings.

E. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.10 LINTELS

A. Comply with requirements on Structural Drawings for type of lintel at each opening, additional lintel sizing, reinforcement, and installation requirements.

B. Install loose steel over openings, where indicated.

C. Maintain minimum 8 inch bearing on each side of opening, unless otherwise indicated.

3.11 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

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

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

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.12 FIELD QUALITY CONTROL

A. Field Testing: The Owner shall engage an independent testing agency to perform field quality control tests, as specified in Section 014000 - Quality Requirements. For each type of masonry unit, 5 randomly chosen units shall be sampled for each 5,000 square feet of wall.
   1. Mortar Tests: Testing agency shall test each type of mortar in accordance with ASTM C780. Mortar shall be tested on each of the first 3 days. Alert testing agency if mortar mix is altered during construction to allow for retesting.

3.13 REPAIR AND CLEANING

A. Remove masonry units that have become damaged or stained, or that do not display acceptable blend of color and texture matching mockup/sample panel. Remove as whole units, do not cut. Replace with new units with fresh mortar joints.

B. Remove excess mortar and mortar droppings.

C. Replace defective mortar and repoint. Enlarge holes or voids at defective mortar, and remove enough adjacent mortar to allow for repointing. Install fresh mortar joint and match to adjacent work.

D. Where expansion/control joints and sealant joints are indicated, clean joints and leave them clear and ready for installation of joint or sealant materials.

E. Clean concrete masonry in accordance with NCMA TEK 08-04A and clean clay masonry in accordance with BIA Technical Notes No. 20. Use hand cleaning/bucket-and-brush methods.

F. To prevent freezing of cleaners and rinse water, do not clean when masonry surface temperature will drop below 40 degrees F.

G. Test cleaning methods and materials on one half of mockup/sample panel; leave the other half uncleaned. Obtain approval of Architect before cleaning the finished work.

H. Protect adjacent non-masonry surfaces from cleaning materials and processes with temporary sheeting or masking.

I. Provide "in-progress" cleaning; clean masonry in each area as soon as possible after mortar has fully cured (approximately 7 to 28 days; coordinate with manufacturer's recommendations for each mortar type specified). Field test a small area to ensure mortar curing is complete prior to large-scale cleaning.

J. Pre-wet masonry surfaces and clean with specified cleaning solution. Rinse surfaces immediately after cleaning; do not allow cleaning solution to dry or set into the masonry.

K. Use non-metallic tools in cleaning operations.

L. Final Cleaning: As part of Project Closeout (prior to Owner's Final Inspection), provide Final Cleaning of masonry veneer. Remove construction dust with a very low pressure rinse. Perform a visual inspection and spot clean to remove efflorescence, staining, or organic growth, in accordance with recommendations of BIA and NCMA technical notes.

3.14 PROTECTION

A. Provide permanent protection board at face of masonry that will be in contact with below grade backfill soils. Trim protection board just below finish grade level. Install prior to Division 32 backfill in accordance with manufacturer's instructions.

B. Provide temporary protective waterproof sheet coverings over tops of walls, parapets, sills, and other horizontal projections as the work progresses, in accordance with FIELD CONDITIONS article in Part 1 above.

C. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

D. Provide protective vertical boards and horizontal sheeting at grade level base of walls to prevent staining or splashing from rain, mud, or mortar droppings.

3.15 MASONRY WASTE

A. Fill Material: Clean masonry waste may be used as fill material. Break up masonry waste into small pieces no greater than 4 inches any direction. Mix with Division 31 engineered fill material so that masonry waste is no more than 33% of the fill (1 part masonry waste, 2 parts engineered fill). Fill containing masonry waste shall be at least 18 inches below grade level.

1. Excess waste shall be removed and disposed of or recycled in accordance with Division 1 waste disposal requirements.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
   2. Grout.

B. Related Requirements:
   1. Division 05 Section "Metal Fabrications" miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at the Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment Drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
   5. Identify members and connections of the Seismic-Load-Resisting System.
   6. Indicate locations and dimensions of protected zones.

7. Identify demand critical welds.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Non-shrink grout.

F. Source quality-control reports.

G. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications:

1. Is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications:

1. A qualified installer who participates in the AISC Quality Certification Program, or
2. Contractor shall hire an independent inspector (not the Chapter 1 or 17 Special Inspector) to certify the Installer. This inspector shall be a Certified Welding Inspector (CWI) and shall be approved by the Architect prior to the start of construction. The Inspector shall observe:
   a. Machine calibration of all equipment used for the project. Including, but not limited to:
      1) Welding machines
      2) Rod ovens
      3) Bolt Tension Calibrator (Skidmore)
   b. Observe welder certifications and WPS's for all welders and for all types of welds involved with the project. Welders with incorrect or incomplete certifications shall be re-certified. No welder shall be allowed to perform welds on the project for which they are not certified.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by

AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using schematic details indicated and AISC 360.
   2. Use Allowable Stress Design; data are given at service-load level.

B. Recycled Content: Provide products with a minimum post-consumer recycled content of 75%.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992, Grade 50.

B. HSS Shapes: ASTM A 500, Grade B.

C. Channels, Angles-Shapes: ASTM A 36.

D. Plate and Bar: ASTM A 36.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53, Type E or Type S, Grade B.
   1. Weight Class: as indicated.

G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. Threaded Rods: ASTM A 36.
   1. Nuts: ASTM A 563 heavy-hex carbon steel.
   2. Washers: ASTM F 436, Type 1, hardened carbon steel.
   3. Finish: Plain.

2.4 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Comply with Division 9.

C. Primer: Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: ASTM A 780.

2.5 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. For Concealed Steel:
   a. SSPC-SP 2, "Hand Tool Cleaning."
   b. SSPC-SP 3, "Power Tool Cleaning."
2. For Exposed Steel:
   a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate where indicated.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E 164.
    d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09, Painting.

D. Touchup Priming: Cleaning and touchup priming are specified in Division 09, Painting.

END OF SECTION 051200

SECTION 054000
COLD-FORMED STEEL FRAMING - STRUCTURAL (CFSF-S)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 092216 - Cold Formed Steel Framing - Non-Structural (CFSF-NS). For non-load bearing studs.

1.02 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2020).

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

D. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).

F. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.04 SUBMITTALS

A. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations and accessories.

B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.

C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
   1. Indicate stud and ceiling joist layout.
   2. Describe method for securing studs to tracks and for bolted framing connections.
   3. Design data:
      a. Shop drawings signed and sealed by a professional structural engineer licensed in the state of which the project is located.
   4. Calculations for loadings and stresses of specially fabricated framing, signed and sealed by a professional structural engineer licensed in the state of which the project is located.
   5. Details and calculations for factory-made framing connectors, signed and sealed by a professional structural engineer licensed in the state of which the project is located.

D. Product test reports for steel sheet, Power-actuated anchors, mechanical fasteners, vertical deflection clips, and miscellaneous structural clips and accessories.

E. Designer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

1.06 DELIVERY, STORAGE AND HANDLING

A. Protect cold-formed steel framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed steel framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
   1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
   2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
   3. Design Loads: As indicated on the drawings.
   4. Framing shall be designed to resist design loads with deflections not greater than the followings:
      a. Ceiling Joist framing shall have a vertical deflection not greater than L/240 for total load and L/360 for live loads.

2.02 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
   1. Stud: 1 5/8 inch flange width; load bearing - 0.0428 in (18 gage) minimum and non-load bearing - 0.0329 inch (20 gage).
   2. Track: 1 1/4 inch flange width; thickness to match stud thickness.
   3. Galvanized in accordance with ASTM A653/A653M, G60/Z180 coating.

B. Joists and Purlins: Fabricated from ASTM A653/A653M steel sheet, with G60/Z180 hot dipped galvanized coating.
   1. Base Metal: Structural Steel (SS), Grade 33/230.
   2. Flange width of 1 5/8 inches, with depths as indicated on plans.
   3. Gauge: As required to meet specified performance levels.

C. Framing Connectors: Factory-made, formed steel sheet.
   1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.

2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.03 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1/D1.1M.

2.04 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.

C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type II - Organic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF JOISTS AND PURLINS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at a maximum of 24 inches on center; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.

D. Set ceiling joists parallel and level, with lateral bracing and bridging.

E. Locate joist end bearing directly over load-bearing studs or provide load distributing member to top of stud track.

F. Provide web stiffeners at reaction points.

G. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION 054000

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.

F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2022).

K. AWS D1.2/D1.2M - Structural Welding Code - Aluminum 2014, with Errata (2020).

L. NAAMM MBG 531 - Metal Bar Grating Manual 2017.

M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic) 2019.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product data for factory fabricated products and accessory materials, including the following:
   1. Stair nosings.
   2. Nonslip finishes.
   3. Nonshrink grout.
   4. Shop primer paint products.
      a. Coordinate with Division 9 Painting topcoat manufacturer and provide compatibility certificates from topcoat manufacturer that shop primers are acceptable substrate for specified topcoats.

C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Include field measurements, and indicate where field measurements differ from documents.

D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.03 QUALITY ASSURANCE

A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.

B. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Slotted Channel Fittings: ASTM A1011/A1011M.

F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

1. Provide stainless steel fasteners for all exterior construction and for fastening aluminum and stainless steel fabrications.
2. Provide stainless steel fasteners at areas subject to moisture or steam, including mechanical rooms, janitor/custodial rooms with floor sinks, and similar spaces.
3. Provide zinc-plated fasteners for interior construction except where stainless steel is indicated.

G. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: SSPC-Paint 15, universal shop primer, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

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

B. Fabricate items with joints tightly fitted and secured.

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

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking and masonry; prime paint finish.

B. Lintels: As detailed; prime paint finish.

C. Door Frames for Overhead Door Openings and Wall Openings: Channel or bent plate sections; prime paint finish.

D. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

E. Bar Gratings: NAAMM MBG 531, Welded or Pressure-Locked Type.
   1. Elevator Sump Grating: Removable; minimum 1-inch high by 1/8-inch thick galvanized bearing bar, spaced approximately 1-1/8-inch o.c. Manufacturer's standard galvanized cross rod or bar, spaced approximately 4 inches o.c.
   2. Provide welded frames for bar gratings, fabricated of galvanized steel shapes, with integral anchors/lugs for casting into concrete.

F. Miscellaneous Steel Shapes: Provide steel shapes for miscellaneous applications indicated on drawings, including but not limited to, reinforcing steel shapes at low partitions/knee walls and concrete slab edge angles.

2.04 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize and do not prime items to be embedded in concrete and items to be embedded in masonry. Do not prime items to be embedded in sprayed fireproofing.

B. Prepare interior items to be primed in accordance with SSPC-SP3 Power Tool Cleaning.

C. Prepare exterior items to be primed, and interior items to receive specialty protective coating such as zinc-rich primer, in accordance with SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.

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

E. Prime Painting: One coat.

F. Galvanizing: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

2.05 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

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

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

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

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055000

SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.

D. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.

E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.

F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.

G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2021.

H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 2004.

1.02 SUBMITTALS

A. Product Data: Provide manufacturer's product data for pipe and tube railings.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
2. Design Data: Include delegated-design shop drawings, including structural calculations and details for loadings and stresses, and anchors and connections.
3. Include the design engineer's seal and signature on each sheet of shop drawings.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.

D. Designer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Indoor Emissions: For each type of paint and coating, comply with the emissions requirements of California Department of Public Health (CDPH); "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers."

D. VOC Content: For each type of paint and coating, comply with VOC content restrictions as required by 40 CFR 59, Subpart D (EPA's "National Volatile Organic Compound Emission Standards for Architectural Coatings").

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Allow for expansion and contraction of members and building movement without damage to connections or members.

E. Dimensions: See drawings for configurations and heights.

F. Provide brackets, flanges, anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete or solid masonry, provide brackets anchored with drilled in expansion shields and hanger or lag bolts.
2. For anchorage to hollow masonry, provide brackets anchored with toggle bolts.
3. For anchorage to stud walls, provide brackets anchored with hanger or lag bolts to fire-retardant-treated wood blocking, or with toggle bolts to steel reinforcing backing plates.
    a. Coordinate anchorage locations with Division 6 "Rough Carpentry" and / or Division 9 "Cold-Formed Steel Framing - Non-Structural (CFSF-NS)" to provide blocking or backing plates in framed walls, as applicable.

G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, galvanized finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: No exposed bolts or screws.

E. Galvanizing: In accordance with requirements of ASTM A123/A123M.

F. Shop and Touch-Up Primer: SSPC-Paint 15 or MPI #79, compatible with topcoat indicated in Division 9 Section "Painting," complying with VOC limitations of authorities having jurisdiction.

1. At exterior and galvanized surfaces, provide zinc-rich primer; SSPC-Paint 20 or MPI #20, compatible with topcoat, and VOC-compliant.

G. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.

1. Grout: Comply with ASTM C1107/C1107M.

2.03 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

D. Welded Joints:

1. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
2. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

SECTION 061000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

C. AWPA U1 - Use Category System: User Specification for Treated Wood 2022.

D. PS 1 - Structural Plywood 2019.

E. PS 20 - American Softwood Lumber Standard 2021.

F. SPIB (GR) - Standard Grading Rules 2021.

1.02 SUBMITTALS

A. Product Data: Provide technical data on fire-retardant materials, wood preservative materials and application instructions.

B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Southern Pine, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.

2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 25 or less, when tested in accordance with ASTM E84 (Class A - UL FR-S).

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Provide hot-dipped galvanized steel complying with ASTM A 153 or stainless steel at exterior, high humidity, and preservative-treated wood locations.
      a. Fasteners at interior FRT shall be per FRT treatment manufacturer's recommendations.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Provide FRT lumber and plywood stamped with name and mark of qualified testing agency, fire-retardant treatment product and manufacturer, wood species and drying method, testing standards, and flame spread and smoke development indices.
      a. For exterior FRT and FRT that will be exposed to moisture, include accelerated weathering test language, with the words "No increase in the listed classification when subjected to Standard Rain Test ASTM D 2898".
   2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat exterior rough carpentry items associated with roof construction, concealed blocking, and as indicated on Drawings.
      c. Do not use treated wood in direct contact with the ground.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 and maximum smoke developed index of 450, when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

b. Treat interior concealed blocking, plywood backing panels, and other rough carpentry items as indicated.
c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

3. Strength Adjustments (Structural Panels/Plywood): Test FRT structural panels/plywood per ASTM D 5516 and develop strength adjustment factors per ASTM D 6305.
4. Strength Adjustments (Lumber): Test FRT lumber per ASTM D 5664 and develop strength adjustment factors per ASTM D 6841.

C. Preservative Treatment:
1. Restrictions: Do not use lumber or plywood treated with chromated copper arsenate (CCA). Do not use lumber or plywood treated with inorganic boron (SBX) for applications exposed to water, ground/soil contact, or interior floor slabs/concrete. Comply with additional treatment restrictions as required by local authorities having jurisdiction.
2. Preservative Pressure Treatment of Lumber & Plywood Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
a. Use Category UC2 is acceptable for interior lumber and plywood above grade (not in contact with floor slab).
b. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
c. Treat lumber exposed to weather.
d. Treat lumber in contact with roofing, flashing, or waterproofing.
e. Treat lumber in contact with masonry or concrete.
f. Treat lumber less than 18 inches above grade, and lumber located directly against below-grade exterior walls.
g. Treat lumber in other locations as indicated.
3. Preservative Pressure Treatment of Lumber in Contact with Ground/Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In metal-framed walls, provide continuous FRT blocking around door and window openings for anchorage of frames, securely attached to stud framing.

C. In metal-framed walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of

support is explicitly indicated.

D. Where PPT blocking is indicated to be installed directly adjacent to metal decking or other galvanized metals, provide flexible flashing/separation material as a continuous barrier to prevent direct contact between materials.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.05 INSTALLATION OF CONSTRUCTION PANELS

A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.06 CLEANING

A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, and shims for installing woodwork items unless concealed within other construction before woodwork installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
   1. Include data for adhesives.
   2. Wood-Preservative Treatment:
      a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
      b. Indicate type of preservative used and net amount of preservative retained.
      c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
   3. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of furring and blocking, including blocking and reinforcement concealed by construction and specified in other Sections.
   2. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.

C. Samples for Initial Selection:
   1. Shop-applied transparent finishes.
   2. Plastic laminates.
   3. PVC edge material.
   4. Solid-surfacing materials.

1.4 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance License: Provide license showing proof of certification in AWI Quality Certification Program.

B. Qualification Data: For woodwork manufacturer/fabricator and Installer.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Woodwork Quality Standard Certificate: Provide AWI Quality Certification Program "Certificate of Compliance" indicating that woodwork, including installation, complies with requirements of grades specified.

1.6 QUALITY ASSURANCE

A. Fabricator's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Fabricator's Certification: Licensed participant in AWI's Quality Certification Program.
   2. Installer Qualifications: Fabricator of products and licensed participant in AWI's Quality Certification Program.

B. Quality Standard: Unless otherwise indicated, comply with "Architectural Woodwork Standards – Edition Two," October 2014 (AWS), published jointly by Architectural Woodwork Institute (AWI), Woodwork Institute (WI), and Architectural Woodwork Manufacturer's Association of Canada (AWMAC) for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

C. Accessibility Requirements: Where casework is indicated to comply with accessibility requirements, comply with the Department of Justice ADA Standards for Accessible Design and ICC/ANSI A117.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
   1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: **White oak, rift sawn or cut**

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no added urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2.
4. Softwood Plywood: DOC PS 1.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1**,** made with adhesive containing no urea formaldehyde.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
   a. Formica Group, Div. of Fletcher Building.
   b. Panolam Industries International Inc.; Nevamar Div.
   c. Panolam Industries International Inc.; Pionite Div.
   d. Wilsonart LLC.

F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. E. I. du Pont de Nemours and Company; "Corian."
   b. Formica Group, Div. of Fletcher Building; "Solid Surfacing."
   c. Hanwha L&C; "Hanex."

d. LG Hausys America; "HI-MACS."
e. Lotte Advanced Materials Co., Ltd.; "Staron."
f. Wilsonart LLC; "Solid Surface."

2. Type: Standard type, unless Special Purpose type is indicated.
3. Thickness: 1/2-inch (13 mm).
4. Colors and Patterns: **As selected by Architect from manufacturer's full range**.

G. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 0.5 mm thick elsewhere.

H. General: Fire retardant treated floor platform and like structural framing, and blocking are specified in Division 6 Section "Rough Carpentry." Where such internal framing is included in the woodwork fabrications, use fire retardant treated material as indicated. No actual finish woodwork items (trim, casings, bases, casework panel and worked lumber components etc.) are fire retardant treated, unless otherwise indicated.

I. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.

1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

J. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:

1. Interior Type A: Low-hygroscopic formulation.
2. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
3. Kiln-dry materials before and after treatment to levels required for untreated materials.

2.3 MISCELLANEOUS MATERIALS

A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Steel Plates and Angles: ASTM A36, shop primed, (field paint in Division 9 Section "Paints"). (miscellaneous clips etc.)

D. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

E. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or as specified above for faces.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Grade: **Premium**

B. Wood Species and Cut: **Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated**.

1. Species: **White oak**
2. Cut: **Plain sliced/plain sawn**
3. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
4. For trim items wider than available lumber, use veneered construction. Do not glue for width.
5. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

E. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

F. Aluminum Millwork Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Products: Design is based on indicated profiles manufactured by Fry Reglet Corp. 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. Flannery, Inc.
    b. Fry Reglet Corp.
    c. Gordon, Inc.
    d. Pittcon Industries.
    e. Stockton Products.
3. Millwork Reveal and Trim Basis-of-Design Profiles: Profile series is indicated. Verify final model number required with profile depth to match wood paneling depth indicated.
    a. Straight Edge Reveal Channel: Model MWR.
    b. Reveal "F" Channel: Model MWRF.
    c. Straight Edge "L" Angle: Model MWRL.
    d. Inside Corner: Model MWRISC.
    e. Outside Corner: Model MWROSC.
    f. Reveal Base: Model MWRB.

g. Bar/Post Detail: Model MWP.
h. Bar/Post L-Shaped Termination: Model MWPT.
i. Bar/Post Outside Corner: Model MWPOSC.
j. Lighted Straight Edge Reveal Channel: LED-MWR.
k. Lighted Reveal "F" Channel: Model LED-MWRF.
l. Lighted Reveal Outside Corner: LED-MWROSC.

4. Trim Profile Characteristics: Provide the following trim types, where indicated. Provide profiles in depth required to match wood paneling depth indicated.
   a. Straight Edge Reveal Channel: 1/2-inch width reveals between millwork panels.
   b. Reveal "F" Channel: 1/2-inch width reveals where millwork is adjacent to a different material.
   c. Straight Edge "L" Angle: Straight edge at ends of millwork panels.
   d. Inside Corner: Straight edge with exposed metal profile at 90° inside corners.
   e. Outside Corner: Straight edge with exposed metal profile at 90° outside corners.
   f. Reveal Base: Metal base flange with L-angle to receive bottom edge of millwork. Exposed base height 4 inches.
   g. Bar/Post: Solid 1/4-inch bar/post between millwork panels.
   h. Bar/Post Termination: Solid 1/4-inch "L" shape termination where millwork is adjacent to other materials.
   i. Bar/Post Outside Corner: Solid 1/4-inch bar/post for use at 90° outside corners. Miter millwork panels to fit against post.
   j. Lighted Reveal Straight Edge Channel: Continuous 1/2-inch wide lighted reveal with integral LED light strip and frosted lens insert.
   k. Lighted Reveal "F" Channel: Continuous 1/2-inch wide lighted reveal with integral LED light strip and frosted lens insert, where millwork panels are adjacent to other materials.
   l. Lighted Reveal Outside Corner: Continuous 1/2-inch wide lighted reveal at 90° outside corners. Miter millwork panels to fit against reveal.
5. Accessories: Provide manufacturer's factory-fabricated intersection components, including custom fabrications as required for reveal layout indicated.
6. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
7. Electrical Requirements: Provide low-voltage control module, power supply dimmer switch, and all required accessories, including but not limited to flexible connectors and power feed, for connection to building power.
8. Finish: **Color anodic**
   a. Color: As selected by Architect from manufacturer's full range.

2.5 PLASTIC-LAMINATE CABINETS

A. Grade: Premium, except as noted for drawer construction

B. AWI Type of Cabinet Construction: Flush overlay
   1. Cabinet Body Construction:
      a. Tops and bottoms are glued and doweled to cabinet sides and internal cabinet components such as fixed horizontals, rails and verticals. Minimum 6 dowels each joint for 24 inch deep cabinets and a minimum of 4 dowels each joint for 12 inch deep cabinets.
         1) Tops, bottoms and sides of all cabinets are 3/4-inch thick particleboard core.

b. Cabinet Backs - Semi-exposed: Minimum 3/8-inch thick prefinished particleboard or 1/4-inch thick medium-density fiberboard fully captured four sides or 1/2-inch prefinished particleboard full overlay construction. Provide 3/4-inch x 4 inch anchor except where backs are ½-inch or thicker per AWI standard.

c. Provide either of the following types of base construction to support cabinet load transfer, isolate the cabinet ends from contact with floor, and permit leveling.

1) Separate Sub-base: Cabinet sub-base shall be separate and continuous (no cabinet body sides-to-floor), exterior grade plywood with concealed fastening to cabinet bottom. Sub-base shall be ladder-type construction of individual front, back, and intermediates, to form a secure and level platform to which cabinets attach. Recess sub-base at exposed cabinet end panels 1/4 inch from face of finished end, for flush installation of finished base material by other trades.

2) Integral Base: Provide end panels, cabinet bottoms, and horizontal toe kick members integrally joined together for structural strength and to facilitate load transfer directly through cabinet ends to the floor. Provide 1-3/8" x 3" x 3/8" thick injection molded, chemical resistant, polypropylene isolation supports factory-applied at the four corners of each toe base to prevent cabinets from contacting the floor. Internally-mount isolation supports to permit surface-application of continuous resilient base.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade VGS.
2. Vertical Surfaces: Grade VGS.
3. Cabinet Body and Shelf Edges: PVC tape, 0.5 mm (0.018-inch) minimum thickness, matching laminate in color, pattern, and finish.
4. Door and Drawer Front Edges: PVC edge banding, 3 mm (0.12-inch) thick, matching laminate in color, pattern, and finish. Provide "eased" edges and corners.

D. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS
   a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.5-mm) minimum thickness, matching laminate in color, pattern, and finish
   b. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
2. Drawer Sides and Backs: Per AWI standard for "Custom" Grade: 15/32-inch minimum, except provide 5/8-inch minimum at drawer boxes wider than 30 inches.
3. Drawer Bottoms: Match material used at drawer sides and backs, 15/32-inch minimum; or 1/4-inch thick thermally fused melamine clad medium-density fiberboard fully captured four sides.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Selected by Architect from laminate manufacturer's full range (standard and premium lines) of product in standard textured finish (textured gloss, fine textured or suede finish).

2.6 SOLID-SURFACING-MATERIAL COUNTERTOPS **AND WINDOW STOOLS**

A. Grade: Custom.

B. Solid-Surfacing-Material Thickness: 1/2-inch (13 mm)

C. Colors, Patterns, and Finishes: **As selected by Architect from manufacturer's full range**.

D. Fabricate tops **and stools** in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops **and stools** with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with loose backsplashes for field application.
3. **Fabricate window stools with loose apron trim, if indicated, for field application. Scribe stools to fit jambs as indicated.**

E. Edge Treatment: Same as solid-surfacing countertop

F. Install integral sink bowls in countertops in shop.

G. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.7 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware." Provide all hardware necessary for complete and functioning cabinets whether included in specification or not.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, **110** and **160** degrees of opening**, self-closing**. **Provide 160 degree opening hinges at ADA sink base cabinets.**

C. Back-Mounted Pulls: BHMA A156.9, B02011.

1. Wire Pulls: Back-mounted, stainless steel, 4 inches (100 mm) long, 5/16-inch (8 mm) in diameter.

D. Handle Locks: Lever style locking disk tumbler, chrome finish, CompX International Inc. C8754, CCL Security Products 1000 Series, Eastloc Engineering L101, or equivalent. Provide model, spindle length, and accessories to suit application.

E. Adjustable Shelf Standards and Supports: **BHMA A156.9, B04071; with shelf rests, B04081**

F. Drawer Slides: Powder-coated, self-closing, heavy-duty drawer slides, designed to prevent drawer rebound; with nylon-tired, ball-bearing rollers; and meeting BHMA A156.9, Type B05011 (bottom edge mount) or B05051 (side mount), and rated as follows:

1. Drawers except as noted: Minimum 100 lbf dynamic load rating at 50,000 cycles. Minimum 150 lb loading static edge load test rating for one minute duration on fully extended drawer. Provide standard (3/4) extension travel.

G. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty (Grade 1, Grade 2, and Grade 3): Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: 2.5-inch (75-mm) OD, black, molded-plastic grommets and matching removable plastic caps with slot for wire passage.
   1. Grommet Size: To suit nominal 2 1/2-inch diameter hole, 2 9/32-inch inside diameter and 5/8 inch deep.
   2. Cap Size: 3-inch overall diameter, with a cord slot 7/8-inch wide.

K. Wire Management: Extruded vinyl channel or trough shapes indicated. Black color and screw-mounting unless noted otherwise.
   1. J-shape wire manager for edge-of-counter mounting, where indicated. 1-inch wide channel, 1-1/2-inches high, with 7/16-inch slot at top for cables.
   2. Bulk wire manager for under counter applications, where indicated. Heavy wall 3 by 3-inch open top channel.
   3. Enclosed wire manager, where indicated. 2-1/8 inches high by 1-5/16 inches wide wire management channel with "hinged" front panel that snaps open and shut to insert and retain data cables.

L. Undercounter Utility Braces: Heavy-duty prefabricated steel braces for full cantilevered support of countertop from rear wall without reducing knee space. Provide braces designed to accommodate leveling cleats and passage of conduit and piping and complete with predrilled holes for screw fasteners.
   1. Load Capacity: 500 pounds minimum per pair at 16 inches o.c. as installed, and up to 1000 pounds per pair as fabricated. Install at 16 inches o.c. along full length of countertops unsupported by cabinetry unless indicated otherwise.
   2. Size: 21 inches x 28 inches minimum for standard 30-inch deep counter unless indicated otherwise. Provide smaller sizes suitable for smaller counters as approved.
   3. Finish: Factory finish baked enamel or primed and ready for field painting. Factory finish color as selected by Architect from manufacturer's full range.
   4. Available Products. Subject to compliance with requirements, provide one of the following products or approved equivalent:
      a. A & M Hardware, Inc.; "Standard Bracket."
      b. Best Brackets; "ADA Workstation Support Standard Steel Bracket."
      c. FastCap; "SpeedBrace."
      d. Lyman Associates; "Counter Top Supports."

M. Fixed L-Shelf Brackets: Fixed L-bracket for shelf depth indicated for minimum 500 lb. loading capacity per pair of brackets. Steel construction with enamel finish, color selected by Architect.
   1. Basic L Bracket:
   2. L Bracket with Strut:
      a. 12" deep x 8" height
      b. 16" deep x 10" height
      c. 20" deep x 13" height
      d. 22" deep x 14" height
   3. L Bracket w/ Strut: Federal Countertop Bracket by Federal Brace
      a. 8" x 8", 10, 12, 14, 16, 18, 20, 24

N. Seat Cushion: Custom seat cushion of base seat board, foam padding, and fabric.
   1. Seat Board: 3/8-inch laminated plywood.
   2. Foam Padding: 2" high density (firm) urethane-ether foam designed for seat cushions.

3. Fabric: Stain-resistant heavy weight upholstery fabric.
   a. Color and pattern as selected by Architect from full range of available fabrics. **Basis of Design Stinson Polygon Mariana.**

O. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
   2. Satin Stainless Steel: BHMA 630.

P. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

Q. Undersink Vinyl Basin Guard: Provide high impact vinyl acrylic molded undersink barrier panel for ADA compliant (wheelchair accessible) sink counters. Include minimum .090" formed panel and sidewall mounting pieces. Material shall have maximum flame spread of 15 when tested per ASTM E84. Color as selected by Architect from manufacturer's standards. Design standard is "Basin Guard" manufactured by Truebro, Inc.

2.8 FABRICATION

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

B. Sand wood lightly to remove raised grain on exposed surfaces before fabrication.

C. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.
   2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).

D. Unless indicated otherwise, where wood studs are indicated, provide nominal 2 x 4 wood stud framing at 16 inches (406 mm) on center.

E. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
   1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of openings in countertops with a coat of varnish.

2.9 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative materials.

B. Shop Priming: Shop apply the prime coat, including backpriming, if any, for items specified to be field finished. Refer to Division 9 painting Sections for material and application requirements.

2.10 SHOP FINISHING

A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation. Refer to Division 9 painting Sections for finishing opaque-finished architectural woodwork.

B. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.
2. Finish: System - 3, Lacquer, Post Catalyzed.
3. Finish: System - 5, Varnish, Conversion.
4. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Staining: Match approved sample for color
6. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
7. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
8. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter according to ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork. For shop-finished items, use filler matching finish of items being installed. For exposed fasteners in cabinets, provide cover caps matching adjacent color.

F. Standing and Running Trim:
   1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
   2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
   3. Scarf running joints and stagger in adjacent and related members.
   4. Fill gaps, if any, between top of base and wall with plastic wood filler; sand smooth; and finish same as wood base if finished.
   5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8-inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
   2. Maintain veneer sequence matching of cabinets with transparent finish.
   3. Resilient base at base cabinets (all exposed sides) is specified in Division 9 Section "Resilient Base and Accessories."
   4. For removable panels, provide zee clips. Arrange panel clearances to adjacent work to allow removal. At under-sink cabinetry access panels, provide steel cable retainer of a length that allows the removable panel to be set aside for clear service access, secured with tamper-resistant fasteners. Alternatively, provide a lock to secure the panel.
   5. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing or blocking or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish. Wall mounted hanger strips are not acceptable.
   6. Present keys to Owner's representative. Identify keys by room number and casework type. Obtain receipt from Owner and turn over to Construction Manager.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   2. Install countertops with no more than 1/8-inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.
4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

I. Window Stools: Anchor securely by approved concealed method underside of window stools.
1. Align adjacent solid-surfacing-material window stool sections of multi-piece stools and form seams to comply with manufacturer's written recommendations using adhesive in color to match stools. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install window stools with no more than 1/8-inch in 96-inch sag, bow, or other variation from a straight line.
3. Caulk space between window stools and both window unit and wall jambs with sealant specified in Division 7 Section "Joint Sealants."

3.3 REPAIR, ADJUSTING, AND TOUCHUP

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Adjust joinery for uniform appearance. Clean, lubricate, and adjust hardware.

D. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.
1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

E. Field Finish: See Division 09 Sections for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.4 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 064023

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

C. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C 2022.

1.02 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

B. Coordinate with insulation manufacturer for UV exposure requirements and coordinate the schedule of construction to ensure insulation is concealed in a timely manner.

PART 2 PRODUCTS

2.01 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136.
   4. Formaldehyde Content: Zero.
   5. Facing: Unfaced.

2.02 MISCELLANEOUS GAP / CRACK FILLER

A. General: Fill miscellaneous joints and cracks with batt insulation (specified above) or with closed-cell polyurethane foam at Contractor's option.

B. Closed Cell Polyurethane Foam:
   1. Provide insulation that conforms to ULC S705.1, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material" or ASTM C 1029, Type II, and performance requirements listed.
   2. Flame-spread index of 0 and maximum smoke development index of 5, when tested in accordance with ASTM E84.
   3. Products:
      a. Dow; Enerfoam Professional Foam Sealant.
      b. Dupont; Great Stuff Pro Gaps & Cracks.

c. Hilti; CF-AS Crack and Joint All Seasons.
d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

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

B. Install in exterior wall and ceiling spaces indicated without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 072100

SECTION 075200
MODIFIED BITUMINOUS MEMBRANE ROOFING - MINOR ALTERATIONS (*ADDENDUM 01)

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.

B. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing 2011 (Reapproved 2016).

C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

D. ASTM D6162/D6162M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements 2021.

E. FM (AG) - FM Approval Guide Current Edition.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Scope and Existing Roof Information: The Work of this section involves roof alterations to an existing roof for installation of new rooftop components and units and patching areas of removed equipment. The Work shall be performed in a manner and shall be by a Soprema qualified Contractor that maintains the existing roof warranty.

1. Existing Roof Warranty: Soprema; twenty year NDL warranty, issued August 18, 2007.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials, insulation, vapor retarder, and surfacing.

B. Shop Drawings: Indicate patching locations and details, joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout.

C. Installer's qualification statement.

D. Warranty: Submit warranty information indicating existing roof manufacturer acceptance of the work, and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with approval of existing roof manufacturer (Soprema).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

B. Store materials in weather protected environment, clear of ground and moisture; ballast materials may be stored outdoors.

C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.

D. Protect foam insulation from direct exposure to sunlight.

1.06 FIELD CONDITIONS

A. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.

B. Do not apply roofing membrane during unsuitable weather.

C. Do not apply roofing membrane when ambient temperature is below 40 degrees F.

D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.

E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

F. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.07 WARRANTY

A. Coordinate with existing roof manufacturer to maintain the terms of existing roof warranty.

B. Correct defective work within a two year period after Date of Owner's Final Acceptance.

PART 2 PRODUCTS

2.01 ROOFING - CONVENTIONAL APPLICATION

A. Modified Bituminous Roofing: Two-ply membrane, cold-applied, with insulation.

2.02 MEMBRANE AND SHEET MATERIALS

A. Membrane: Polymer modified asphalt, reinforced with nonwoven fabric; granule surfaced; with the following characteristics:

1. Minimum Quality: ASTM D6162, ASTM D6163, or ASTM D6164 Type II; styrene-butadiene-styrene (SBS) modified, glass fiber and/or polyester reinforced.

B. Flexible Flashing Material: Same material as membrane.

C. Seaming Tape: Modified bitumen, self-adhering tape with reinforced mat of nonwoven glass fiber strands, coated on both sides with styrene-butadiene-styrene (SBS) polymers and select asphalt; sanded top surface with adhesive backing covered with silicone treated release film.

2.03 COVER BOARDS

A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.

1. Thickness: 1/2 inch, fire-resistant.
2. Manufacturers:
   a. Georgia-Pacific; DensDeck Prime.
   b. National Gypsum; DEXcell FA Glass Mat Roof Board.
   c. USG; Securock Ultralight Glass-Mat Roof Board.

2.04 INSULATION

A. Surface Burning Characteristics: Foam plastic insulation shall have a maximum flame spread index of 75, and maximum smoke developed index of 450, when tested in accordance with ASTM E84 at maximum thickness intended for use.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Class 1 - Faced with glass fiber reinforced cellulosic felt facers on both major surfaces of core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
   2. Tapered Board: Slope as indicated; but not less than 1/4 inch per foot; fabricate of fewest layers possible.
   3. Preformed Shapes: Provide saddles crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, but no less than 1/4 inch per 12 inches, and no less than 1/8 inch per 12 inches in valleys.

2.05 FLUID-APPLIED PROTECTIVE COATING - ALTERNATE NO. 2 (*AD 01)

A. **Fluid-Applied Protective Roof Coating: White, cold-applied, single-component, silicone elastomer roof coating; approved by existing modified bitumen roof manufacturer (Soprema) to maintain existing roof warranty. Roof coating shall have a minimum 10 year manufacturer warranty for material defect.**
   1. **Provide manufacturer's recommended primer formulated specifically for modified bitumen substrate and compatible with silicone coating.**
   2. **Provide manufacturer's recommended silicone mastic flashing for use with silicone top coating.**

2.06 ACCESSORIES

A. Cant Strips: Wood; pressure preservative treated.

B. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
   1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.

D. Sealants: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 INSTALLATION - INSULATION, CONVENTIONAL

A. Attachment of Insulation:
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instruction and FM (AG) Factory Mutual requirements.
   2. Embed subsequent layer(s) of insulation into cold-applied insulation adhesive in accordance with roofing and insulation manufacturers' instructions.

B. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

C. Place tapered insulation, crickets, and other special shapes to the required slope pattern in accordance with manufacturer's instructions.

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

E. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

F. Do not apply more insulation than can be covered with membrane in same day.

3.03 INSTALLATION - MEMBRANE

A. Install modified bituminous membrane roofing system in accordance with manufacturer's recommendations and NRCA (RM) applicable requirements.

B. Install membrane; lap and seal edges and ends permanently waterproof.

C. Install smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.

D. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.

E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces.
   2. Apply flexible flashing over membrane.

F. Around roof penetrations, mop in and seal flanges and flashings with flexible flashing.

G. Coordinate installation of roof drains and sumps and related flashings.

3.04 INSTALLATION – FLUID-APPLIED COATING – ALTERNATE NO. 2 (*AD 01)

A. **Install fluid-applied roof coating and accessories in accordance with manufacturer's installation instructions.**

B. **Apply primer across full modified bitumen substrate at manufacturer's recommended application rate.**

C. **Pre-treat seams, penetrations, end laps, and other terminations with manufacturer's recommended silicone mastic flashing.**

D. **Coating Installation Thickness: Install coating in a single pass to a minimum of 24 wet mils. Apply with dedicated equipment used for silicone coatings only.**

E. **After coating has cured for a minimum of 72 hours, provide a complete visual inspection of roof coating and flashings, and repair or touch up all deficiencies.**

3.05 FIELD QUALITY CONTROL

A. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work. Existing roofing manufacturer shall verify that new work is being installed in a manner that maintains the existing warranty.

3.06 CLEANING

A. Remove bituminous markings from finished surfaces.

B. Repair or replace defaced or damaged finishes caused by work of this section.

C. Provide a final cleaning of the roof membrane immediately prior to Owner's Final Inspection to remove dirt, clay and other soiling.

3.07 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 075200

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

E. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction 2022.

F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

G. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

H. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.02 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used including technical material properties.
   1. Include installation instructions and manufacturer's recommendations for installation and maintenance.
   2. Include ANSI/SPRI/FM 4435/ES-1 wind pull-off performance data for systems that will be used in edge metal conditions.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.

D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with 2012 SMACNA (ASMM) requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work, with experience in projects of size and scope similar to this Project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 22 gauge (0.028-inch) thick base metal, shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
   2. Color: To be selected by Architect from Manufacturer's full range.

B. Pre-Finished Aluminum: ASTM B209/B209M; 18 gauge, 0.040 inch thick; plain finish shop pre-coated with PVDF coating.
   1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; pretreated metal with two-coat system including primer and color coat with at least 70 percent PVDF coating.
   2. Color: To be selected by Architect from Manufacturer's full range.

C. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 24 gauge (0.025-inch) thick; smooth No. 2D finish.

D. Copper: ASTM B370, cold rolled 16 oz/sq ft, 24 gauge, 0.0216 inch thick; natural finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Tin edges of copper sheet to be soldered; solder shop formed metal joints, and after soldering, remove flux, wipe and wash solder joints clean; provide weathertight joints.

F. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
   1. Hem exterior corners of flashings and drip edges, in a manner that eliminates sharp, exposed cut metal edges, at locations below 6'-0" above grade (locations within reach range of building occupants).

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.03 GUTTER AND DOWNSPOUT FABRICATION

A. General: Provide minimum 0.040-inch aluminum extrusions for gutters and minimum 0.032-inch aluminum for downspouts. Finish all parts of gutter/downspout system a single color to match, including brackets, elbows and bends, and exposed fastener heads.

B. Gutters: SMACNA Ogee profile (Style K); unless otherwise indicated.

C. Downspouts: Rectangular profile; unless otherwise indicated.

D. Gutter and Downspout Sizing: Unless otherwise indicated, provide 4-inch deep by 5-inch wide downspouts, with gutter depth to accept 4-inch deep downspout.

E. Accessories: Profiled to suit gutters and downspouts. Provide additional elbows, bends, extended bracket depths, and other accessories as required for downspouts to avoid conflict with cladding profiles, masonry or precast extrusions, and other surface ornamentation on wall.
   1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.

2. Gutter Supports: Straps and spacer bars (SMACNA figure 1-17), spaced no more than 24 inches on center.
3. Downspout Supports: Brackets; spaced no more than 60 inches on center.
4. Downspout Strainers: Provide ball-type mesh strainer at each downspout; pre-fabricated, non-corrosive construction compatible with gutter/downspout material.

F. Splash Blocks: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment. Lightweight "patio" blocks are not acceptable.
1. Provide a splash block at all conditions where downspout is not indicated to connect to downspout boot, and at conditions where downspout empties onto lower roof.

G. Downspout Boots: Cast iron, inlet sized to match downspout; outlet sized for underground drainage piping. Coordinate with Plumbing Drawings and Division 22.

H. Seal metal joints.

2.04 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

F. Reglets and Counterflashings (Masonry): Embedded type, copper. Coordinate with Division 4 Section "Unit Masonry."

G. Reglets and Counterflashings (Non-Masonry): Surface mounted two-piece reglet and counterflashing, or one-piece counterflashing, fabricated of pre-finished aluminum or galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

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

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

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets and one-piece counterflashings true to lines and levels, and seal tops with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

A. Comply with SMACNA installation instructions and drawing details.

B. For reglets installed into masonry veneer, furnish reglets to mason for installation as Division 4 Unit Masonry work progresses.

C. Insert flashings into reglets to form tight fit; secure in place with wedges; seal flashings into reglets with sealant.

D. Secure flashings in place using concealed fasteners.

E. Apply plastic cement compound between metal flashings and felt flashings.

F. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

G. Seal metal joints watertight.

H. Secure gutters and downspouts in place with concealed fasteners.

I. Slope gutters 1/4 inch per 10 feet, minimum.

J. Connect downspouts to downspout boots, and grout connection watertight.

K. At low roof conditions, and where not indicated to connect to downspout boots, provide a bottom elbow and set splash blocks under downspouts.

END OF SECTION 076200

SECTION 078400
FIRESTOPPING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

C. ITS (DIR) - Directory of Listed Products Current Edition.

D. FM (AG) - FM Approval Guide current edition.

E. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

F. UL (FRD) - Fire Resistance Directory Current Edition.

1.02 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Installer's qualification statement.

1.03 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.

B. Labeling: Provide permanent labels adjacent to each firestopping assembly. Labels shall be durable metal or plastic and fastened mechanically or with a self-adhering backing. Labels shall include the tested assembly/system number, fire rating of the adjacent building element/ firestopping, the firestopping installer and certification, date of installation, and specific instructions to "Do Not Disturb" and "Alert Building Personnel of Damage."

C. Installer Qualifications: Company specializing in performing the work of this section and trained/certified by firestopping manufacturer.

1.04 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products.
   2. A/D Fire Protection Systems Inc.
   3. Rectorseal, a CSW Industrials Company.
   4. Hilti, Inc.
   5. Specified Technologies Inc.
   6. Tremco Commercial Sealants & Waterproofing.
   7. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

A. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero (0) in accordance with ASTM G21.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
   1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated, but not less than 1 hour.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Air Leakage (Smoke Barriers): Provide systems that have been tested to show L Rating of no more than 5.0 cfm/sq. ft., both at ambient and elevated 400 deg F temperatures.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

1. Coordinate with Division 09 Painting contractor to ensure that all fire-rated walls and partitions are properly labeled.

3.04 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 078400

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants 2018 (Reapproved 2022).

B. ASTM C834 - Standard Specification for Latex Sealants 2017.

C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2022.

H. ASTM C1311 - Standard Specification for Solvent Release Sealants 2022.

I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

1.02 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section, and is approved and/or certified by manufacturer.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.

2. Compatibility Testing: In accordance with ASTM C1087.
3. Allow sufficient time for testing to avoid delaying the work.
4. Deliver to manufacturer sufficient samples for testing.
5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

E. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after date of Owner's Final Acceptance.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Joints between different exposed materials.
      c. Openings below ledge angles in masonry.
      d. Other joints indicated below.
   2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Wall and ceiling joints.
      c. Joints between plumbing fixtures and floor or wall construction.
      d. Tamper- or pick-resistant sealant in secure areas.
      e. Other joints indicated below.
   3. Do not seal the following types of joints.
      a. Intentional weepholes in masonry.
      b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      d. Joints where installation of sealant is specified in another section.
      e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant (ES-1), unless otherwise indicated.
   1. Type ES-5 - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
   2. Type ES-1 or ES-2 - Joints between walls and frames of doors, windows, and louvers.
   3. Type SRS-1 - Bedding joints.

C. Interior Joints: Use non-sag polyurethane sealant (ES-4), unless otherwise indicated.
   1. Type ES-3 - Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
   2. Type ES-5 - Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
   3. Type AS-1 - Joints at sound-rated or acoustic assemblies, and at full-height panel wall and partition assemblies indicated to have sound attenuation batts.
   4. Type LS-1 - Joints around perimeters of interior doors, windows, elevator entrances, and similar framed openings.

D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.02 NONSAG JOINT SEALANTS

A. Type ES-1 - Low-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Manufacturers:
      a. Master Builders Solutions; MasterSeal NP 100.
      b. Momentive Performance Materials, Inc/GE Silicones; SCS 2000 SilPruf.
      c. Pecora Corporation; Pecora 890 NST (Non-Staining Technology) or 890 FST (Field Tint).
      d. Polymeric Systems, Inc.; PSI-641.
      e. Tremco Commercial Sealants & Waterproofing; Spectrem 3 or Spectrem 4-TS (Field Tint).
      f. Substitutions: See Section 016000 - Product Requirements.

B. Type ES-2 - Medium-Modulus Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
   3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
   4. Color: To be selected by Architect from manufacturer's full range.
   5. Manufacturers:
      a. Dow Chemical Company; DOWSIL 795 Silicone Building Sealant.
      b. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant.
      c. Pecora Corporation; Pecora 895 NST (Non-Staining Technology).
      d. Tremco Commercial Sealants & Waterproofing; Spectrem 2.
      e. Substitutions: See Section 016000 - Product Requirements.

C. Type ES-3 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic. Neutral- or acid-curing per manufacturer standard.
   1. Color: White.
   2. Manufacturers:
      a. Dow; DOWSIL 786 Mildew Resistant.
      b. Pecora Corporation; Pecora 898 NST (Non-Staining Technology).
      c. Tremco Commercial Sealants & Waterproofing; Tremsil 600 or Tremsil 200.
      d. Substitutions: See Section 016000 - Product Requirements.

D. Type ES-4 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; multi-component; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Color: To be selected by Architect from manufacturer's full range.
   3. Manufacturers:

a. ITW Polymers Sealants; Permathane SM 7200.
b. Master Builders Solutions by BASF; MasterSeal NP2.
c. Pecora Corporation; DynaTrol II.
d. Sika Corporation; Sikaflex-2c NS.
e. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC or Vulkem 227.
f. Substitutions: See Section 016000 - Product Requirements.

E. Type LS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's full range.
2. Grade: ASTM C834; Grade NF.
3. Manufacturers:
a. Bostik, Inc; Chem-Calk 600.
b. ITW Polymers Sealants; SM 8200.
c. Master Builders Solutions; MasterSeal NP 520.
d. Pecora Corporation; AC-20 +Silicone.
e. Tremco Commercial Sealants & Waterproofing; Tremflex 834.
f. Substitutions: See Section 016000 - Product Requirements.

F. Type AS-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging acoustical sealant.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).
2. Grade: ASTM C834; Grade NF.
3. Manufacturers:
a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
b. Franklin International, Inc; Titebond GREENchoice Acoustical Smoke & Sound Sealant.
c. Hilti, Inc; CP 506 Smoke and Acoustical Sealant.
d. Master Builders Solutions; MasterSeal NP 520.
e. Momentive Performance Materials, Inc/GE Silicones; RCS20 Acoustical.
f. Pecora Corporation; AC-20 FTR or AIS-919.
g. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant.
h. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound.
i. Substitutions: See Section 016000 - Product Requirements.

G. Type SRS-1 - Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag; not expected to withstand continuous water immersion or traffic.
1. Manufacturers:
a. Bostik, Inc; Chem-Calk 300.
b. Pecora Corporation; Pecora BC-158 Butyl Rubber Sealant.
c. Tremco Inc.; Tremco Butyl Sealant.
d. Substitutions: See Section 016000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

A. Type ES-5 - Self-Leveling Polyurethane Sealant for Traffic: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure.
1. Movement Capability: Plus and minus 25 percent, minimum.

2. Manufacturers:
    a. Bostik, Inc.; Chem-Calk 550.
    b. ITW Polymers Sealants; Permathane SM 7201.
    c. Pacific Polymers, Inc; Elast-Thane 227 Type 1 (Self-Leveling).
    d. Polymeric Systems, Inc; PSI-270SL.
    e. Tremco Commercial Sealants & Waterproofing; THC-901 or THC-900.
    f. W. R. MEADOWS, Inc; POURTHANE SL.
    g. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
    1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
    2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
    3. Record each test on Preinstallation Adhesion Test Log as indicated.
    4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
    5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

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

B. Perform installation in accordance with ASTM C1193.

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

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

D. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 079200

SECTION 081113
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

C. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames 2016.

D. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2019.

1.02 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company.
   2. Curries, an Assa Abloy Group company.
   3. Fleming Door Products, an Assa Abloy Group company.
   4. Krieger Specialty Products.
   5. Mesker, dormakaba Group.
   6. Pioneer Industries, Inc.; an Assa Abloy Group company.
   7. Republic Doors, an Allegion brand.
   8. Steelcraft, an Allegion brand.
   9. Technical Glass Products.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.

3. Door Top and Bottom Closures: Flush end closure channel, with top and door faces aligned.
    a. Inverted channel closure is acceptable for bottom edges and top edges of interior doors that are not exposed to view from above.
4. Door Edge Profile: Hinged edge square, and lock edge beveled Beveled edge.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated. Fabricate from metallic-coated steel sheet.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 2 - Seamless.
    d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
    a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
3. Door Thermal Resistance: R-Value of 6, minimum.
4. Door Thickness: 1-3/4 inches, nominal.
5. Weatherstripping: Refer to Division 08 "Door Hardware".

C. Interior Doors, Non-Fire-Rated: Fabricate from either cold-rolled steel sheet or metallic-coated steel sheet.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.

d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements, except kraft paper honeycomb core is not acceptable.
3. Door Thickness: 1-3/4 inches, nominal.

D. Fire-Rated Doors: Comply with NFPA 80.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Match construction and physical performance levels above for interior or exterior doors, as applicable.
2. Fire Rating: As indicated, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Per NFPA 80, fire exit doors shall be labeled “Fire Door to Be Equipped with Fire Exit Hardware,” and shall be reinforced and constructed to maintain the rating of the specific listed and labeled fire exit devices mounted on them.
4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
a. Attach fire rating label to each fire rated unit.
5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inches, nominal.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Face welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
3. Weatherstripping: Refer to Division 08 Section "Door Hardware".

D. Interior Door Frames, Non-Fire Rated: Face welded type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

E. Door Frames, Fire-Rated: Face welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
1. Where removable mullion is indicated, coordinate with removable mullion to be provided as an exit device accessory per Division 08 Section "Door Hardware."

H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

K. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
   1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
   2. Style: Sightproof inverted V- or Y-blade.
   3. Fasteners: Exposed or concealed fasteners.

B. Glazing: As specified in Section 088000.

C. Removable and Fixed Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
   1. Provide fixed stops for exterior applications, and toward the secure side of interior glazed lites (for example, toward the corridor or more public accessible spaces).
   2. Heights of Stops: Unless otherwise indicated or recommended by glazing manufacturer, provide standard 5/8-inch height stops where allowed by standards, and provide 3/4-inch height for exterior 1-inch glazing units.

D. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
   1. Provide UL listed products, complying with NFPA 80, and as required to maintain indicated fire rating.
   2. Provide surface mounted overlapping-type astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.

E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

F. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

G. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

H. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
   1. Install in accordance with ANSI/SDI A250.11.

2. Do not remove temporary frame spreaders until after frames have been properly set and secured.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 087100.

F. Comply with glazing installation requirements of Section 088000.

G. Coordinate installation of electrical connections to electrical hardware items.

H. Touch up damaged factory finishes.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

1. Comply with clearances indicated in NFPA 80 for fire-rated doors.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION 081113

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2022.

C. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.02 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

C. Samples: Submit two samples of door veneer, approximately 8 by 8 inches in size illustrating wood grain, stain color, and sheen.

D. Warranty, executed in Owner's name.

1.03 QUALITY ASSURANCE

A. Source Limitations: Provide all flush wood doors from a single manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Eggers Industries.
   2. Lambton Doors.
   3. Masonite Architectural; Aspiro Select Wood Veneer Doors.
   4. Oshkosh Door.
   5. VT Industries, Inc.

2.02 DOORS

A. Doors: See drawings for locations and additional requirements.
   1. Doors shall be manufactured by the hot-press method, bonding faces, crossbands, and core together in a single operation with Type I glue. Doors manufactured by cold-pressing 2- or 3-ply pre-manufactured door skins to multiple cores in the same press will not be accepted.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled.
      a. Provide stile construction with concealed intumescent seals at pairs of doors, meeting required fire-ratings without the need of astragal or metal edge construction.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), particleboard Grade LD-2 per ANSI A 208.1; plies and faces as indicated.
   1. Provide structural-composite-lumber (SCLC) core for doors with glazing area cut out for 9-inch stile width doors.
   2. Provide structural-composite-lumber (SCLC) core for doors with exit devices.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Select white maple, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Any option allowed by quality standard for grade.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.

C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:
   a. System - 5, Varnish, Conversion or System 11, catalyzed polyurethane.
   b. Sheen: Satin.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing where doors will be exposed to view from above.

2.07 ACCESSORIES

A. Wood Louvers:
   1. Material and Finish: Match species of door panels.

B. Metal Louvers:
   1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
   2. Louver Blade: Inverted V blade, sight proof, light proof; fire rated to indicated rating, with fusible link designed to UL requirements.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws. At fire-rated doors, provide noncombustible wood stops with concealed metal clips for indicated fire rating.

D. Door Hardware: Refer to Section 087100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION 081416

SECTION 083100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ITS (DIR) - Intertek Testing Service; Directory of Listed Products.

B. UL (FRD) - Underwriters Laboratories; Fire Resistance Directory.

1.02 SUBMITTALS

A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

B. Shop Drawings: Indicate exact position of each access door and/or panel unit.

1. Include a schedule indicating wall/ceiling type, door types, sizes, and hardware for each access door required.

1.03 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in “Submittals” Article.

1. This (083100) material specification includes access doors required for Divisions 21 (Fire Suppression), Division 22, (Plumbing), 23 (HVAC) and Division 26 (Electrical) work and any other access doors indicated on Drawings.

PART 2 PRODUCTS

2.01 WALL AND CEILING MOUNTED ACCESS UNITS

A. Manufacturers:

1. Activar Construction Products Group, Inc. - JL Industries.
2. ACUDOR Products Inc.
3. Babcock-Davis.
4. Bauco Access Panel Solutions Inc.
5. Best Access Doors.
6. Cendrex, Inc.
7. Karp Associates, Inc.
8. Larsen's Manufacturing Company.
9. Milcor, Inc.
10. Nystrom, Inc.
11. Williams Brothers Corporation of America.
12. Substitutions: See Section 016000 - Product Requirements.

B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

1. Material: Steel.
2. Style (Gypsum Board locations): Recessed door panel for infill with wall/ceiling finish.
   a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
3. Style (Masonry locations): Exposed frame, with door surface flush with frame surface.

4. Door Style: Double-skinned hollow panel.
5. Frames: 16 gauge, 0.0598 inch, minimum thickness.
6. Double-Skinned Hollow Steel Sheet Door Panels: 16 gauge, 0.059 inch, minimum thickness, on both sides and along each edge.
7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
    a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
    b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
    c. Fire-rated door assemblies shall conform with and be installed in accordance with (1) NFPA 80, (2) door and frame manufacturer's installation instructions, and (3) listing requirements of qualified testing agency.
8. Steel Finish: Primed.
9. Hardware:
    a. Hardware for Fire-Rated Units: As required for listing.
    b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

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

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 083100

SECTION 084126
ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

C. ASTM C1036 - Standard Specification for Flat Glass 2021.

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

E. BHMA A156.4 - Door Controls - Closers 2019.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each component in all-glass entrance assembly.

C. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include elevations showing:
      a. Appearance of all-glass entrance layouts.
      b. Locations and identification of manufacturer-supplied door hardware and fittings.
      c. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include details of:
      a. Requirements for support and bracing at openings.
      b. Installation details.
      c. Appearance of manufacturer-supplied door hardware and fittings.

D. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Experienced installer of specified systems, approved by manufacturer of all glass storefronts.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. All-Glass Entrances and Storefronts:

1. Avanti Systems USA. (Basis-of-Design: Solare Single Glazed)
2. C.R. Laurence Co., Inc.
3. DAMS Incorporated.
4. Dormakaba.
5. Oldcastle Building Envelope.
6. Trulite Glass & Aluminum Solutions, LLC.
7. Virginia Glass Products Corporation.
8. Substitutions: See Section 016000 - Product Requirements.

B. Fittings and Hardware:

2.02 ALL-GLASS ENTRANCES AND STOREFRONTS ASSEMBLIES

A. Entrances and Storefronts: Factory fabricated assemblies consisting of frameless glass panels fastened with metal structural fittings in configuration indicated on drawings.
   1. Operational Loads: Designed to withstand door operation under normal traffic without damage, racking, sagging, or deflection.
   2. Prepared for all specified hardware whether specified in this section or not.
   3. Finished metal surfaces protected with strippable film.
   4. Factory assembled to greatest extent practicable; may be disassembled to accommodate shipping constraints.

2.03 FITTINGS AND HARDWARE

A. Rail Style Fittings for Fixed Glazing:
   1. Top and Bottom Rails: Provide "frameless" type system with a minimal 1 inch square fitting at top and bottom rails, and at each end of complete system. Do not provide fittings in vertical joints between glass sections.

B. Patch Style Fittings for Swinging Doors: Provide fittings that coordinate with closer and pivot specified.
   1. Top Fittings: 6-1/2 inches long by 2 inches high, nominal (per Avanti basis-of-design).
   2. Bottom Fittings: 7-1/4 inches long by 2-3/4 inches high, nominal (per Avanti basis-of-design).
   3. Exposed Edge Profile: Square.

C. Floor Mounted Concealed Door Closers and Top Pivots for Glass Swinging Doors: Non-handed closer for both single and double-acting doors with mechanical backcheck, and meeting requirements of BHMA A156.4, Grade 1.
   1. Application: Center hung, with swing as indicated on drawings.
   2. Hold Open: Adjustable.
   3. Opening Force: Comply with requirements of authorities having jurisdiction.
   4. Closer Dimensions: 10-3/4 inches long by 3-1/2 inches wide, by 2 inch deep, per Avanti basis-of-design, with stainless steel cover plate with #4 satin finish.
   5. Provide accessories as required for complete installation.

2.04 MATERIALS

A. Glass: Flat glass meeting requirements of ASTM C1036, Type I - Transparent Flat Glass, Quality Q3, and Kind FT, fully tempered, in accordance with ASTM C1048, and as follows:
   1. Thickness: 1/2 inch.
   2. Color: Class 1, Clear.
   3. Prepare glazing panels for indicated fittings and hardware before tempering.

4. Polish edges that will be exposed in finished work to bright flat polish.
5. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.

B. Stainless Steel Components: Comply with ASTM A666, Type 304.

C. Sealant: One-part silicone sealant, comply with ASTM C920, clear.

2.05 ACCESSORIES

A. Exposed Fittings and Hardware: Stainless steel, brushed/satin finish.

B. Fixed Glazed Panel Fittings: Sufficient to structurally support glazing and doors under specified loads; including but not limited to cover caps for door hardware, glazing mullions, clamp fittings, and panel corner patches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are acceptable.

B. Do not begin installation until substrates and openings have been properly prepared.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

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

3.03 INSTALLATION

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

B. Tolerances:
1. Horizontal Components and Sight Lines: Not more than 1/8 inch in 10 feet variation from level, non-cumulative.
2. Vertical Components and Sight Lines: Not more than 1/8 inch in 10 feet variation from plumb, non-cumulative.
3. Variation from Plane or Indicated Location: Not more than 1/16 inch.

3.04 ADJUSTING

A. Adjust doors to operate correctly, without binding to frame, sill, or adjacent doors.

B. Adjust door hardware for smooth operation.

3.05 CLEANING

A. Clean installed work to like-new condition.

3.06 PROTECTION

A. Protect installed products until Date of Owner's Final Acceptance.

B. Touch-up, repair or replace damaged products before Date of Owner's Final Acceptance.

END OF SECTION 084126

SECTION 085113
ALUMINUM WINDOWS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.

B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.

C. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).

D. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes 2020.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.03 SUBMITTALS

A. Product Data: Provide component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.

C. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

D. Installer's Qualification Statement.

E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of AAMA CW-10.

B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F.

B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.07 WARRANTY

A. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Peerless Products, Inc; Model G600 Series, with custom Offset Fixed Window panning, per UNCW design and construction guidelines. Manufacturers offering comparable products shall be required to submit full product data including custom color and trim profile capability for approval by university.

2.02 ALUMINUM WINDOWS

A. Aluminum Windows: Extruded, thermally broken, aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
   1. Frame Depth: 4 inch.
   2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
   3. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
   5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   6. Thermal Movement: Design to accommodate thermal movement caused by 180 degrees F surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.

B. Fixed, Non-Operable Type:
   1. Construction: Thermally broken.
   2. Glazing: Double; clear; transparent; insulated glazing unit per Division 8 "Glazing".
   3. Exterior Finish: High performance organic coatings; Custom White color matching UNCW standard.
   4. Muntins/Grilles: Provide triple grid; with grilles permanently installed between panes of insulating glass and on both exterior and interior of window; muntin layout as indicated on Drawings. Match custom frame color.

2.03 PERFORMANCE REQUIREMENTS

A. Design Pressure (DP): In accordance with ASCE 7.

B. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.

C. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, tested by independent agency in accordance with ASTM E1996 for Wind Zone 2 - Basic Protection for Large and Small Missile impact and pressure cycling at design wind pressure.
   1. Wind Zone 2: ASTM E1996 Large Missile "D" (8 ft. 2 x 4 @ 50 f/s) and Small Missile "A" (2 g. steel ball @ 130 f/s).

D. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 psf.

E. Air Leakage: 0.1 cfm/sq ft maximum leakage per unit area of outside window frame dimension when tested at 1.57 psf pressure difference in accordance with ASTM E283/E283M.

F. Overall Thermal Transmittance (U-value): 0.42, maximum, including glazing, measured on window sizes required for this project.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work under this section comprises the furnishing and installation of finish and security hardware specified herein and noted on drawings for a complete and operational system, including any electrified door hardware components including finish and security hardware and auto operators for aluminum entrance doors, FRP doors, and wood doors.

B. Items include but are not limited to the following:

1. Hinges: Butt-type and Continuous
2. Flush Bolts: Manual and Automatic
3. Exit Devices
4. Locksets and Cylinders
5. Push Plates - Pulls
6. Coordinators
7. Closers / ADA Operators
8. Kick, Mop and Protection Plates
9. Stops, Wall Bumpers, O.H. Controls
10. Thresholds, Gasketing and Door Bottoms
11. Silencers
12. Miscellaneous Trim and Accessories
13. Electrified Hardware Items, Controls and Power Supplies

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary conditions and Division 1 specifications sections apply to this section.

1.3 RELATED WORK

A. Work specified elsewhere that should be examined for its effect upon this section.

1. Section 081113, Hollow Metal Doors and Frames
2. Section 081416, Flush Wood Doors
3. Section 088000, Glazing
4. Division 26 Electrical.

5. Division 28 Electronic Safety and Security.
6. Division 1 Alternates.

1.4 REFERENCES SPECIFIED in this section subject to compliance by:

A. NFPA-80-2013 - Standard for Fire Doors and Windows.

B. NFPA-101- Life Safety Code as adopted.

C. NC Electrical Code – 2014, effective as April 2016.

D. ADA - The Americans with Disabilities Act - Title III - Public Accommodations

E. ANSI-A117.1-1992 American National Standards Institute - Accessible and Usable Buildings and Facilities

F. ANSI-A156.5-American National Standards Institute - Auxiliary Locks and Associated Products

G. UL 10 C – UBC 7.2 – Positive Pressure Testing

H. ANSI-A250.6-1997/SDI -107" Hardware on Steel Doors" (reinforcement- application).

I. Architectural Woodwork Institute (AWI)

J. International Building Code as Adopted / NC Building Code 2018.

K. U.L. - Underwriter's Laboratories

L. WHI - Warnock Hersey International, Division of Intertek Testing Services

M. State and Local Codes including Authority Having Jurisdiction.

1.5 SUBMITTALS

A. Shop Drawings: Indicate door and frame elevations and sections, materials, gauges, finishes, door thickness, door swing, stile and rail dimensions, veneers, undercuts, fabrication and erection details, locations of finish hardware by dimension and locations/details of all openings and louvers. Do not proceed with any fabrication until all details are approved.

B. Hardware Schedule: Schedule to be in vertical format, listing each door opening, including: Keying Information, handing of opening, all hardware scheduled for each opening or otherwise required to allow for proper function of door opening as intended, and finish of the hardware. At doors with door closers or door controls include degree of door opening. All submittals (schedules, cut sheets, wiring diagrams, operational descriptions and elevation drawings) shall be reviewed and approved by the UNCW Project Manager and by the UNCW Locksmith Supervisor Physical Plant. UNCW Business Applications shall review the submittal for electrified hardware applications, along with the wiring diagrams. These submittals shall be approved by UNCW prior

to ordering of materials. The Hardware Supplier shall submit the schedules and all templates within three (3) weeks from the date the purchase order is received from the GC.

C. Manufacturer's Catalog Cuts: Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.

D. Certification of Compliance: Submit any information necessary to indicate compliance to these specifications.

E. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to the Owner at time of job completion. All electrical components shall be listed by opening, in the hardware submittals.

F. Operational Descriptions: Provide complete operational descriptions of electronic components listed by opening in the hardware submittals. Operational descriptions to detail how each electrical component functions within the opening including all conditions of ingress and egress. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to owner at time of job completion.

G. Elevation Drawings: Provide elevation drawings of electronic hardware and systems identifying locations of the system components with respect to their placement in the door opening. Provide a copy with each hardware schedule submitted for approval. Supply another copy with delivery of hardware to job site and another copy to the Owner at time of job completion.

1.6 QUALITY ASSURANCE

A. Door Openings Supplier shall be a qualified direct distributor of products to be furnished. In addition, the distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience, who will be available at reasonable times to consult with the Architect/Contractor and/or Owner regarding any matters affecting the door opening assembly.

B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL (Underwriter's Laboratories) or Warnock Hersey (WHI) approved for fire. Exit Devices. Non-labeled openings to be listed for panic application.

C. Pre-Installation Meetings: The Contractor shall initiate and conduct a jobsite meeting with the supplier and installer, and all related trades for mechanical hardware, and a meeting for Electronic Hardware. This meeting shall convene at least one month prior to commencement of the related work. All approved shop drawings and schedules shall be made available to all related trades as required for work to be performed. Prior to installation of wiring, and installation of power supplies for electronic hardware, arrange conference between supplier, installers and related trades to review materials, procedures, review door opening functions, and coordinating related work. The Owner's Construction Project Manager and the Locksmith Supervisor -Physical Plant shall attend all pre-install meetings. The Owner's Construction Project Manager, and the Business Applications Services representative.

D. All hardware products furnished to the project, shall be furnished by an authorized distributor of each product to insure quality compliance, service, and warranty of the products. Product representatives of the following products: Locksets, Closers, Exit Devices, Electrified Hardware, shall conduct a certified training session at the pre-install meeting for product installation training.

E. All closers and exit devices shall be mounted to doors with the manufacturer's recommended sex-nut/through-bolt fasteners.

F. Keying Conference: A keying Conference shall be conducted at least 30 days after approval of all hardware submittals on each Building Project. Attendance to this conference shall be: UNCW Construction Project Manager, the area Department Heads, the UNCW Locksmith -Physical Plant and the Schlage Key representative.

1.7 DELIVERY, STORAGE AND HANDLING

A. Finish Hardware

1. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
2. Pack each item complete with all necessary parts and fasteners.
3. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.
4. Inventory hardware jointly with the General Contractor, Hardware Distributor and Installer until each is satisfied that all products and counts are correct. Any shortages shall be replaced immediately.
5. The General Contractor shall provide secure lock up in a clean, dry, well-lit space for finish and security hardware storage as delivered to the Project. Control handling and installation of hardware and security items to insure the installation will not be delayed due to hardware losses, both before and after installation.
6. Hardware shipped to the jobsite is to be packaged in biodegradable packs such as paper or cardboard boxes and wrapping. If non-biodegradable packing such as plastic, plastic bags or large amounts of styrofoam is utilized, then the Contractor will be responsible for the disposal of the non-biodegradable packing to a licensed or authorized collector for recycling of the non-biodegradable packing.
7. The Manufacturers' Representative and Owners Representative will make several inspections of the installation of Finish and Security Hardware during that phase of construction. Any deficiencies in installation of all products in this Section shall be corrected before installation continues.

1.8 SEQUENCING AND SCHEDULING

A. Deliver all openings components to the job site in a timely manner so not to delay progress of other trades.

1.9 WARRANTY

A. Hardware Warranty: Part of respective manufacturers' regular terms of sale. Provide manufacturers' warranties:

1. Hinges: Life of the building.
2. Mortise Locksets shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
3. Door closers shall carry manufacturer's 30-year warranty against manufacturing defects. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
4. Continuous gear hinges shall carry manufacturer's Lifetime warranty to be free from defects in material and workmanship.
5. ADA operators shall carry manufacturer's 2-year warranty against manufacturing defects and workmanship.
6. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.

B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Inspect the work within 24 hours after receipt of notice from the UNCW Construction Project Manager.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish finish hardware with all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.

B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. **All door closers and exit devices shall be thru-bolted mounted.**

C. All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.

D. Design of all fastenings shall harmonize with the hardware as to material and finish.

E. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

F. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

G. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 HINGES

A. Provide full mortise type, five knuckle exposed tip design ball bearing hinges as specified. Continuous Geared Hinges shall be furnished for all exterior doors with card reader applications and at all Storefront and FRP type doors. Continuous Hinges shall be furnished at any interior door as directed by the Project Manger during the project review. Verify all continuous hinge applications. Unless otherwise scheduled, the required weight, size and hinge type shall be as follows:

1. Butt hinges required per door leaf:
   a. Doors up to 5'0" in height 2 hinges
   b. Doors over 5'0" to 7'6" in height 3 hinges
   c. Doors over 7'6" to 9'0" in height 4 hinges
2. Size and weight requirements:
   a. Doors over 36" in width, shall have extra-heavy weight hinges, 5 inches in width.
   b. At exterior openings, hinge pins shall be stainless steel.

B. Finish: Except as otherwise indicated, provide all hinges with the following finish:

1. Exterior US32D (630) Satin Stainless Steel
2. Interior US26D (652) Satin Chrome

C. Approved Butt Hinge Manufacturers: Ives, McKinney, Hager

D. Approved Continuous Geared Hinge Manufacturer: Select, Ives, McKinney. At exterior doors with card reader function, the continuous hinge shall be as IVES 112XY EPT prep

2.3 LOCK CYLINDERS AND KEYING

A. General: Provide ten (10) temporary keyed construction cores for the contractor's use during the construction period of the project. Furnish keyed construction cores at all exterior doors, including the cylinder dogging at exit devices. Balance of locks/cylinders may be furnished with factory produced plastic plugs. Construction control and operating keys and cores shall not be part of the Owner's permanent keying system, or furnished on the same keyway as the Owner's permanent keying system. Permanent cores and keys shall be keyed to the approved keying schedule. All cylinders shall be Everest 7-pin, interchangeable core and keyed to existing patented Factory-Registered Grand Masterkey System.

B. Permanent keys and cores shall be stamped with applicable key mark for identification. These visual key control codes shall not include the actual key cuts. Permanent keys/key blanks will also be stamped "Do Not Duplicate."

C. The Owner's existing key system: "Schlage", with the specific keyway to be determined by the Owner, and with the Schlage Key representative.

D. Furnish keys in the following quantities:

2 each Master keys per set

1. 3 each Change Keys per keyed core or keyed group. Do not cut keys for any exterior door cylinders where the UNCW card reader function is specified.

2 each Construction Master keys

2. 3 each key blanks per core

E. At project completion, the UNCW Locksmith Shop shall install the permanent keyed cores. All construction cores and keys shall be returned to the University Construction Project Manager for return the hardware supplier. All permanent keyed cores, keys, and key blanks shall be delivered directly to the Owner from the hardware supplier via Registered Delivery, Return Receipt Required.

2.4 LOCKS, LATCHES AND BOLTS

A. Mortise Lock and Latches shall be as manufactured by Schlage, series L9000, Grade 1. Trim design shall be as manufactured by Schlage, 17N. Finish shall be: 626 (US26D), unless otherwise noted. Locksets and Latchsets shall be UL listed for use on fire doors. Furnish latch bolts with ¾" minimum throw. Deadbolts shall have 1" throw. All strikes shall be curved lip. Lock function at all instructional/classroom door shall include a thumb-turn and an indicator on the inside trim to indicate the status of the outside trim: locked/unlocked. Acceptable manufacturers: Schlage L series; Falcon M series; Best 42H series.

B. Provide knurled levers or abrasive strips to all rooms that are considered hazardous, in order to comply with the North Carolina Building Code requirements. This includes but is not limited to all electrical, mechanical and telecommunications rooms.

C. Auxiliary Locks shall be Grade 1, as scheduled.

D. Padlocks: Provide a hardware set for each project to include the following padlock as manufactured by: Schlage KS41F1200 x less core x 2" shackle. Verify with the Owner's Construction Project Manager for the quantity required for each project. The Owner will not accept an "add" change order for padlocks not include with the Hardware Submittal.

E. Cylinders used in any locking mechanism such as in Rolling/Overhead/Coiling Doors, or for a remote Key Switch, shall be furnished with a Schlage Everest 7-pin SFIC housing and keyed core, and follow the UNCW keying requirements listed per Section 2.3 of this document.

F. Locksets at all teaching spaces shall include a classroom locking function with a thumb-turn and an indicator.

2.5 CLOSERS

A. General: One manufacturer for closer units throughout the Project Work, including surface closers, overhead-concealed closers, and electromagnetic hold-open closers.

B. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

C. Surface Closers:

1. Door Closers shall be heavy-duty type, Grade 1 with thirty-year warranty.
2. Cylinders shall be cast iron with forged 1 ½" diameter steel.
3. Closer main arm shall be forged on all closers. Parallel arms shall be rigid forearms.
4. Shaft/Pinion shall be 11/16" diameter shaft and double heat-treated.
5. All closers shall have "all-weather" hydraulics to operate in temperatures from –30degrees to 120 degrees F. without valve adjustments and conforms to positive pressure fire test standards UL10C & UBC 7-2.
6. All stop arm and spring stop arm closers shall have bronze bushings and shoulder bolts. Where stop type arm is specified, closer shoe shall have a cast-in solid stop. Where spring stop arm is specified, arm shall provide an additional five-degree cushion.
7. Closers shall be certified by an independent testing laboratory to Ten Million (full load) cycles.
8. Closers shall be ISO 2000 certified. Units shall be stamped with date-of-manufacture code.
9. Closers shall be thru-bolt mounted.
10. Provide plates, brackets and special templating as specified and per manufacturer's recommendation.
11. Spring power shall be continuously adjustable over the full range of closer sizes and allow for reduced opening force for the physically handicapped.
12. Acceptable manufacturers: LCN 4111/4011 series; Norton 7501PR series w/ extra duty forged arms; Sargent 281 series with extra duty forged arms.
13. Pressure relief valves are not acceptable.

D. ADA Operators: Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are specified for doors required are to be accessible to the disabled, furnish electro-hydraulic or electro-mechanical, as specified. Powered operators shall comply with ADA guidelines for opening force and time to close standards. Full closing force shall be provided when the power or assist cycle ends. All power operator systems shall include the following features and functions:

1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
2. The operator shall be designed to prevent damage to the mechanism if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
4. UL listed for use on labeled doors.

5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.

6. Provisions in the control box or module shall provide control (inputs and outputs) for: electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, stop side sensors. The operator shall provide a power shut-off switch to the operator control box. The ADA operator supplier shall indicate this switch on the wiring diagram submittal as reference only.

7. All electrically powered operators shall include the following features or functions:
   a. "second chance feature": when an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
   b. Easily accessible main power and maintain hold-open switches will be provided on the operator.
   c. An electronically controlled clutch to provide adjustable opening force.
   d. A microprocessor to control all motor and clutch functions.
   e. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
   f. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.

8. Electrical control functions shall be provided by a control module in lieu of a separate control box. Only two Actuators shall be required to create the complete, stand alone, powered door system(s). All components: ADA operator, electrified exit device, keypads, and card readers shall be compatible and operate in compliance with Life Safety, ADA regulations, and with the authority having jurisdiction. ADA operators shall be UL and NEC compliant, including the soft-start motor control and meet the following Standards. ADA Law Section 4.13.12 / ANSI A156.19, Section 2.1 / ANSI A117.1, Section 4.13.13 / UL 325 / UL Listed for Fire Rated Door Operators with Automatic Closers, File (GUJY).

9. All door closers, closer controls and ADA Operators shall be the products of one manufacturer.

10. ADA Operators shall be as LCN 4630/4640 series.

11. Acceptable manufacturers shall meet all of the above specified features and descriptions.

2.6 EXIT DEVICES

A. General: All devices shall be the products of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non-handed and capable of direct field conversion of all available trim functions. All devices shall carry a three-year warranty against manufacturing defects and workmanship.

1. Furnish all devices with stainless steel touch bars. Plastic parts are not acceptable.

2. Furnish all exit devices with deadlocking latchbolts or guarded latch (GL) feature.

3. Furnish all exit devices with cast metal end caps.

4. Furnish built-in damping / silencing feature. Furnish heavy duty, chassis mounted design with removable cover to eliminate the need to remove the device from the door for

maintenance or cylinder change out. Device springs shall be compression type only. Torsion springs are not acceptable.

5. Furnish roller strikes with all exit devices.

6. Furnish stabilizers similar to Von Duprin 154 with keyed locking feature at all removable mullions.

7. All Exit Devices and mullions shall be from one manufacturer.

8. All latchbolts shall be deadlocking. Latchbolts shall be moly-coated.

9. Lever trim shall be solid cast material with a break-away feature to limit damage to the unit from vandalism.

10. Exit devices at instructional/classrooms shall include a thumb-turn and indicator on the device head.

11. Acceptable Manufacturer: Von Duprin 99/98 series devices; Precision 2100 series x deadlocking latchbolts and roller strikes; Sargent 80 series with deadlocking latchbolts and roller strikes. Keyed removable mullions shall be as manufactured by Von Duprin KR4954/9954 series, and shall include stabilizer kits. Mullion shall be by the same manufacturer as the exit device.

12. Surface Vertical Rod devices are not acceptable.

13. Concealed exit device application shall be concealed cable device and only as approved by the UNCW Locksmith. Concealed cable device shall include the option for less bottom cable, electrified options as required for card reader applications, fire-rating as required by the door, and out-side trim options which match the rim devices.

14. Electrified functions shall be specified and furnished as Request to Exit and Electric Latch Retraction (QEL-RX-LC). Each opening specified with Request to Exit and Electric Latch Retraction shall be specified and furnished with a PS914-4RL power supply box. The power supply boxes and electrified exit devices shall be by the same manufacturer. Power supply box shall have a regulated output, field selectable for either 24VDC @2 amps or 12VDC @ 4amps. The input shall be universal at 120VAC @ 1 amp or 240VAC @ 0.5amp. The option board compatibility shall include 2 relay QEL panic device control board. The power supply shall five (5) knockout holes for conduit connection with a terminal block that handles up to 14 gauge size wire.

2.7 DOOR TRIM UNITS

A. Fasteners: provide manufacturers standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units): either machine screws or self-tapping screws.

B. Fabricate edge trim of stainless steel, not more than ½" nor less than 1/16" smaller in length than door dimension.

C. Fabricate protection plates (armor, kick or mop) not more than 2" less door width on stop side and not more than 1" less door width on pull side X the height indicated.

D. Metal Plates: Stainless Steel .050" (U.S.18ga.), unless otherwise specified.

E. Approved Manufacturers: Ives/ Rockwood/Trimco

2.8 MISCELLANEOUS

A. Provide manual or automatic flush bolts, including coordinators and mounting brackets at pairs of doors as specified.

B. Generally provide door stops or controls at each door leaf. Provide wall, floor. or stops and holders as specified.

C. Provide OH Controls, stops or holders as specified.

D. Approved Manufacturers: Ives/ Glynn Johnson/ Rixson

2.9 THRESHOLDS /WEATHERSTRIP

A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, size and profiles shown or specified. Provide non-corrosive fasteners as recommended by manufacturer for application intended. Except as otherwise indicated provide ADA standard aluminum thresholds of type, size and profile specified.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from manufacturers stock.

C. Acceptable Manufacturers: National Guard/Pemko/Zero.

D. Provide thresholds that are 1" wider than frame depth. Unless return closed ends are specified, furnish thresholds 2" longer than the opening width for notching around the frame. Hardware installer shall be responsible for notching thresholds to the frame by field measuring after the door opening assembly is installed.

2.10 DOOR SILENCERS

A. At all hollow metal frames furnish gray resilient rubber silencers. Quantity: Three each at single door openings; two each at double door openings.

2.11 KEY LOCK BOX

A. Furnish one each secure storage box for emergency personnel use. This box shall be located per the architect and fire marshal at the exterior of the building.

B. Dual Lock Model, Recessed Mount, 1/4" plate steel housing, 5/8" thick steel door with interior gasket seal. Vault and Lock UL listed. Lock has 1/8" dust cover with tamper seal mounting capability. Vault has anti-theft re-locking mechanism with drill resistant hard-plate lock protector.

C. Acceptable Manufacturers: Knoxbox 3200

2.12 ELECTRIFIED HARDWARE FUNCTIONS

A. General: Operation of the card reader access control system shall be managed by the UNCW Business Applications Department. Card readers, credentials, monitoring, alarms shall be furnished under Division 28. Refer to the current UNCW Standards & Procedures for Installation of Access Control Equipment by UNCW Physical Security & Access Department.

B. Where specified in the Finish and Security Hardware Sets openings shall be furnished with all materials listed to provide the security function and control required by the Owner.

C. The door function shall be as specified in the Part 3 – Hardware Sets. Finish Hardware submittals shall include operational descriptions and wiring diagrams for all electrified hardware functions.

D. Card reader equipment shall be provided and installed by the Division 28 subcontractor. Handicap Operators shall be installed and terminated by the General Contractor and/or the Hardware Installer. UNCW Information Technology Systems Division shall install required bridge wiring after door operator is installed. All electrical applications specified shall be confirmed by review with the UNCW Physical Security & Access Department.

E. All exterior building entry doors shall be specified with one or more of the above listed electrical functions, or the openings shall be specified with provision for future card readers and electrified hardware.

2.13 OWNERS SERVICE AND STOCK ITEMS

A. Provide four (4) Final Field use Finish and Security Hardware Schedules with Cut Sheets, Service Instructions and any materials pertinent to the service and maintenance of the Hardware and Systems.

B. Provide four (4) Sets of all Electrical Drawings illustrating Riser and Point-to-Point Diagrams.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount hardware units at heights indicated in the following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by the Architect. Mounting Height of exit devices, with the exception of full glass aluminum doors, shall not interfere with lite kits shown on elevations. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Install with only fasteners furnished with each hardware item, or exact match if additional fasteners are required. Any substitute fastener shall be approved by UNCW Locksmith Supervisor prior to installation. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work

specified in the Division 9 Section. Do not install surface mounted items until finishes have been completed on the substrates involved.

1. Gaskets: install jamb-applied gaskets before door closers, overhead stops, rim strikes, etc. Install sweeps across bottoms of doors before astragals. Trim astragals to tops of sweeps.
2. Locate floor stops not more than 4 inches from the wall.
3. Drill pilot holes for fasteners in wood doors and/or frames.
4. ~~Thru-Bolts: All closers and exit devices.~~

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers".

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

G. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

H. Certified installers: Contractor's personnel, and Section 087100 supplier/installer shall be certified prior to installation of exit devices, locksets, closers, and electrified hardware, including ADA operators, electric strikes, electrified hinges, electric exit devices, and electric door releases. Certification shall be obtained by attendance of manufacturer's training at the pre-install meeting. The manufacturer's representative shall provide written certification to the installers and a copy of the certification shall be provided to the Contractor, the University Construction Project Manager, and the University Locksmith Supervisor. Hardware Installers working on the project site not certified by attending the above specified training, shall be removed from the project site.

I. All conduit, outlet and backboxes, provisions for 120VAC power, wiring types required for access control system, pulling of correct wiring to appropriate locations, fire alarm system installation and interface, coordination of electrical applications shall be furnished by the Electrical Contractor (Division 26).

3.2 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and system of each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

B. Clean adjacent surfaces soiled by Hardware Installation. Avoid the use of caustic cleaners which may mar the finish of the Hardware.

C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to work one week before final acceptance and make final check and adjustment of all hardware in such space or area. Clean operating items as necessary. Adjust door controls after HVAC Test and Balance to insurer proper door control.

D. Instruct Owners Personnel in the proper adjustment and maintenance of Hardware and Systems during the final adjustment period.

E. Continued Maintenance Service: Approximately six (6) months after acceptance of the Project, the Installer, accompanied by the Owners representative and the Finish and Security Hardware Representative(s) shall return to the project and survey the project, readjusting any items as required to restore the hardware to its original function. Replace any failed products failed due to faulty design, materials or installation. Prepare and deliver to the Owners representative a written report of any potential problems in the performance of the hardware with recommended service procedures to insure continued correct function of the products.

3.3 INSPECTION

A. Door Hardware Supplier's Field service:

1. Inspect door hardware items for correct installation and adjustment prior to Owner's permanent core installation. The hardware installer shall be present for this inspection. The Owner shall give written notice to the Contractor 5 days prior to inspection. The Hardware Supplier shall submit a written report of the inspection, including any exceptions noted during the inspection, to the Contractor, Architect, the University Construction Project Manager, and the University Locksmith Supervisor.

2. The Hardware Installer Shall reply to the inspection report within three (3) working days after the inspection report. The Installer's response shall include a list of the required repairs or alterations, and the date the repair work shall be performed. All repairs, and or alterations shall be performed with one week after the Installer's response report.

3. The written inspection report and the Installer's repair report shall become part of the Contractor's punch list report. All reports shall be submitted to the project architect, and the University Construction Project Manager.

3.4 HARDWARE SETS

Access Control System equipment, including card readers, wiring, connections, and any system related work shall be provided by others. All Electrical work shall be by Div. 26.

Hardware Group No. 01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR

EXISTING HARDWARE TO REMAIN

Hardware Group No. 02

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR

EXISTING HARDWARE TO REMAIN.

Hardware Group No. 03

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 (ADA THUMBTURN)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 17N	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98-L-2SI-17	626	VON
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	RIM CYL THUMBTURN	XB11-979	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	770AA-S	AA	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 09

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 10

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 11

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 13

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
8	EA	HINGE	5BB1HW 5 X 4.5 NRP		652	IVE
2	EA	FIRE EXIT HARDWARE	9827-L-BE-F-LBR-17-499F		626	VON
2	EA	SURFACE CLOSER	4111 SCUSH		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
2	EA	MAGNET	SEM7820 12V/24V/120V	↯	689	LCN
1	EA	MEETING STILE	328AA-S		AA	ZER
1	EA	GASKETING	488SBK PSA		BK	ZER

DOORS NORMALLY HELD OPEN BY WALL MAGNETS. UPON LOSS OF POWER OR FIRE ALARM, MAGNETS TO RELEASE.

Hardware Group No. 14

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

EXISTING LOCKSET TO BE REUSED.

Hardware Group No. 15

Provide each BD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	BARN DOOR TRACK	200WF	626	JOH
1	EA	BARN DOOR LOCK	9100BDL-3	626	ACC
1	EA	SFIC EVEREST CORE	80-037	626	SCH

Hardware Group No. 16

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	OFFICE/ENTRY LOCK	L9050BDC 17N L583-363 L283-711 (ADA THUMBTURN AND INSIDE INDICATOR)	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH

PATCH FITTINGS, HINGES, CLOSER BY DOOR SUPPLIER.

Hardware Group No. 17

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-9827-EO	626	VON
1	EA	PANIC HARDWARE	LD-9827-NL	626	VON
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SFIC EVEREST CORE	80-037	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA	BK	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER

REUSE EXISTING HARDWARE IN GOOD CONDITION, REPLACE LOCKING HARDWARE WITH PANIC HARDWARE.

Hardware Group No. 18

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 19

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17N L583-363 L283-722 (ADA THUMBTURN AND EXTERIOR INDICATOR)	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 087100

SECTION 087100 – DOOR INDEX

Door#	HwSet#
101	08
101.1	08
103A	03
103D	03
106	14
106A	03
106C	03
106I	03
106K	03
201.1	16
201.3	15
201.4	15
201A	09
203	07
204	11
204B	03
204C	03
204D	05
204E	12
204F	03
204G	03
204H	03
204I	04
204K	03
204L	03
204M	03
204N	10
204O	03
205	07
206	16
206.1	16
C103	03
EXM100	17
EXS101	01
H200	06
M201	01
R101	18 (ALT #8)
R102	19
R200	19
R201	19
S100	13
S100.1	08
S101.1	08
S101.2	13
S200	13

SECTION 088000
GLAZING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).

E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2019.

I. GANA (GM) - GANA Glazing Manual 2008.

J. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).

K. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2020.

L. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2020.

M. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2023.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Certificate: Certify that products of this section meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and IGMA TM-3000 for glazing installation methods.

1.05 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Float Glass Manufacturers:
   1. AGC Glass North America, Inc.
   2. Cardinal Glass Industries.
   3. Guardian Glass, LLC.
   4. Pilkington North America Inc.
   5. Vitro Architectural Glass (formerly PPG Glass).

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7 and values indicated on Structural Drawings.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and air barrier.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.

2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
3. Provide Type I, Quality-Q3, Class 1 (clear) glazing unless otherwise indicated.
   a. Tinted Glazing: Where tinted glazing is indicated, provide Class 2 (tinted).
4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.04 INSULATING GLASS UNITS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: Manufacturer's warm-edge technology design.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: Manufacturer's standard.
      c. Products:
         1) Quanex IG Systems, Inc; Super Spacer TriSeal.
         2) Technoform Glass Insulation; TGI-Spacer.
         3) Substitutions: See Section 016000 - Product Requirements.
   4. Spacer Color: Black.
   5. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
      b. Color: Black.
   6. Purge interpane space with dry air, hermetically sealed.

2.05 GLAZING UNITS

A. Type G1 & G3 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully-tempered float glass. Provide with safety glazing labeling.
   3. Tint: Clear.
   4. Thickness: 1/4 inch or 1/2 inch, nominal, as indicated.

B. Type G2 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Heat-strengthened / fully-tempered float glass, 1/4 inch thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
      c. Coating Products (Low-E; Clear):
         1) AGC; Energy Select 23 (2) Clear.
         2) Guardian; SNX 51/23.
         3) Viracon; #VNE 1-53.
         4) Vitro; Solarban 90.

4. Warm-edge spacer.
5. Inboard Lite: Heat-strengthened / fully-tempered float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
6. Total Thickness: 1 inch.
7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.42, maximum.
8. Solar Heat Gain Coefficient (SHGC): 0.25, maximum.
9. Glazing Method: Dry glazing method, gasket glazing.
10. Provide with safety glazing labeling.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing,

plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Owner's Final Acceptance in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Owner's Final Acceptance.

END OF SECTION 088000

SECTION 088813
FIRE-RATED GLAZING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

C. GANA (GM) - GANA Glazing Manual 2008.

D. ITS (DIR) - Directory of Listed Products Current Edition.

E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2022.

F. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies 2022.

G. UL (DIR) - Online Certifications Directory Current Edition.

H. UL 9 - Standard for Fire Tests of Window Assemblies Current Edition, Including All Revisions.

I. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.

J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene preinstallation meeting one week before starting work of this section; require attendance by each of affected installers.

1.03 SUBMITTALS

A. Product Data on Glazing Unit Glazing Types: Provide structural, physical, and environmental characteristics, size limitations, special handling and installation requirements.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Certificate: Certify that products of this section meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with GANA (GM) for glazing installation methods.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.05 FIELD CONDITIONS

A. Ambient Conditions: Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during, and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty for Coated or Laminated Fire Glass: Provide five-year manufacturer warranty coverage for coating deterioration or delamination, including providing products to

replace failed units, and commencing on the Date of Owner's Final Acceptance. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads and withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   2. Provide glass edge support system sufficiently stiff to limit lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   3. Glass thicknesses listed are minimum.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Comply with ASTM C1048.
   2. Kind FT - Fully Tempered Type: Comply with ASTM C1048.

2.03 GLAZING UNITS

A. Type G4 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire rating period(s) as indicated on drawings.
   1. Applications:
      a. Glazing in fire-resistance-rated door assemblies.
      b. Other locations as indicated on drawings.
   2. Glass Type: Safety ceramic glass.
   3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
   4. Safety Glazing Certification: 16 CFR 1201 Category II.
   5. Glazing Method: As required for fire rating.
   6. Fire-Rating Period: As indicated on drawings.
   7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
      a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
      b. "OH" - meets fire window assembly criteria, including hose stream test of NFPA 257 or UL 9 fire test standards.
      c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
      d. "XXX" - placeholder that represents fire-rating period, in minutes.
   8. Products:
      a. SCHOTT North America Inc; PYRAN Platinum F (Surface-Applied Safety Film).
      b. Technical Glass Products; Firelite NT.
      c. Vetrotech North America; Keralite/Select Filmed.

2.04 ACCESSORIES

A. Setting Blocks: Aluminum silicate, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape: Flexible tape made from spun calcium-magnesium-silica fibers in binder; designed to remain stable at temperatures up to 2,012 degrees F.
   1. Thickness: As recommended by framing manufacturer for glazing application.

D. Glazing Gaskets: Flexible intumescent seals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION - GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers unless more stringent requirements are indicated, including those in referenced glazing standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with contaminating substances that may result from construction operations including, but not limited to weld spatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

A. Application - Interior Glazed: Set glazing infills from interior of building.

B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sightline.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.

E. Place glazing tape on free perimeter of glazing in same manner described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Carefully trim protruding tape with knife.

3.05 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than four days prior to Date of Owner's Final Acceptance in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

A. After installation, mark pane with 'X' by using removable plastic tape or paste; do not mark heat-absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Owner's Final Acceptance.

END OF SECTION 088813

SECTION 089100
LOUVERS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2012 (Reapproved 2015).

C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.

1.02 SUBMITTALS

A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.

C. Samples: Manufacturer's color charts indicating full range of available colors.

D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.03 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.

1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers:

1. Airline Louvers.
2. Airolite Company, LLC.
3. American Warming and Ventilating.
4. Construction Specialties, Inc.
5. Industrial Louvers, Inc.
6. NCA, a brand of Metal Industries Inc.
7. Pottorff.
8. Ruskin.
9. United Enertech.
10. Substitutions: See Section 016000 - Product Requirements.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511; provide AMCA Certified seal/marking on all louvers.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
   2. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   3. Screens: Provide insect screens at non-ducted louvers.

B. Storm-Resistant/Wind-Driven Rain Resistant Louvers: Inverted "V" blade, extruded aluminum construction.
   1. Basis-of-Design Product: Construction Specialties; RS-5300.
   2. Free Area: 47 percent, minimum.
   3. Pressure Drop: 0.10 inches of water gauge maximum per square foot of free area at velocity of 500 fpm, when tested in accordance with AMCA 500-L, test unit size 48 inch by 48 inch.
   4. Wind-Driven Rain Performance: AMCA certified Class A; 99 percent effectiveness when tested at a rainfall rate of 3.0 inches per hour, wind speed of 29 mph, and nominal core ventilation rate of 300 ft/min (1.5 m/s).
   5. Blades: Inverted V-shaped, drainable. Provide with integral gutters to direct water to the exterior.
   6. Frame: 5 inches deep, channel profile; corner joints mitered, with continuous recessed caulking channel each side.
   7. Aluminum Thickness: Frame 0.080 inch minimum; blades 0.060 inch minimum.
   8. Aluminum Finish: High performance organic coatings; finish welded units after fabrication.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

2.04 FINISHES

A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

B. Color: As selected from manufacturer's standard colors.

2.05 ACCESSORIES

A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

B. Insect Screen: 18 x 16 size aluminum mesh.

C. Fasteners: Concealed type; stainless steel. If exposed fasteners are unavoidable, provide color-matched heads to match framing color.

D. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

E. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Set sill members and sill flashing in continuous bead of sealant.

D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

E. Secure louver frames in openings with concealed fasteners.

F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION 089100

SECTION 092216
COLD FORMED STEEL FRAMING - NON-STRUCTURAL (CFSF-NS)

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Refer to Section 054000 - Cold-Formed Steel Framing - Structural (CFSF-S): Requirements for structural, load-bearing, metal stud framing and overhead/suspended/bulkhead framing.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).

H. ASTM E413 - Classification for Rating Sound Insulation 2022.

1.03 SUBMITTALS

A. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel.
   1. Steel Thickness (Studs and Runners): Minimum 0.0179-inch (18 mil / 25 gauge) unless otherwise required to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf, and as indicated below:
      a. Provide minimum 0.0329-inch thickness (33 mil / 20 gauge - structural) for all partitions using 3-5/8-inch-deep studs where stud partition height is greater than 12 feet above floor level.
      b. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for high-density board applications, such as ASTM C 1178 tile backing panels and ASTM C 1629 abuse- or impact-resistant gypsum board, and at door frames.
      c. Provide minimum 0.0329-inch (33 mil / 20 gauge - Structural) for walls receiving heavy wall-hung items or loads, including but not limited to wall cabinets, wall-hung countertops, TV brackets, liquid tanks, folding and fixed seats, grab bars, handrails, exercise equipment, and shelving greater than 9 inches deep and over 3 feet in length.
   2. Studs: C shaped with knurled or embossed faces.
   3. Runners: U shaped, sized to match studs.

4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

C. Backer Plates: Provide horizontal galvanized plate, 6 inch wide by 16 gauge, by length required for items to be supported. Screw or reivet-attach to face of metal studs in gypsum board partitions to provide reinforced backing for wall mounted items. Coordinate with Drawings to identify locations, extents, and mounting heights of plates.

D. Non-Loadbearing Framing Accessories:
   1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
   3. Sheet Metal Backing: 0.036 inch thick, galvanized.
   4. Fasteners: Self-tapping screws designed for attachment of metal framing and recommended by manufacturer.
   5. Anchorage Devices: Powder actuated or screw anchors with sleeves, recommended by manufacturer for anchorage to indicated substrates.
   6. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness as indicated, or sized to fit stud depth indicated.
   7. Acoustic Sealant: Refer to Division 07 Section "Joint Sealants."

2.02 GYPSUM BOARD SUSPENSION SYSTEM

A. For interior overhead gypsum board, in lieu of separate stick built fixed-framing bulkheads and soffits fabricated of Structural Cold-Formed Steel Framing (CFSF-S), Contractor may provide a direct hung suspension system, per ASTM C645, composed of pre-fabricated beams and cross-furring members, specifically designed for use with gypsum board.

B. Products:
   1. Armstrong; Quikstix Drywall Grid System.
   2. Certainteed; 1-1/2" Drywall Suspension System.
   3. Rockfon; Chicago Metallic Drywall Grid System.
   4. USG; Drywall Suspension System.

2.03 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.

B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

A. Extend partition framing to deck at locations indicated, and to a height 4 inches above ceiling level at all other locations, unless otherwise indicated.

B. Partitions Terminating to Deck: Secure partitions to building structure in accordance with Structural Drawings. Do not fasten runner directly to floor/roof deck; provide clearance for firestopping. Coordinate with Section 078400 - Firestopping for head-of-wall joint firestopping assemblies and firestopping around structural elements as required.

C. Partitions Terminating Above Ceiling: Attach studs to runner using specified mechanical devices in accordance with manufacturer's instructions. Brace runners to structural elements in accordance with Structural Drawings.

D. Align and secure top and bottom runners at 24 inches on center.

E. At partitions indicated with an acoustic rating:
   1. Provide components and install as required to produce STC ratings as indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.

F. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.

G. Install studs vertically at 16 inches on center, unless otherwise indicated.

H. Align stud web openings horizontally.

I. Secure studs to tracks using crimping method. Do not weld.

J. Fabricate corners using a minimum of three studs.

K. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.

L. Coordinate erection of studs with requirements of door frames; install supports and attachments.

M. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

N. Blocking/Backer Plate: Use galvanized metal plate backer, secured to studs. Provide backer plates for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, and other built-in-place wall mounted items and equipment.

O. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

3.03 GYPSUM BOARD SUSPENSION SYSTEM

A. Install suspension system in accordance with manufacturer's instructions. Do not attach overhead suspension hangers to or suspend from steel floor or roof deck; fasten to primary structural beams/joists or provide intermediate slotted track as supplemental structure between primary structural elements.

3.04 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch in 10 feet.

B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION 092216

SECTION 092900
GYPSUM BOARD

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 2019.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017 (Reapproved 2022).

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

E. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

F. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units 2022.

G. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

H. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2019.

I. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2019, with Editorial Revision (2020).

J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

K. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.02 SUBMITTALS

A. Product Data: Provide data on gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.

1.03 DELIVERY, STORAGE, HANDLING, AND FIELD CONDITIONS

A. Do not deliver or install until building is weather-tight and conditioned.

B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent damage and to prevent marring and soiling of finished surfaces.

C. Do not install gypsum products that have gotten wet or moldy, or show signs of past moisture damage.

D. Maintain uniform temperature and humidity at occupancy conditions during and after installation. Allow products to acclimatize prior to installation.

PART 2 PRODUCTS

2.01 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; with tapered edges.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

a. Mold-resistant board is required whenever gypsum board is indicated in rooms subject to steam or water, including mechanical rooms, toilet rooms, custodial rooms, and kitchens.

3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
4. Thickness:
   a. Vertical Surfaces: 5/8 inch.
   b. Ceilings: 1/2 inch, sag-resistant type.
   c. Curved Surfaces: Provide flexible 1/4 inch thickness gypsum board.

B. Impact Resistant Wallboard:
1. Application: High-traffic areas indicated, including corridors, lobbies, and stairs.
2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
7. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
8. Glass Mat-Faced Type: Gypsum wallboard, as defined in ASTM C1658/C1658M.
9. Type: Fire-resistance-rated Type X, UL or WH listed.
10. Thickness: 5/8 inch.
11. Edges: Tapered.
12. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc IR Type X.
    b. CertainTeed Corporation; Extreme Impact Resistant Drywall with M2Tech.
    c. National Gypsum Company; Gold Bond Hi-Impact XP Gypsum Board.
    d. Substitutions: See Section 016000 - Product Requirements.
13. Glass Mat Faced Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
    b. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough VHI.
    c. Substitutions: See Section 016000 - Product Requirements.

C. Tile Backing Board:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. ANSI Cement-Based Board: Non-gypsum-based; cementitious panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 and ASTM C 1288 or ASTM C1325.
   a. Thickness: 5/8 inch.
   b. Available Products:
      1) FinPan, Inc.; Util-A-Crete Backer Board.
      2) National Gypsum Company; PermaBase Cement Board.
      3) USG Corporation; Durock Cement Board.
      4) Substitutions: See Section 016000 - Product Requirements.

2.02 GYPSUM BOARD ACCESSORIES

A. Sound Attenuation Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness sized to fit metal stud cavity.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant. Refer to sealant AS-1 in Division 07 Section "Joint Sealants."

C. Putty Pads: Non-hardening endothermic material, in pad form, faced on both sides with poly liner, designed to seal around penetrations and wiring devices, enhancing acoustic performance.
   1. Nominal Size: 7-1/4 x 7-1/4 x 3/16 inches.
   2. Available Products:
      a. 3M; Fire Barrier Moldable Putty Pads MPP+.
      b. Hilti; Firestop Putty Pad, CFS-P PA.
      c. Specified Technologies, Inc.; SpecSeal Putty Pad.

D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Trim with Tear-Away Strip: Sized to fit gypsum wallboard size(s) indicated.

E. Decorative Metal Trim:
   1. Material: Extruded aluminum alloy 6063-T5 temper.
   2. Finish: Anodized, clear.
   3. Type: Profile as selected from manufacturer's standard range.

F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

A. Sound Attenuation Batts: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Install gypsum board with an open horizontal joint (gap) not to exceed 5/8-inch above finished floor slab, and tape and finish vertical joints to bottom edge of board to afford a smooth substrate for applied wall base.

F. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints in compliance with ASTM C 840, consistent with lines of building spaces, and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

D. Putty Pads: Install putty pads on the backside of items penetrating gypsum board on STC-rated walls/partitions. Items include, but are not limited to, wiring devices, cable, conduit, and pipe. Completely cover and seal around each penetration.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: All exposed to view walls and ceilings to receive paint finish, and other areas specifically indicated.
   2. Level 4: All exposed to view walls and ceilings in utility rooms such as, but not limited to, mechanical, electrical, and data rooms, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 092900

SECTION 093000
TILING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.

B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.

C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).

D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.

E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive 2019.

F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2021.

G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy 1999 (Reaffirmed 2019).

H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).

I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.

J. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).

K. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.

L. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs 2020.

M. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2021.

N. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2014 (Reaffirmed 2019).

O. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014 (Reaffirmed 2019).

P. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2022.

Q. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2022.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting at the Project Site one week before starting work of this section; require attendance by affected installers.
   1. Review substrate preparation requirements.
   2. Review each type of tile, mortar, grout, and TCNA installation methods.
   3. Review requirements for waterproofing and/or crack isolation membrane(s).

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
   1. Include waterproofing details at floor drains, shower pans, cove base, and thresholds.

D. Installer's Qualification Statement.
   1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
   2. Submit documentation of completion of apprenticeship and certification programs.

E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have documented experience of work similar in scope, materials, and design to that indicated for this Project, with a record of successful in-service performance, with references upon request. Installer shall hold company-wide accreditation or employ individuals with one of the listed certifications (comply with at least one):
   1. Company-wide accreditation from one of the following:
      a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
   2. Installer Certification:
      a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
      b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.

1.05 MOCK-UPS

A. See Section 014000 - Quality Requirements for general requirements for mock-up.

B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
   1. Provide mock-up of minimum 5 square feet for each type of floor tile, unless otherwise indicated.
   2. Provide mock-up of minimum 5 square feet for each type of wall tile, unless otherwise indicated.
   3. Approved mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store tile, grout, and mortar off the ground, protected from weather and water infiltration.

B. Store products in unopened containers or packages until ready for use.

C. Protect materials from freezing or overheating in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature and humidity at levels required by referenced ANSI and TCNA tile standards, and per manufacturer's instructions.

PART 2 PRODUCTS

2.01 TILE

A. Manufacturers: All products of each type by the same manufacturer.

B. Glazed Wall Tile, Type GWT-A: ANSI A137.1 standard grade.
   1. Size: 3 by 12 inch, nominal
   2. Surface Finish: Glossy.
   3. Color(s): To be selected by Architect from manufacturer's full range.
   4. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.
   5. Products:
      a. Dal-Tile Corporation.
      b. Ceramic Technics.
      c. TileBar.
      d. Architessa.

C. Glazed Wall Tile, Type GWT-B: ANSI A137.1 standard grade.
   1. Size: 3 by 8 inch, nominal
   2. Surface Finish: Glossy.
   3. Color(s): To be selected by Architect from manufacturer's full range.
   4. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.
   5. Products:
      a. Dal-Tile Corporation.
      b. Ceramic Technics.
      c. TileBar.
      d. Architessa.

D. Porcelain Tile, Type P-TILE-1: ANSI A137.1 standard grade.
   1. Size: 12 by 24 inch, nominal.
   2. Thickness: 3/8 inch.
   3. Color(s): To be selected by Architect from manufacturer's full range.
   4. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.
   5. Products:
      a. Ceramic Technics

b. Dal-Tile Corporation.
c. TileBar
d. Architessa

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Open edges of wall tile.
      b. Open edges of floor tile.
      c. Wall corners, outside and inside.
      d. Transition between floor finishes of different heights.
      e. Thresholds at door openings.
      f. Expansion and control joints, floor and wall.
      g. Floor to wall joints.
      h. Borders and other trim as indicated on drawings.
   2. Manufacturers:
      a. Schluter-Systems.
      b. Genesis APS International.
      c. Blanke.
      d. Ceramic Tool Company (CTC).
      e. Substitutions: See Section 016000 - Product Requirements.

B. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
   1. Applications:
      a. At doorways where tile terminates.

2.03 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4
   1. Applications: Use this type at all locations where thinset mortar is indicated, unless otherwise indicated.
   2. Products:
      a. H.B. Fuller Construction Products, Inc.; TEC Full Flex TA 390/391.
      b. LATICRETE International, Inc.; 252 Silver.
      c. MAPEI Corporation; Ultraflex 2.
      d. Summitville Tiles, Inc.; S-1000 MP Thin-Set Latex Mortar.
      e. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

A. Provide setting and grout materials from same manufacturer.

B. Water-Cleanable Epoxy Grout: ANSI A118.3 stain-resistant epoxy grout.
   1. Applications: Where indicated.
   2. Heat Resistance: Tested by manufacturer for continuous exposure up to 140 deg F, and intermittent exposure up to 212 deg F.
   3. Color(s): As selected by Architect from manufacturer's full line.

4. Products:
    a. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout.
    b. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout.
    c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout.
    d. MAPEI Corporation; Kerapoxy CQ.
    e. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy.
    f. Summitville Tiles, Inc; S-500 Ultra Max.
    g. Substitutions: See Section 016000 - Product Requirements.

2.05 MAINTENANCE MATERIALS

A. Tile Sealants: Moisture- and mildew-resistant type sealants; one-part silicone for wall applications and multi-part urethane for floor applications. Sealants and accessories shall comply with requirements below and with requirements of Division 7 Section "Joint Sealants."
    1. Color(s): As selected by Architect from manufacturer's full line. Sealant colors shall match grout colors in adjacent joints unless otherwise indicated.
    2. Silicone Sealant (Walls): ASTM C 920, Type S, Grade NS, Class 25; Uses NT (non-traffic), G (glass), A (aluminum), O (other substrates indicated).
        a. Products:
            1) GE Silicones, a division of GE Specialty Materials; SCS1700 Sanitary.
            2) Pecora Corporation; Pecora 898 NST.
            3) Tremco Inc.; Tremsil 200.
            4) Substitutions: See Section 016000 - Product Requirements.
    3. Urethane Sealant (Floors): ASTM C 920, Type M, Grade P, Class 25; Uses T (traffic), M (mortar), A (aluminum), O (other substrates indicated).
        a. Products:
            1) Master Builders Solutions; MasterSeal SL 2.
            2) Pecora Corporation; NR-200 Urexpan.
            3) Sika Corporation; Sikaflex-2c SL.
            4) Tremco Inc.; THC-901.
            5) Substitutions: See Section 016000 - Product Requirements.
    4. Sealant Accessories: Provide backer rod, primer, and other sealant accessories as recommended by sealant manufacturer for applications required.

B. Grout Sealer: Liquid-applied, penetrating, moisture and stain protection for existing or new Portland cement grout.
    1. Composition: Water-based colorless silicone.
    2. Products:
        a. Custom Building Products; Aqua Mix Sealer's Choice Gold.
        b. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer.
        c. SGM, Inc.; Grout Sealer.
        d. Summitville Tiles, Inc.; SL-99 Summitseal II.
        e. Substitutions: See Section 016000 - Product Requirements.

C. Tile Sealer: Stain protection for exposed surfaces of unglazed ceramic tile, other porous tile, and grout. Provide penetrating sealer with no sheen, preserving natural tile appearance.
    1. Products:
        a. Custom Building Products; Aqua Mix Sealer's Choice Gold.

b. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer.
c. STONETECH, a division of LATICRETE international, Inc; STONETECH Heavy Duty Sealer.
d. Substitutions: See Section 016000 - Product Requirements.

D. Grout Release: Temporary, water-soluble pre-grout coating.
1. Products:
a. Custom Building Products; Aqua Mix Grout Release.
b. MAPEI Corporation; UltraCare Grout Release.
c. Substitutions: See Section 016000 - Product Requirements.

2.06 ACCESSORY MATERIALS

A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/8 inch gap, minimum; comply with ANSI A118.12.
2. Fluid or Trowel Applied Type with Embedded Reinforcing Fabric:
a. Material: Synthetic rubber or Acrylic.
b. Thickness: 30 mils, minimum, dry film thickness.
c. Products:
1) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
2) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane.
3) LATICRETE International, Inc; 9235 Waterproofing Membrane.
4) MAPEI Corporation; Mapelastic AquaDefense.
5) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard 2000.
6) Summitville Tiles, Inc.; S-9000.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work, per ANSI A108.01, and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. For ease of cleaning and to prevent staining, precoat tile with temporary grout release. For unglazed ceramic and other porous tile types, provide either combination tile sealer/grout release, or a temporary grout release with final tile sealer applied after tile installation.

3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F122/F122A, over combination waterproofing/crack-isolation membrane, with epoxy grout.

1. Provide modified dry-set mortar in a standard thinset bed, except provide LHT mortar in a 5/8-inch medium bed at all large format tile (tile 12 inches or greater in any dimension).

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, with modified dry-set mortar and epoxy grout.

B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, with modified dry-set mortar and epoxy grout.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

C. Shop Drawings: Coordination drawings for reflected ceiling plans, drawn accurately to scale ¼" = 1'-0" indicating penetrations, light fixtures, HVAC outlets and inlets, speakers, sprinkler heads, special moldings at walls, columns and relationship with adjoining materials and planes.

D. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

E. Sample Warranty: For panel and grid (single source) warranty systems specified.

F. Maintenance Data: For each panel finish provided to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

C. Surface-Burning Characteristics: Provide ceiling panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions, for seismic design category indicated, according to the following:

1. Current edition of the **NCBC 2018** which references applicable requirements of ASCE 7, "Minimum Design Loads for Buildings and Other Structures," which references applicable requirements of ASTM E 580, "Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.6 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1. Indicated stud partition assemblies terminate with a foam gasket isolation strip at underside of suspended ceilings as work of Section 092216. Stud top runner is attached to suspension grid, not acoustical ceiling panels.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

1.8 WARRANTY

A. Special System Warranty: Manufacturer shall warrant ceiling panel system (including acoustical ceiling panels and suspension system) to be free of manufacturing defects

1. Failures include, but are not limited to, the following:

a. Sag, warp, shrinkage, and delamination.
b. Growth of mold and mildew.
c. Greater than 50% red rust on suspension system.

2. Warranty period: Minimum of fifteen (15) years from date of Owner's Final Acceptance.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACP

A. Products: Subject to compliance with requirements, provide Basis of Design USG Clima Plus or one of the following:

1. Armstrong World Industries, Inc.; "Ultima" Item #1910.
2. CertainTeed Ceilings, Inc.; "Symphony m" Item #1222.
3. Basis of Design: USG Interiors, Inc.; "Mars ClimaPlus" Item #86185

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Pattern: E (lightly textured) or G (smooth).

C. Color: White.
D. LR: Not less than 0.89.
E. NRC: Not less than 0.70.
F. CAC: Not less than 35.
G. Edge/Joint Detail: Square.
H. Thickness: 3/4 inch (19 mm).
I. Modular Size: 24 by 24 inches (610 by 610 mm).
J. Humidity Resistant: Minimum 10-year warranty against sag.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of pre-consumer recycled content is not less than **25** percent.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion anchors.

b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm) diameter wire.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING ACP

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.; "Prelude XL"
2. Chicago Metallic Corp.; "1200 Seismic/211-1274 Main Tee"
3. CertainTeed Ceilings, Inc.; "15/16" Classic Stab System"
4. USG Interiors, Inc.; "DX 24 System" (Donn)

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges. Provide main beams and 48-inch (1220 mm) length cross-tees of same depth and support load carrying capacity required for main beams for specified structural class (intermediate duty). Provide positive locking cross-tee to main beam connection and override cross-tee ends, and a bayonet type end coupling (vs. knuckle type) for main runners.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.

2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For lay-in panels with reveal edge details, provide standard 7/8 by 7/8-inch size edge angle molding mounted in same plane as suspended grid. Provide cut reveal edge at cut edge of ceiling panels to match factory profile.
4. For all lay-in panels, provide "shadow-line" stepped edge molding that forms 3/4 by 3/4-inch reveal at wall and nominal 3/4-inch bottom flange at exposed suspension member. (In all cases, set bottom flange of exposed grid members at bottom step.)
5. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Acoustical Sealant for Exposed and Concealed Joints:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. Hilti CP506 Smoke and Acoustical Sealant.
      c. USG Corporation; SHEETROCK Acoustical Sealant.
   2. Acoustical Sealant for Concealed Joints:
      a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
      b. Pecora Corporation; BA-98.
      c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant**, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),** complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant**, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24),** recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.7 SOUND ATTENUATION BLANKETS

A. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. Provide [3-inch] thickness blankets unless indicated otherwise
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this

and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans wherever possible.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636, per manufacturer's written instructions **, and per seismic design requirements indicated, including ASCE 7 and ASTM E 580**.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
2. Apply acoustical sealant in a continuous bead at top edge of vertical legs of moldings after they are installed.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as indicated in finish schedule or directed by Architect.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of (factory- and field-cut) reveal edge in firm contact with top surface of runner flanges.

G. Sound Attenuation Blankets: For designated application areas, provide sound attenuation blankets above the suspended acoustical ceiling assembly installed in accordance with suspended acoustical ceiling manufacturer's recommendations.

1. Install rolls perpendicularly to the cross tees with the grid supporting the weight of the insulation.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2021.

B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile 2004 (Reapproved 2018).

C. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile 2020.

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

1.02 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Shop Drawings: Indicate seaming plans and floor patterns.

C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

D. Installer's Qualification Statement.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

1.05 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and installation.

C. Installer's Warranty: Installer shall warrant that the products have been installed in accordance with manufacturer's instructions.

1. The installer shall provide a ten (10) year warranty against product failure due to excessive moisture vapor transmission through the slab.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Luxury Vinyl Tile - LVT-A: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
   1. Manufacturers:
      a. Mannington Commercial, a unit of Mannington Mills, Inc
      b. Milliken
      c. Patcraft
      d. Shaw Contract
   2. Minimum Requirements: Comply with ASTM F1700, Class III.
   3. Plank Tile Size: 9 by 59 inch.
   4. Wear Layer Thickness: 0.020 inch.
   5. Total Thickness: 0.197 inch.
   6. Color: To be selected by Architect from manufacturer's full range.

B. Luxury Vinyl Tile - LVT-B: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
   1. Manufacturers:
      a. Mannington Commercial, a unit of Mannington Mills, Inc
      b. Milliken
      c. Patcraft
      d. Shaw Contract
   2. Minimum Requirements: Comply with ASTM F1700, Class III.
   3. Plank Tile Size: 6 by 36 inch.
   4. Wear Layer Thickness: 0.020 inch.
   5. Total Thickness: 0.118 inch.
   6. Color: To be selected by Architect from manufacturer's full range.

2.02 ACCESSORIES

A. Subfloor Filler: Type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moisture Vapor Treatment: Where resilient flooring and accessories are installed over concrete slabs-on-grade, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab per the following:
   1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
      a. Duraamen Engineered Products, Inc.; Perdure MVT.
      b. Maxxon Corporation; Maxxon MVP.
      c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
   2. Performance Requirements:
      a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer’s warranty.
      b. Low-VOC: Provide product with VOC content less than 15 g/L.

c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft^2/in-Hg, per ASTM F3010.
e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Floor Polish: Fluid-applied polish recommended by resilient flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
1. Test as Follows: Perform one of each test per 1,000 sf of installation area.
a. Alkalinity (pH): ASTM F710.
b. Internal Relative Humidity: ASTM F2170.
c. Moisture Vapor Emission: ASTM F1869.
2. After initial testing, apply moisture vapor treatment (MVT) in accordance with manufacturer's requirements.
3. If test results indicate moisture content is acceptable to flooring manufacturer, MVT may be omitted upon approval of the Architect with a credit to the Owner for unused product.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

C. Prohibit traffic until filler is fully cured.

D. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
1. Fit joints and butt seams tightly.
2. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern, unless otherwise indicated.

3.05 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Polish: Apply not less than three coats of floor polish. Provide additional coats as required to comply with manufacturer's recommendations.

3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 096500

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Product Schedule: For resilient products. **Use same designations indicated on Drawings.**

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

C. Source Limitations: Obtain resilient base and resilient molding accessories through single source from single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not below 70 deg F (21 deg C) or above 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Date of Owner's Final Acceptance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

1.6 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than (1) one box for each (50) fifty boxes or fraction thereof, for each type, color, pattern, and size installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE (**RB)**

A. Resilient Base Available Type TP (rubber, thermoplastic):

1. Subject to compliance, provide basis of design product "Roppe Contours" or comparable product by one of the following:
   a. Flexco (USA), Inc.
   b. Mannington Commercial Burkbase
   c. Roppe Corporation
   d. Tarkett, Johnsonite

B. Resilient Base Standard: ASTM F 1861.

Material Requirement and Manufacturing Group: Type TP (rubber, thermoplastic), Group I (solid, homogeneous) or Group II (layered).

1. Style: Basis of Design Roppe Contours Simplicity #00

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm)

E. Lengths: Coils in manufacturer's standard length.

F. Outside and Inside Corners: Job formed.

G. Finish: As selected by Architect from manufacturer's full range.

H. Colors and Patterns: As selected by Architect from full range of industry colors. Basis of Design Color: Roppe 178 Pewter.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flexco (USA), Inc.
   b. Mannington Commercial Burkbase
   c. Roppe Corporation
   d. Tarkett, Johnsonite

B. Description: Reducer strip for resilient floor covering, Joiner for tile and carpet, Transition strips.

C. Material: **Vinyl**.

D. Colors and Patterns: **As selected by Architect from full range of industry colors**.

2.3 SUBFLOOR LEVELING ACCESSORY

A. Subfloor Leveling Accessory: Provide subfloor leveling system to provide smooth transition between two different flooring elevations. Leveling strips shall comply with applicable ANSI A117.1 requirements & ADA Accessibility Guidelines governing Changes in Level.

1. Manufacturers: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johnsonite; "Subfloor Leveler System."

b. Mannington Commercial; "Subfloor Leveling System."
c. Roppe Corporation, USA; "Subfloor Leveler."
d. Flexco; "Subleveling Systems."

2. Profile: Provide as indicated, or as required for indicated transition depth.
3. Length: Provide continuous for full length of indicated transitions.
4. Adhesive: Provide manufacturer recommended adhesive for application to substrate indicated.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
a. Cove Base Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Accessories: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform not less than 2 tests in each installation area and with test areas evenly spaced in installation areas.

a. Perform anhydrous calcium chloride test according to ASTM F 1869.

b. Perform relative humidity test using in situ probes according to ASTM F 2170.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of [**carpet**] [**resilient floor covering**] that would otherwise be exposed.

C. Subfloor Leveling Accessory: Butt to adjacent materials and tightly adhere leveling strips to substrate throughout length of each piece.

1. At door openings, leveling strips shall be centered under doors. At cased openings, transition strips shall be centered in the frame.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Date of Owner's Final Acceptance.

END OF SECTION 096513

SECTION 096813
TILE CARPETING

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).

B. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2023.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Substitutions/Prequalification: Manufacturers seeking consideration to bid their product as an acceptable alternative shall provide full product data and full range of selection samples during the bid period. Products that do not meet the technical and aesthetic criteria will not be accepted. No substitutions shall be permitted for carpet tile after receipt of bids.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings and transition strips.

1. Where multiple carpet tile products are specified (including multiple products in a single space installed in an indicated pattern), indicate on the shop drawings the locations where each product is being installed.

D. Selection Samples: Submit manufacturer's color charts indicating full range of colors for carpet tiles and for accessories.

E. Verification Sample: Submit full size sample for each required color, pattern, and texture.

1. Submit samples in manufacturer's standard size for each accessory product.

F. Installer's Qualification Statement.

G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1. Include specific procedures and materials that are not recommended, including those that may be harmful to carpet tile or that would void warranty.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

A. Critical Radiant Flux: All carpet tiles shall be Class I rated, with a minimum CRF of 0.45 watts/sq cm, when tested by an independent testing agency in accordance with ASTM E648 or NFPA 253.

1.05 FIELD CONDITIONS, STORAGE AND HANDLING

A. Comply with the Carpet and Rug Institute (CRI) Publication "CRI 104 - Standard for Installation of Commercial Carpet." Comply with Section 4.0 for storage and handling, Section 7.0 for ambient temperature and ventilation, and Section 9.0 for Product Acclimation.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Carpet Tile Warranty: Provide a ten (10) year manufacturer warranty, covering defective material and faulty installation.

1. Warranty shall cover excessive surface wear (defined as more than 10% loss by weight of face fiber), edge raveling, backing separation, shrinking, stretching, cupping, doming, static electricity, or color loss or fading.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting: Provide the basis-of-design carpet tiles or a prequalified alternate tile. No substitutions will be considered after the award of Contract.

1. Bentley Mills.
2. Interface, Inc.
3. Mannington Commercial.
4. Milliken & Company.
5. Tandus-Centiva.

2.02 MATERIALS

A. Tile Carpeting, Type C-TILE-A: Tufted, manufactured in one color dye lot.

1. Product: Major Frequency: One manufactured by Milliken.
2. Tile Size: 10 by 39 inch, nominal.
3. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
4. Gauge: 1/12 inch.
5. Stitches: 9.5 per inch.
6. Primary Backing Material: Manufacturer's standard; recycled vinyl with fiberglass reinforcing.

B. Tile Carpeting, Type C-TILE-B: Tufted, manufactured in one color dye lot.

1. Product: Major Frequency: One manufactured by Milliken.
2. Tile Size: 10 by 39 inch, nominal.
3. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
4. Gauge: 1/12 inch.
5. Stitches: 9.5 per inch.
6. Primary Backing Material: Manufacturer's standard; recycled vinyl with fiberglass reinforcing.

C. Tile Carpeting, Type C-TILE-C: Tufted, manufactured in one color dye lot.

1. Product: TBD manufactured by Milliken.
2. Tile Size: 10 TBD inch, nominal.

3. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
4. Gauge: TBD inch.
5. Stitches: TBD per inch.
6. Primary Backing Material: Manufacturer's standard; recycled vinyl with fiberglass reinforcing.

2.03 ACCESSORIES

A. Subfloor Filler: Type recommended by flooring material manufacturer.

B. Edge Strips: Rubber, color as selected by Architect.

C. Moisture Vapor Treatment: Where carpeting and accessories are installed over concrete slabs, provide alkaline-resistant product designed to control excessive moisture vapor transmission through concrete slab, per the following:
   1. Products: Provide product approved by flooring manufacturer and complying with performance requirements below, equivalent to one of the following:
      a. Duraamen Engineered Products, Inc.; Perdure MVT.
      b. Maxxon Corporation; Maxxon MVP.
      c. Tnemec Company Inc.; Epoxoprime MVT, Series 208.
   2. Performance Requirements:
      a. Verify with flooring manufacturer that submitted product maintains compliance with all provisions of flooring manufacturer’s warranty.
      b. Low-VOC: Provide product with VOC content less than 15 g/L.
      c. Bond Strength to Concrete: Minimum 400 psi per ASTM D 4541 (100% concrete failure).
      d. Permeance: Maximum 0.1 perm per ASTM E 96, and 0.10 grains/hr/ft^2/in-Hg, per ASTM F3010.
      e. Applications: Provide MVT for all concrete slabs on-grade and lightweight concrete elevated slabs.

D. Adhesives:
   1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

E. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated.

F. Locate change of color or pattern between rooms or at transitions to other finish flooring material directly under the door leaf centerlines, or at the center of cased openings.

G. Fully adhere carpet tile to substrate.

H. Install carpet tile into wall recesses, knee spaces under cabinets or countertops, closets, and other similar spaces.

I. Trim carpet tile neatly at walls and around interruptions.

J. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING AND PROTECTION

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

C. Protect installed carpet in accordance with CRI 104, Section 13.7 "Post Installation."

END OF SECTION 096813

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate **pattern placement** seams and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by **36-inch- (914-mm)** long in size.
   1. Wall-Covering Sample: From same production run to be used for the Work, with specified **treatments** applied. **Show complete pattern repeat. Mark top and face of fabric.**

D. Product Schedule: For wall coverings. **Use same designations indicated on Drawings.**

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to **5** percent of amount installed.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer regularly engaged, for past 5 years, in manufacture of commercial wallcoverings.

B. Installer Qualifications:
   1. Installer regularly engaged, for past 3 years, in installation of commercial wallcoverings.
   2. Employ persons trained for installation of commercial wallcoverings.

C. Pre-installation meeting:
   1. Convene pre-installation meeting prior to commencing work of this section.
   2. Require attendance of installation material manufacturer, installer, and installers of related work. Review installation procedures and coordination required with related work.
   3. Check specified material to ensure that specified pattern/color(s) have been ordered.
   4. Review surface preparation, testing for and eliminating sources of moisture accumulation into walls, installation, cleaning, protection, and coordination with other work.
   5. Meeting agenda includes but is not limited to:
      a. Surface preparation.
      b. Product and installation material compatibility.
      c. Edge protection, transition and pre-fabricated joint profiles.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Low-Emitting Materials: Wall-covering system shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: **250** or less.
   2. Fire-Growth Contribution: No flashover and heat and smoke release according to **NFPA 286**.

2.2 VINYL WALL COVERING – **(VWC-A)**

A. General:

1. Products: Subject to compliance with requirements, provide Basis of Design **DeNovo "World Tour",** or comparaple custom digital print product by one of the following:
    a. Basis of Design: DeNovo
    b. Eykon Design Resources.
    c. Koroseal
    d. MDC
    e. National Solutions

B. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:
1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium-Duty products.
2. ASTM F 793 for wall coverings.
    a. Category: II, Decorative with Medium Serviceability

A. Description: Provide products in rolls from same production run and complying with the following:
1. FS CCC-W-408D for Type II, Medium-Duty products.

B. Total Weight: 20 oz min excluding coatings.

C. Width: 54 inches (1372 mm)

D. Backing: Osnaburg.

E. Stain-Resistant Manufacturer's Standard Coating.

F. Colors, Textures, and Patterns: Basis of Design pattern is DeNovo "World Tour". Custom Scale and Color through manufacturer's graphics department to match design intent.
1. Provide digital graphics service for custom art through the manufacturer.

2.3 VINYL WALL COVERING – (**VWC-B)**

A. General:
1. Products: Subject to compliance with requirements, provide Basis of **Design Level Digital "Line Up"** or comparable custom digital print product by one of the following:
    a. Basis of Design: Level Digital
    b. Eykon Design Resources.
    c. Koroseal
    d. MDC
    e. National Solutions

B. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:
1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium-Duty products.
2. ASTM F 793 for wall coverings.
    a. Category: II, Decorative with Medium Serviceability

C. Description: Provide products in rolls from same production run and complying with the following:

1. FS CCC-W-408D for Type II, Medium-Duty products.

D. Total Weight: 20 oz min excluding coatings.

E. Width: 54 inches (1372 mm)

F. Backing: Osnaburg.

G. Stain-Resistant Manufacturer's Standard Coating.

H. Colors, Textures, and Patterns: Basis of Design pattern is Level Digital "Line Up". Custom Scale and Color through manufacturer's graphics department to match design intent.

1. Provide digital graphics service for custom art through the manufacturer.

2.4 HEAVY DUTY IMPACT-RESISTANT WALL COVERING (**IRWC**)

A. General:

1. Products: Subject to compliance with requirements, provide the basis of design product **"J. Josephson, Inc.; P3TEC Advanced Wall Protection"** or a comparable product by one of the following:
   a. Versa Wallcovering.
   b. Koroseal Wall Protection Systems.
   c. WG Design Studio; Wolf Gordon.

B. Description: Provide products in rolls from same production run and complying with the following:

1. Total Weight: Not less than 32 oz per linear yard, excluding coatings.
2. Width: Not less than 48 inches (1219 mm).
3. Backing: Heavy Polyester/Cotton knit.
4. Material Thickness: 0.32 inch.
5. Repeat: Not applicable.
6. Protection: PVF protective cap film.
7. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.
8. Installation Method: Straight hand, Random match.
9. Impact Resistance: Passes ASTM D-5420 Gardner Drop Dart.
10. Abrasion Resistance: Passes ASTM D-4060 Taber CS-10f wheel (500 gram load).
11. Chemical Resistance: Passes ASTM D-1308 (10 cleaning agents, 10 staining agents).
12. Cleaning and Stain Resistance: Passes ASTM F-793 (10 cleaning agents, 10 staining agents).
13. Fire Safety: Class "A" rated, ASTM E-84, NFPA 286.

2.5 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099100 "Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Metal Primer: Interior ferrous metal primer complying with Section 099100 "Painting" and recommended in writing by primer and wall-covering manufacturers for intended substrate.

D. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Match pattern 72 inches above the finish floor.

F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 099100 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DESCRIPTION OF WORK:

A. Extent of painting work is indicated on drawings and schedules, and as herein specified.

B. Work includes painting and finishing of interior and exterior exposed items and surfaces throughout Project, except as otherwise indicated.

1. Fire- and Smoke-Rated Wall Identification: Permanently label fire- and smoke-rated walls, partitions, and barriers per requirements of applicable building code, with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using stenciled lettering not less than 3 inches high and with minimum 0.375-inch strokes.
    a. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet. Locate on the inside of ceiling access doors or panels which provide access to rated walls.
    b. Do not provide lettering at rated walls that are exposed to view (that is, in spaces without dropped ceilings).
    c. Refer to the Life Safety Plans and Partition types for rated wall locations; and reflected ceiling plans for concealed rated wall locations.
2. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
3. Painted Patterns and Accent Colors: Location of multi-color paint patterns and accent color areas are indicated in "Interior Accent Paint Color Schedule" on Drawings.

C. Work includes field painting of exposed bare and covered pipes and ducts, and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work. (Labeling on pipes and ducts, including possible stencil lettering, is included in Division 21, 22 and 23 work.) Exposed to view ductwork shall be painted an accent color.

D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers, fillers, & other applied materials whether used as prime, intermediate or finish coats.

E. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in "schedules." Where items or surfaces are not specifically mentioned to be painted, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.

F. Following categories of work are not included as part of field-applied finish work.

1. Pre-Finished Items: Unless otherwise indicated, do not field-paint items specified for factory- or installer-finishing; such as toilet enclosures, acoustic materials, architectural woodwork, mechanical and electrical equipment, switchgear and distribution cabinets.

2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, and pipe spaces, and elevator and duct shafts.
3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
4. Operating Parts: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts will not require finish painting.

G. Following categories of work are included under other sections of these specifications.
1. Shop Primers: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
2. Unless otherwise specified, shop priming of fabricated components such as architectural woodwork, wood casework and shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.

H. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates. Do not paint over fire alarm devices, sprinklers and similar fire safety devices.

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility: Provide primers, other undercoat paint, and finish coat products produced by same manufacturer for each paint system. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.
1. Test primers, bonding primers and coating products for compatibility and adhesion to existing substrates.

C. Field Samples: On designated wall surfaces and other interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface until required sheen, color and texture are obtained; simulate finished lighting conditions for review of in-place work.
1. Water-Borne Epoxy Enamel System: Prior to providing 100 sq. ft. sample area on CMU substrate, conduct a Preinstallation Conference for water-borne epoxy enamel system including the Contractor, painting subcontractor, coating system manufacturer's representative, and Architect to establish preparation, material application methods, film thickness, and inspection requirements.

D. Color Selection Sample Areas: Architect will designate required field sample area colors and locations when color schedule is issued. Final acceptance of those colors will be from job-applied samples.

E. All paint materials and workmanship are subject to a 2 year (24 months) period from the date of Owner's Final Acceptance, as noted in the General Conditions.

1.4 SUBMITTALS:

A. Inspection Report: Paint manufacturer's technical representative will inspect existing facility to confirm the existing paint systems, and note substrates which require bond or barrier coating to render them compatible with specified paint systems. Submit copy of report to Architect.

1. Inspector shall indentify MPI DSD 3 Degree of Surface Degradation surfaces ("severely deteriorated paint") recommended to have paint film completely removed.

B. Product Data: Submit manufacturer's technical information including Paint label analysis and application instructions for each material proposed. Include paint system schedule in the format used in this specification section.

1. For DTM enamel and water-borne epoxy enamel products, provide the following performance data.

a. Abrasion Resistance test data per ASTM D4060 with CS-17 wheel, 1000 gram load for 1000 cycles. (CS-10 wheel data not acceptable).
b. Direct Impact Resistance test data per ASTM D2794.
c. Adhesion test data per ASTM D4541.

C. Color Chips: Submit color chips of manufacturer's *complete range of colors* for each paint type for Architect's review of color and texture (sheen). These will be used for initial color selection if the submitted range is adequate.

1. Based on products of the selected manufacturer and paint systems specified in this Section, the Architect will prepare an initial color schedule indicating paint colors to be used in each space. The Architect will indicate required colors by referencing the selected paint manufacturer's color chips, or by referencing drawdowns or other standard (such as "match laminate color").

2. Provide 8-1/2 x 11 inch color samples ("drawdowns") for all paint colors and sheens for which the color in Architect's color schedule is not indicated by colors of the selected paint manufacturer for approval prior to application in the field. Provide paint drawdowns in finish sheens applicable to those in the field.

1.5 DELIVERY AND STORAGE:

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

1. Name or title of material.
2. Manufacturer's stock number and date of manufacture.
3. Manufacturer's name.
4. Contents by volume, for major pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.

C. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take precautions to ensure workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.6 JOB CONDITIONS:

A. Apply paints only when temperature of surfaces to be painted and surrounding air are between 50°F and 90°F for water-base paints; and between 45°F and 95°F for solvent-thinned paints, unless otherwise permitted by paint manufacturer's printed instructions.

B. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature and humidity limits specified by paint manufacturer during application and drying periods.

C. Wind: Do not spray coatings if wind velocity exceeds manufacturer's recommended limit.

D. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.

E. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants.

2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Paint Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Benjamin Moore and Co. (Ben Moore).
2. PPG Architectural Coating/PPG Paints (PPG).
3. Sherwin-Williams Co. (S-W). (Duron, a regional division of S-W, is not acceptable)

B. Special Coatings Manufacturer: Subject to compliance with requirements, provide moisture curing aliphatic urethane coating system products of one of the following or prequalified other manufacturer:

1. Benjamin Moore and Co. (Ben Moore).
2. PPG Architectural Coating/PPG Paints (PPG).
3. Sherwin-Williams Company (S-W).

2.2 MATERIALS:

A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated. Lead content in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been correct in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION:

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove oil and grease prior to mechanical cleaning.
2. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
3. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Surface Preparation of Previously Painted [Hard Surfaces] [CMU and Steel Doors and Frames]: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Test all remaining previously painted substrates for adhesion of the current coating systems using physical testing procedure ASTM D 3359 (Measuring Adhesion by Tape).
2. If indicated by testing remove all layers of poorly adhering coatings from previously coated substrates.
3. Abrade tightly adhering previously coated/ painted substrates to provide a sufficient surface profile for new coatings systems.
4. Provide barrier primers and/or bonding primers over prepared previously coated substrates and previously coated tightly adhering coating systems on all substrates.

E. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of

finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

F. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, suitable solvent, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

1. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.
2. When transparent finish is required, use specified sealer (varnish) for backpriming.

G. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

1. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

H. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent. Provide wash coat if required by paint system manufacturer for prepared substrate.

3.3 SURFACE-PREPARATION SCHEDULE FOR PREVIOUSLY PAINTED SURFACES

A. General: Before painting, prepare surfaces for painting according to applicable requirements specified in this schedule.

1. Examine surfaces to evaluate each surface condition according to the paragraphs below.
2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.

B. Surface Preparation for MPI DSD 0 Degree of Surface Degradation:

1. Surface Condition: Existing paint film in good condition and tightly adhered.
2. Paint Removal: Not required.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.

C. Surface Preparation for MPI DSD 1 Degree of Surface Degradation:

1. Surface Condition: Paint film cracked or broken but adhered.
2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.

D. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.
2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.

3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

E. Surface Preparation for MPI DSD 3 Degree of Surface Degradation:

1. Surface Condition: Paint film severely deteriorated, obscuring fine architectural detail work because of paint-layer buildup and / or surface indicated in paint manufacturer's technical representative's inspection report to have paint completely removed.
2. Paint Removal: Completely remove paint film by hand-tool or chemical paint-removal methods. Remove rust.
3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

3.4 MATERIALS PREPARATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Maintain paint mixing and application containers in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.5 APPLICATION:

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Provide access to representative of selected coating manufacturer for observation of material application only at all times during painting work. Unless specifically indicated by Architect, this representative shall have no authority to make decisions about the work.
2. Paint surface treatments and finishes are indicated in "schedules" of Contract Documents.
3. Provide finish coats that are compatible with prime paints used.
4. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
5. Paint surfaces behind movable and permanently fixed equipment and furniture.
6. Paint duct interior surfaces visible through registers or grilles, with flat, non-specular black paint.
7. Paint back sides of access panels, and removable or hinged covers.
8. Finish exterior and interior doors on tops, bottoms and side edges same as faces.
9. Sand lightly between each succeeding enamel or varnish coat.
10. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless required to prevent "show-through" for finish topcoats.

B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firms, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish total DFT indicated or as recommended by coating manufacturer.

D. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces. Do not paint prefinished equipment items unless directed otherwise.

E. Prime Coats: Apply prime coat to material which is required to be painted or finished, and which has not been prime coated by others. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

F. Finish Coats: Provide finish quality for new and repainted surfaces as follows:

1. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

2. Transparent (Clear) Finish: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats, unless otherwise noted.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

H. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.6 CLEAN-UP AND PROTECTION:

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or damage finished surfaces.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work until date of Owner's Final Acceptance. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs to protect newly-painted finishes. Remove temporary protective wrappings provided by others for their work after completion of painting.

2. At completion of work of other trades, touch-up & restore all damaged painted surfaces.

3.7 INTERIOR PAINT SCHEDULE:

A. General: Refer to UNCW's Design and Construction Guidelines for paint finish for given function spaces.

B. General: Provide the following paint systems for the various substrates, as indicated. Dry film thickness is noted as "DFT." Provide compatibility test areas on existing painted substrates.

1. Low-Emitting Materials: Provide low-VOC paints for all applications. Paints and coatings field applied inside the weatherproofing system shall be tested and determined compliant in accordance with California Department of Public Health's "Standard Method for Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers (2017)" AND shall meet applicable VOC limits of California Air Resources Board's "Suggested Control Measure for Architectural Coatings (2020)" or South Coast AQMD "Rule 1113 for Architectural Coatings" (amended 2016).

C. Concrete Masonry Units: Low-VOC Acrylic Semi-Gloss Finish. 2 Coats over filler, with total DFT not less than 2.5 mils. (Provide for CMU except where "epoxy finish" is indicated.)

1. Filler Coat, 100% Acrylic. Apply at a rate to ensure complete coverage. Brush, spray or roller apply and back roll or squeegee for smooth, pinhole-free treatment.

   S-W: B42W46 Heavy Duty Block Filler
   Ben Moore: 571 Ultra Spec Hi-Build Masonry Block Filler
   PPG 16-90 Pitt Glaze WB Acrylic Interior Exterior Block Filler.

2. Bonding Primer (previously painted): Acrylic bonding primer for exceptional adhesion. Test for adhesion. Brush, spray or roller apply and back roll.

   S-W: B51W150 Extreme Bond Interior/Exterior Primer
   Ben Moore/Insul-X: Stix Bonding Primer.
   PPG: 17-921 PPG Seal Grip Acrylic Universal Primer/Sealer
   Ben Moore: N376 Eco SpecWB Zero VOC Interior Semi-Gloss
   PPG 9-500 Pure Performance Interior Semi-Gloss Latex
   S-W: B10 Harmony Low Odor Interior Latex Semi-Gloss

3. First & Second Finish Coats: Commercial Interior Low-VOC Acrylic Semi-gloss Finish. Provide for wall finishes unless indicated otherwise.

   S-W: B31-2600 ProMar 200 Zero VOC Interior Latex Semi-Gloss
   Ben Moore: N539 Ultra Spec 500 Interior Semi-Gloss Finish
   PPG 6-4500 Speedhide Zero VOC Interior Semi-Gloss Latex

D. Concrete Masonry Units - Semi-Gloss Water-Borne Epoxy Finish (EPX): 2 Coats over filler:

1. Block Filler Coat: Acrylic-latex or as required by manufacturer for topcoat. Brush, spray or roller apply and back roll for smooth pinhole-free treatment.

   S-W: B42W46 Heavy Duty Interior/Exterior Block Filler.
   Ben Moore: 571 Ultra Spec Hi-Build Masonry Block Filler
   PPG: 6-15 Speedhide Int/Ext Acrylic Masonry Block Filler
   PPG: 16-90 Pitt-Glaze WB Int/Ext Block Filler Latex

2. First and Second Coats: Two-component, semi-gloss water-borne epoxy enamel applied at a DFT of 1.5 to 4.0 mils per coat. **Polyamide-epoxy**.

   S-W: B73V300 Pro Industrial Water Based Catalyzed Epoxy Hardener
   Corotech (Ben Moore): V400 Polyamide Epoxy Coating
   PPG: 98-100 Aquapon WB Water Base Epoxy – Semi-Gloss

E. Gypsum Board Systems with Latex Finish: Semi-gloss finish at walls, and flat finish on ceilings except as noted. Provide best commercial Low-VOC formulation with 0 VOC per EPA test method 24.

1. Filler Coat: 0 VOC (per EPS test method 24) Latex Primer

   S-W: B28-2600 ProMar 200 Zero VOC Interior Latex Primer
   Ben Moore: 534 Ultra Spec 500 Primer Flat
   PPG: 6-4900 Speedhide Zero VOC Interior Latex Primer

2. First & Second Finish Coats: Interior Low-VOC Acrylic Flat Finish. Provide for ceiling and private office applications unless indicated otherwise.

   S-W: B30-2600 ProMar 200 Zero VOC Interior Latex Flat
   Ben Moore: 536 Ultra Spec 500 Flat
   PPG: 6-4100 Speedhide Zero VOC Interior Latex Flat

3. First & Second Finish Coats: Interior Low-VOC Acrylic Semi-Gloss Finish. Provide for wall finishes unless indicated otherwise.

   S-W: B31-2600 ProMar 200 Zero VOC Interior Latex Semi-Gloss
   Ben Moore: N539 Ultra Spec 500 Interior Semi-Gloss Finish
   PPG: 6-4500 Speedhide Zero VOC Interior Semi-Gloss Latex

F. at walls and flat finish on ceilings unless indicated otherwise. Provide alkali-resistant primer/sealer.

1. Prime Coat: Bonding primer-sealer.

   Ben Moore: 608 UltraSpec Masonry Int/Ext 100% Acrylic Sealer/Primer
   PPG: 4-2 PPG PermaCrete 100% Acrylic Masonry Primer
   S-W: Loxon Conditioner or Loxon Masonry Primer

2. First and Second Coats: As specified for gypsum drywall systems.

G. Ferrous Metal: Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with total DFT not less than 5.0 mils.

1. Prime Coat: Lead-free, acrylic Base Primer. Not required on shop primed items.

   Ben Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss
   PPG: 90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel
   S-W: B66 W1 DTM Acrylic Primer/Finish (or B66 W200)

2. Bonding Primer (previously painted): Acrylic bonding primer designed for previously painted ferrous metal to ensure secure bond. Brush, spray or roller apply and back roll.

   Moore: SXA-110 Insl-X Stix Waterborne Bonding Primer
   PPG: 90-912 Pitt-Tech Plus DTM Industrial Primer
   S-W: B66A50 DTM Bonding Primer

3. First and Second Coat: DTM Acrylic Semi-Gloss Enamel. (30-40 units @ 60°)

   Ben Moore: HP29 Ultra Spec HP DTM Acrylic Semi-Gloss
   PPG: 90-1210 Pitt-Tech Int/Ext Semi-Gloss DTM Industrial Enamel
   S-W: B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating

4. First and Second Coat: DTM Acrylic Satin Enamel. (15-25 units @ 60°) Provide one finish coat over bonding primer at previously painted ferrous metal.

   Ben Moore: HP25 Ultra Spec HP DTM Acrylic Low Lustre
   PPG: 90-1110 Pitt-Tech Int/Ext Satin DTM Industrial Enamel
   S-W: B66W1250 Series Pro Industrial DTM. Acrylic Eg-Shel

H. Zinc-Coated Metal: Semi-Gloss Direct to Metal ("DTM") Acrylic Enamel Finish: 2 Coats over primer, with min. total DFT of 2.5 mils.

1. Prime Coat: Lead-free, acrylic base interior galvanized metal primer, premium grade.

Ben Moore:	HP04 Ultra Spec HP Acrylic Metal Primer
PPG:	90-712 Pitt-Tech Int/Ext Primer/Finish Industrial Enamel
S-W:	B66W1150 Series Pro Industrial DTM Acrylic Semi-Gloss Coating

2. First and Second Coats: DTM Acrylic Semi-Gloss Enamel. Same as for ferrous metal.

I. Natural Finish Woodwork: Satin Urethane Varnish Finish: 2 Finish coats over sealer coat, 3.5 mils DFT. This applies to work of Division 6 Section "Interior Finish Carpentry."

1. First Coat: Thin 1 part thinner to 4 parts varnish or as recommended by manufacturer.

Ben Moore:	N435 Benwood Polyurethane Finish, Low Luster
PPG:	43886 Olympic Premium Urethane Satin Varnish
S-W:	A67 V1 Wood Classics Polyurethane Varnish.

2. Second and Third Coats: Satin Clear Polyurethane Varnish, full strength.

Ben Moore:	N435 Benwood Polyurethane Finish, Low Luster
PPG:	43886 Olympic Premium Urethane Satin Varnish
S-W:	A67 V1 Wood Classics Polyurethane Varnish.

J. Stained woodwork with transparent finish is specified in Division 6 Section "Interior Architectural Woodwork" by woodworker.)

END OF SECTION 099100

SECTION 101400
SIGNAGE

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.

B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.02 SUBMITTALS

A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

B. Selection Samples: Where colors are not specified, submit color selection charts or chips for each type of signage.

C. Verification Samples: Submit samples, manufacturer's standard size, showing selected colors for each type of signage.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.04 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Provide signs in accordance with the UNCW Interior Signage Standards.
2. Sign Type: Flat signs with engraved panel media as specified.
3. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
4. At indicated locations, signage shall have a "window" section for replaceable occupant name. The Contractor shall supply and install all graphic inserts on paper (pre-cut and printed) for these signs.

2.02 PANEL SIGNAGE TYPES

A. Manufacturers: Provide signage by one of the following pre-approved UNCW signage manufacturers.

1. Best Sign Systems, Inc.
2. Corum Signs.
3. ASI Sign System.
4. Signature Signs, Inc.
5. 290 Sign System.

B. Flat Signs: Signage media without frame. Panel signs shall be manufactured via a photomechanical etching process, leaving teh copy and braille raised. The panel shall be laminated to a 1/8 inch opaque acrylic base sheet and finished with acrylic polyurethane enamel in colors matching UNCW signage standards.
   1. Edges: Bevelled.
   2. Corners: Square.
   3. Wall Mounting of One-Sided Signs: Tape adhesive.
      a. For signs mounted to glass, such as at door sidelights, provide a rear cover plate so the backside of sign will not be visible through the glass.
   4. Tactile Signage: Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.

C. Color and Font: Unless otherwise indicated, panel signage, font, and color shall be selected from manufacturer's full range.

2.03 ACCESSORIES

A. Concealed Screws: Stainless steel, or other non-corroding metal.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 PREPARATION

A. Signage Schedule and Pre-Fabrication Meeting with Owner: The signage contractor shall meet with representatives of the Owner to develop the final signage schedule, including signage style and layout, individual sign locations, including locations of code required signage and wayfinding signage, and final room naming and numbering. The Architect shall provide the signage contractor with floor plan drawings on request for use in determining signage locations.

3.02 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
   1. Room Signs: Mount on latch side, with a clear space of 18 inches by 18 inches beyond the door swing arc, centered on the tactile characters. At double doors, mount to the right of right-hand leaf or on nearest adjacent wall. Mount at height that is compliant with ADA Standards.

D. Protect from damage until Date of Owner's Final Acceptance; repair or replace damaged items.

END OF SECTION 101400

SECTION 102113.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls.

1.03 SUBMITTALS

A. Product Data: Provide data on panel construction, hardware, and accessories.

B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

1. Include field measurements, and indicate where field measurements differ from documents.

1.04 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to fabrication and verify that dimensions and tolerances are acceptable for fabricated products to fit the space. Indicate field measurements on shop drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Toilet Compartments:

1. Accurate Partitions Corporation.
2. American Sanitary Partition Corporation.
3. Bobrick Washroom Equipment, Inc.
4. General Partitions Mfg. Corp.
5. Global Partitions, an ASI Group Company.
6. Metpar Corp.
7. Partition Systems International of South Carolina (PSiSC).

2.02 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.

B. Doors:

1. Thickness: 3/4 inch.
2. Width: 24 inch.
3. Width for Accessible and Ambulatory Compartments: 36 inch, out-swinging.
4. Height: 58 inch.

C. Panels:

1. Thickness: 1/2 inch.
2. Height: 58 inch.

D. Pilasters:
   1. Thickness: 3/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.

B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.

C. Wall and Pilaster Brackets: Natural anodized aluminum or satin stainless steel; continuous type.

D. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.

E. Hardware: Satin stainless steel, unless otherwise indicated. All hardware at out-swinging doors shall comply with accessibility regulations.
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Door Latch: Slide type with exterior emergency access feature.
   3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
   4. Coat hook with rubber bumper; one per compartment, mounted on door.
   5. Provide door pull and door bumper for outswinging doors.
      a. Provide a door pull on both sides of door for accessible and ambulatory compartments, in compliance with the ADA Standards for Accessible Design.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.

B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

C. Adjust adjacent components for consistency of line or plane.

END OF SECTION 102113.17

SECTION 102600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies 2014.

1.02 SUBMITTALS

A. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

B. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

C. Selection Samples: Provide manufacturer's color charts for each product and material requiring color selection.

D. Verification Samples: Submit physical samples, manufacturer's standard size, for each selected color.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Protect work from UV light damage.

D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer and installer warranty for wall and door protection items.

1. Failures include, but are not limited to, the following:
    a. Structural failures, internal connection failures, and/or detachment of rail system from substrates.
    b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Babcock-Davis
   2. Construction Specialties, Inc
   3. Inpro
   4. Koroseal Interior Products
   5. Nystrom, Inc
   6. Trim-Tex, Inc
   7. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

2.03 PRODUCT TYPES

A. Corner Guards - Surface Mounted:
   1. Basis-of-Design Product: Construction Specialties; Acrovyn VA Series.
   2. Material: Polyethylene terephthalate (PET or PETG); PVC-free with full height extruded aluminum retainer.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Width of Wings: 1-1/2 inches.
   5. Corner: Square.
   6. Color: To be selected by Architect from manufacturer's full range.
   7. Length: One piece, 6 feet (72 inches) in length.

B. Adhesives and Primers: As recommended by manufacturer.

2.04 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.05 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.
   1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for

remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard with bottom of corner guard immediately above top of wall base.

C. Position protective wall covering no less than 1 inch above finished floor to allow for floor level variation.

1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
2. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
3. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
4. Use a roller to ensure maximum contact with adhesive.
5. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

B. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION 102600

SECTION 102800
TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ICC A117.1 - 2009 - Accessible and Usable Buildings and Facilities.

B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.

C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2022.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2022.

E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

F. ASTM C1036 - Standard Specification for Flat Glass 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2022.

J. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2022.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.03 SUBMITTALS

A. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Maintenance Data: For each type of accessory, to include in maintenance manual per Section 017800 - Closeout Submittals. Include list of replacement parts and service recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. A&J Washroom Accessories, Inc.
   2. American Specialties, Inc.
   3. Bobrick Washroom Equipment.
   4. Bradley Corporation.

B. Diaper Changing Stations:

1. American Specialties, Inc.
2. Bradley Corporation.
3. Diaper Deck & Company.
4. Foundations Worldwide, Inc.
5. Koala Kare Products.
6. Safe-Strap Company, Inc.

C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide 6 master/universal keys, minimum, to Owner.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
   1. Provide mechanical attachment of all accessories. Use of adhesive or double-side tape is not acceptable.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 TOILET ACCESSORIES SCHEDULE, GENERAL

A. General: The following products make reference to the designations indicated on the Toilet Accessories Schedule, Toilet Assemblies, and toilet room plans on the drawings; herein designated as "TA-x".

2.05 COMMERCIAL TOILET AND BATH ACCESSORIES

A. Grab Bars (TA-A, B, & C): Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.
      e. Products:
         1) A&J Washroom Accessories, Inc.; UG2 Series.
         2) American Specialties, Inc.; 3700 Series.
         3) Bobrick Washroom Equipment, Inc.; B-5806 Series.
         4) Bradley Corporation; 832 Series.

B. Toilet Paper Dispenser (TA-D): Owner shall provide surface mounted paper towel dispenser for installation by Contractor.

C. Sanitary Napkin Disposal Unit (TA-E): Owner shall provide surface mounted paper towel dispenser for installation by Contractor.

D. Soap Dispenser (TA-F): Owner shall provide surface mounted paper towel dispenser for installation by Contractor.

E. Mirrors (TA-G): Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings.
   3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Products:
      a. A&J Washroom Accessories, Inc.; U700 Series.
      b. American Specialties, Inc; 0600 A Series.
      c. Bobrick Washroom Equipment, Inc.; Model B-290.
      d. Bradley Corporation; Model 780.

F. Paper Towel Dispenser (TA-Q): Owner shall provide surface mounted paper towel dispenser for installation by Contractor.

G. Robe Hook (TA-T): Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish. Provide one centered on interior face of door of all single-user toilet rooms and one adjacent to each shower, unless otherwise indicated on Drawings; verify final mounting locations with Architect in field.
   1. Products (Double-Prong):
      a. A&J Washroom Accessories, Inc.; Model UX112.
      b. American Specialties, Inc.; Model 7345.
      c. Bobrick Washroom Equipment, Inc.; Model B-7672.
      d. Bradley Corporation; Model 9124.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
   3. Construction: 1/8 inch flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
      b. Microbial and Fungal Resistance: Comply with ASTM G21.
   4. Color: White.
   5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.07 DIAPER CHANGING STATIONS

A. Diaper Changing Station (TA-R): Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Material: Polyethylene.
   2. Mounting: Surface.
   3. Color: As selected.
   4. Minimum Rated Load: 250 pounds.

5. Products:
    a. American Specialties, Inc; Model 9014.
    b. Bradley Cor; Model 9632.
    c. Diaper Deck & Co.; Diaper Deck.
    d. Foundations Worldwide; Classic Horizontal Wall Mounted Changing Station
    e. Koala Kare Products, Div. of Bobrick; KB300.
    f. Safe Strap Company, Inc; Diaper-Depot Basic.

2.08 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
    1. Drying rod: Stainless steel, 1/4 inch diameter.
    2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
    3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
    4. Length: 36 inches.
    5. Products:
        a. A&J Washroom Accessories, Inc.; Model UJ41B.
        b. American Specialties, Inc; Model 1315-4.
        c. Bobrick Washroom Equipment, Inc.; Model B-224 x 36.
        d. Bradley Corporation; Model 9984.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on Drawings.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 102800

SECTION 122113
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. WCMA A100.1 - Safety of Window Covering Products 2018.

1.02 SUBMITTALS

A. Product Data: Provide data indicating physical and dimensional characteristics.

B. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Horizontal Louver Blinds Without Side Guides:
   1. CACO, Inc; Summit.
   2. Crown Shade Company; Classic 1" Mini Blinds.
   3. Hunter Douglas Architectural; CE80.
   4. Levolor; Mark 1 DustGuard.
   5. SWFcontract, a division of Springs Window Fashions, LLC; S3000.
   6. Substitutions: See Section 016000 - Product Requirements.

2.02 BLINDS WITHOUT SIDE GUIDES

A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.

B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.

C. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
   1. Width: 1 inch.
   2. Thickness: 0.006 inch, minimum.
   3. Color: White.

D. Slat Support: Woven polypropylene cord, ladder configuration.

E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.

F. Bottom Rail: Pre-finished, formed steel; with end caps.
   1. Color: Same as headrail.

G. Lift Cord: Braided nylon; continuous loop; complying with WCMA A100.1.

H. Control Wand: Extruded hollow plastic; hexagonal shape. Wand shall be full height of window opening, less 3 inches.

I. Headrail Attachment: Wall brackets.

J. Accessory Hardware: Type recommended by blind manufacturer. Provide installation wall brackets and fasteners of type recommended for indicated substrate(s).

2.03 FABRICATION

A. Determine sizes by field measurement.

B. Blinds Installed Outside of Rough Opening: Fabricate blinds to cover window frames completely, with a 1-1/2 inch overlab at each jamb and at bottom of blinds, unelss otherwise indicated.

1. Where width of a glazing section between jambs or mullions exceeds blind manufacturer's maximum width, provide two equally sized blind units to fill opening. Minimize light gap between blind units to greatest extent possible.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive the work.

3.02 INSTALLATION

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

B. Install blinds directly to wall structure or blocking. Do not install to window framing.

C. Install with a minimum 2 inch gap to window glass surface.

D. Secure in place with flush countersunk fasteners.

3.03 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

B. Maximum Offset From Level: 1/8 inch.

3.04 ADJUSTING

A. Adjust blinds for smooth operation.

3.05 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION 122113

SECTION 122400
WINDOW SHADES

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2023.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

B. Sequencing:

1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
2. Do not install shades until final surface finishes and painting are complete.

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

B. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

C. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.

D. Selection Samples: Include fabric samples in full range of available colors and patterns.

E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

F. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Authorized installation representative of fabricator/manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Owner's Final Acceptance, covering the following minimum terms:
   1. Manual Operating Mechanism / Clutch: 10 years, minimum (excludes bead chain).
   2. Fabric: 10 years, minimum.
   3. Balance of Shade Hardware and Non-Operating Materials and Components: 25 years, minimum.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Draper, Inc; Crank-Operated FlexShade (Basis-of-Design).
   2. Lutron Electronics Co., Inc.
   3. MechoShade Systems LLC.

B. Source Limitations: Provide products produced by a single manufacturer and obtained from a single supplier.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
      a. Drop Position: Regular roll.
      b. Roll Direction: Roll down, closed position is at window sill.
      c. Mounting: Ceiling mounted.
      d. Size: As indicated on drawings for rough opening sizes; field verify rough openings prior to fabrication.
   2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   3. Roller Tubes: As required for type of shade operation.
      a. Material: Extruded aluminum, clear anodized finish or electrogalvanized/epoxy primed steel, as standard with manufacturer.
      b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
      c. Fabric Attachment: Utilize manufacturer's standard method for attaching shade fabric material to rollers.
   4. Hembars: Designed to maintain bottom of shade straight and flat.
      a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
   5. Manual Operation for Interior Shades:

a. Crank Operator: Manufacturer's standard material and design with gear box fabricated of die cast aluminum and steel, permanently lubricated.
   1) Provide permanently mounted crank handle.
b. Idler Assembly: Provide idler assembly of molded nylon with an adjustable length idler pin to facilitate easy installation and removal of shade for service.

6. Accessories:
   a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; custom powder coat finish in color selected by Architect.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Ceiling Pockets: Premanufactured metal shade pocket for recess mounting shade hardware into ceiling. Provide removable closure panel to conceal underside of brackets and roller tubes.
   d. Fasteners: Noncorrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. Phifer, Inc; SheerWeave Series SW2400; 3% open (Basis-of-Design per UNCW standards).
      b. Mermet Corporation; E-Screen 3%.
      c. Lutron Electronics; SheerLite 3%
      d. MechoShade Systems LLC; Soho -1600 Series (3% open).
   2. Material: Vinyl coated fiberglass.
   3. Performance Requirements:
      a. Flammability: Pass NFPA 701 large and small tests.
      b. Fungal Resistance: No growth when tested according to ASTM G21.
   4. Color: Custom color to be selected by Architect.
   5. Fabrication:
      a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
      b. If height of opening requires multiple panels of railroaded fabric, use manufacturer's standard sewn seams.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
   1. Vertical Dimensions: Fill openings from head to sill with 1/4 inch maximum space between bottom bar and window stool.
   2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb, with maximum 1/4 inch gap at each edge of jamb.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

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

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Date of Owner's Final Acceptance.

END OF SECTION 122400

SECTION 140120 - ELEVATOR REHABILITATION

PART 1 - GENERAL

1.1 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

1.2 SUBMITTALS

A. Product Data:
   1. Exposed finishes and replacement materials.

B. Qualification Data: For Installer.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced elevator installer who is trained and approved for installation of units required for this Project.

B. Accessibility Requirements: Comply with the 2010 ADA Standards for Accessible Design.

C. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B. The installation of devices indicated in this section shall not affect the fire-ratings of the elevator entrance assemblies.

1.4 COORDINATION

A. Coordinate elevator rehabilitation work with Owner's elevator maintenance contractor. Work shall not violate or void any warranties and shall be in compliance with the elevator manufacturers' specifications or instructions for operable components.

1.5 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
   1. Warranty Period: One year from date of Owner's Final Acceptance.

PART 2 - PRODUCTS

2.1 DOOR REOPENING DEVICES

A. Where replacement of doors is indicated, either reuse existing door reopening devices or provide new replacement door reopening devices.

B. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance from floor level to a minimum of 72" above floor. Interruption of one or more of the light beams shall cause doors to stop and reopen.
   1. The Basis-of-Design reopening device is the Otis; "Optiguard" per UNCW standards. Comparable devices must be submitted to the Owner for review and approval.

C. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

D. Provide a keyed switch in the car operating panel or a toggle switch in the service cabinet that will disconnect the door reopening device for service.

2.2 FIXTURES AND MACHINERY

A. Operational fixtures and elevator machinery shall be maintained in good working condition. Contractor shall inventory and record defects prior to commencing work. All faulty fixtures and parts shall be repaired or replaced as required to maintain operational integrity.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevators, with Installer present, for existing conditions and conditions affecting performance.
   1. For the record, prepare a written report of existing deficiencies.

3.2 PREPARATION

A. Protection: Protect exposed equipment, door operators, car safeties, guide shoes, interlocks, limit switches, and other operational equipment from damage and foreign materials during the course of construction.

3.3 REMOVALS

A. Remove all items superseded by the Work including existing reopening devices. Patch and finish all voids resulting from removals.

3.4 INSTALLATION

A. Install new elevator door reopening device in accordance with manufacturer's instructions.

3.5 COORDINATION

A. Coordinate with the following Sections for work related to elevators:
   1. Division 26 Sections for electrical service for elevators.

3.6 DEMONSTRATION

A. Check operation of elevator door reopening device with Owner's personnel present and before date of Owner's Final Acceptance. Determine that operation systems and devices are functioning properly.

END OF SECTION 140120

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

4. Escutcheons.

1.4 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 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.

1.5 DELIVERY, STORAGE, AND HANDLING

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

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing 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 plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

A. Plumbing drawings are diagrammatic, indicating general locations and arrangements of pipe, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.

C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not shown on the drawings are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

1.8 INSTALLED EXTRA PIPING AND EQUIPMENT

A. The Plumbing Contractor (PC) shall include in his bid, labor and material for the installation of the following:
   1. 5 domestic water backflow prevention devices to serve coffee brewers, tea brewers, ice machines, and other general beverage dispensing equipment.
   2. 5 water supply boxes to serve ice making and water dispensing equipment and refrigerators.
   3. 5 interior, flush-mounted, loose-key operated, hose bibbs.

B. Each of these items shall include 30' of ½" domestic water piping, fittings, valves, insulation, and accessories, etc… As needed throughout the project, the A/E or Owner will direct the Plumbing Contractor (PC) where these items are to be installed.
   1. There shall be a line item on the plumbing schedule of values titled "Extra Piping and Equipment".
   2. At project completion, a credit shall be given to the Owner for all unused extra piping and equipment. It shall be the Plumbing Contractor's responsibility to keep track and record of this work.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to other Division 22 piping sections for pipe, tube, and fitting materials and joining methods.

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

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:

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

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

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

C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

A. Manufacturer: Victaulic

B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, 2 bolts and 2 nuts.

C. Gasket Material: Grade "E" EPDM suitable for use up to 250 degrees F.

D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

A. Where piping of dissimilar metals is joined together use yellow brass unions or as below.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300 psig working pressure, as required to suit system pressures.

1. Available Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

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.

E. Molded PE: Reusable, PE, tapered-cup-shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

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: With set screw.

1. Finish: Polished chrome-plated.

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

1. Finish: Polished chrome-plated.

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

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

2.7 GROUT

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

1. Characteristics: Post-hardening, volume-adjusting, non-staining, 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 PLUMBING DEMOLITION

A. Refer to Division 2 Sections "Site and Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Remove equipment and associated piping back to main unless otherwise indicated. Cap services.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services. Remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Remove equipment and associated piping back to main unless otherwise indicated. Cap services. Remove equipment, clean, and store as directed (May be off-site). Make available to owner at time of the owner's choosing.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following and Division 22 Sections specifying piping systems.

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

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

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

E. Install piping to permit valve servicing.

F. Install piping at the minimum slopes required by authorities having jurisdiction unless otherwise indicated.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

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

1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.

3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.
6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below

L. Sleeves are not required for core-drilled holes.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

M. Permanent sleeves are not required for holes formed by removable PE sleeves.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

N. Install sleeves for pipes passing through walls, floors, or roofs.

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.

2. Install sleeves as walls and slabs are constructed.

a. PVC Pipe Sleeves: Permitted for pipes smaller than NPS 6 except aboveground, exterior-walls.
b. Steel Sheet Sleeves: Permitted for pipes NPS 6 and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.

c. Stack Sleeve Fittings: For pipes penetrating floors. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor. Seal space outside sleeve fittings with grout.

3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants".

O. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer 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.
4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

P. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

Q. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

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

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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

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

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Non-pressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

N. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
3. Install dielectric unions or flanges for connections of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 HOUSEKEEPING PADS AND EQUIPMENT PADS

A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
    a. Housekeeping pads inside the building shall be 4" thick and 6" larger all around than supported equipment. Provide a 1" chamfer on all edges.
    b. If details are not provided, equipment pads outside the building shall be 8" thick with a 24" deep 12" wide turndown (footing) all around the outside edge of the pad. Provide welded wire mesh reinforcement. Pad shall be 12" larger all around than supported equipment.
    c. Install dowel rods to connect housekeeping pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad. Provide a 1" chamfer on all edges.
    d. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.
    e. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
    f. Install anchor bolts to elevations required for proper attachment to supported equipment.
    g. Install anchor bolts according to anchor bolt manufacturer's written instructions.
    h. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

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

3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
   1. Excavate trenches to indicated gradients, lines, depths, and elevations.
      a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
   3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.
   4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
   5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 220500

SECTION 220513 – MOTORS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with NFPA 70.

1.4 COORDINATION

A. Equip all motors with overload protection.

1. Locate overload protection near the motor.
2. Overload protection:
    a. Locate between the circuit breaker/fuse provided under Division 26 and the motor windings.
    b. Comply with one of the following:
        1) Locate in motor by motor manufacturer. (Design Standard)
        2) Locate separate overload device near motor.
        3) Locate in, or with, disconnect switch by equipment manufacturer. Provision of such switch shall not modify, change, or eliminate Division 26 requirements. Provide indicated disconnecting means.

B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

C. Compatible with controller.

D. Matched to torque and horsepower requirements of the load.

E. Matched to ratings and characteristics of supply circuit and required control sequence.

F. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

G. Belt tension must be wrench and socket adjustable.

H. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply except as follows:

B. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.

C. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

A. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

C. Duty: Continuous at 105 deg F and 3300 feet above sea level.

D. Capacity and Torque sufficient to:

1. Start, accelerate, and operate connected load.
2. Maintain designated speeds.
3. Operate at installed altitude and environment.
4. Operate with indicated operating sequence.
5. Operate without exceeding nameplate ratings.
6. Operate without utilizing service factor.

E. Enclosure: Open drip-proof unless otherwise indicated.

F. Minimum Service Factor: 1.15 unless otherwise indicated.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Motor efficiency shall conform to the standard for integral horsepower motors under 10 CFR Part 431 as published by the US Department of Energy.

C. Efficiency: Premium

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation: NEMA starting Code F or G.

J. Enclosure: Cast iron.

K. Finish: Gray enamel.

L. 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.

M. Measure winding resistance.

N. Read no-load current and speed at rated voltage and frequency.

O. Measure locked rotor current at rated frequency.

P. Perform high-potential test.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.
2. Demonstrate correct rotation, alignment, and speed.
3. Test interlocks and control features for proper operation.
4. Verify that current in each phase is within nameplate rating.
5. Verify RPM is in accordance with nameplate.
6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

A. Align motors, bases, and shafts.

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.

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Available Manufacturers:

1. Smith, Jay R. Mfg. Co.
2. Wade
3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. GPT, EnPro Industries
d. Metraflex Co.
e. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

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

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.

E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
    a. Piping Smaller Than 6": Cast-iron wall sleeves with sleeve-seal system.
        1) Select sleeve size to allow for one inch (1") annular clear space between piping and sleeve for installing sleeve-seal system.
    b. Piping 6" and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 220517

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.3 ABBREVIATIONS:

A. AFF Above finished floor
B. F Fahrenheit
C. SS Stainless Steel

PART 2 - PRODUCTS

A. Manufacturers: Subject to compliance with the requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. FNW.
   2. Weiss Instruments, Inc.
   3. Winters Instruments.

B. Standard: ASME B40.3.

C. Solar powered, variable angle digital thermometer.

D. Case: Hi-impact ABS

E. Sensor: Glass passivated thermistor

F. Display: ½" LCD digits.

G. Stem:
   1. Duct Installation: Aluminum ventilated.
   2. Pipe Installation: Brass.

H. Thermowell Connector for Pipe Installation: 1¼" with ASME B1.1 threads.

I. Accuracy: 1% of reading or 1°F whichever is greater.

J. Scale Range: Suitable for service.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into threaded fitting.
3. Material: Brass.
4. Type: Stepped shank unless straight or tapered shank is indicated.
5. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
6. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
7. Bore: Diameter required to match thermometer bulb or stem.
8. Insertion Length: Length required to match thermometer bulb or stem.
9. Lagging Extension: Include on thermowells for insulated piping and tubing.
10. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Available Manufacturers:

   a. AMETEK, Inc.; U.S. Gauge.
   b. Ashcroft Inc.
   c. Ernst Flow Industries.
   d. Flo Fab Inc.
   e. Marsh Bellofram.
   f. Miljoco Corporation.
   g. Noshok.
   h. Palmer Wahl Instrumentation Group.
   i. REOTEMP Instrument Corporation.
   j. Tel-Tru Manufacturing Company.
   k. Trerice, H. O. Co.
   l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   m. Weiss Instruments, Inc.
   n. WIKA Instrument Corporation - USA.
   o. Winters Instruments - U.S.

2. Standard: ASME B40.100.
3. Case: Solid-front, lead-free, pressure relief type; stainless steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Phosphor bronze.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: + or – 1.0 percent of full scale.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings to match sizes.

C. Install thermowells with extensions on insulated piping.

D. Install direct-mounted thermometers in thermowells and adjust positions.

E. Install pressure gages in piping tees located between 36" and 60" above finished floor unless otherwise indicated.

F. Install valve and snubber for each pressure gage.

G. Install test plugs in piping tees at locations indicated.

H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

I. Install flowmeter elements in accessible positions in piping systems.

J. Install permanent indicators on walls or brackets at 50" above finished floor unless otherwise indicated..

K. Install connection fittings in accessible locations for attachment to portable indicators.

L. Install thermometers in the following locations:
   1. Inlet and outlet of each water heater.

M. Install pressure gages in the following locations:
   1. Inlet and outlet of each water heater.
   2. Suction and discharge of each pump.

N. Install a test plug at each thermometer and pressure gauge.

3.2 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 F with 2-degree scale divisions.

B. Scale Range for Domestic Hot-Water and Hot-Water Recirculation Piping 30 to 240 F with 2-degree scale divisions.

3.3 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Water Piping: 0 psi to 100 psi.
   1. Provide pressure scale range so that normal operating high and low pressures are within 25%-75% of the full scale range.

END OF SECTION 220519

SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. MPTFE: Modified polytetrafluoroethylene plastic.
   4. NBR: Acrylonitrile-butadiene rubber.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. RPTFE: Reinforced polytetrafluoroethylene plastic.
   7. SWP: Steam working pressure.
   8. TFE: Tetrafluoroethylene plastic.
   9. WOG: Water Oil Gas.

1.3 SUBMITTALS

A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
   1. Exceptions: Domestic hot- and cold-water valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance:
   1. NSF 61 for valve materials for potable-water service.
   2. NSF 372 for Lead content requirements in drinking water system components.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)

C. Bronze Valves: 2" and smaller with threaded or soldered ends, unless otherwise indicated.

D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.

F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.

G. Valve Actuators:
1. As indicated in other Part 2 articles.
2. Where indicated, provide a chain actuator.
3. Chain Actuator: For attachment to valves of size and mounting height indicated.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

H. Extended Valve Stems: Provide on insulated valves.

I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.

J. Valve Grooved Ends: AWWA C606.

K. Threaded: With threads according to ASME B1.20.1.

L. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port) (1/4" to 2-1/2"):
1. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries-Apollo 77CLF series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE (RPTFE)
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

2.3 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:
1. Conbraco Industries-Apollo 161S/T
2. Other Manufacturers:
   a. Milwaukee
   b. Stockham
   c. Nibco
3. Bonnet: ASTM B-62 bronze.
4. Body: ASTM B-62 bronze.
5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
6. Disc Hanger:
   a. Sizes ¼" thru ¾": Type 304 stainless steel.
   b. Sizes 1" and larger: ASTM B-62 bronze.
7. Hanger Nut: ASTM B-16 bronze.
8. Disc Holder: ASTM B-62 bronze.
9. Seat Disc:
   a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
   b. Steam: TFE
10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
13. Rating: 125 psig SWP and 200 psig CWP.
14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:
   1. Conbraco Industries-Apollo 61-100 series
   2. Other Manufacturers:
      a. Milwaukee
      b. Stockham
      c. Nibco
   3. Body: ASTM B-584 alloy C84400 bronze.
   4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
   5. Ball Check: RPTFE or
   6. Disc Holder 316 Stainless steel
      a. Disc:
         1) Water, Oil, Gas: Buna-N
         2) Steam: TFE
      b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
      c. Body End: ASTM B-584 alloy C84400 bronze.
      d. Rating: 125 psig SWP and 250 psig CWP.
   7. Guide: ASTM B16 Brass
   8. Spring: Type 316 stainless steel.
   9. Rating: 125 psig SWP and 400 psig WOG.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully-open to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Shutoff valves shall be located on each floor, on takeoffs from all vertical risers, branch lines from the mains, for each bathroom group, and at the connection to each fixture.

3.3 ADJUSTING

A. Adjust valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly valves.
   2. Throttling Service: Ball or butterfly valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:
   1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   3. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
   4. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.

B. Structural Performance: Hangers and supports for Plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.

2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE

PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	**2**	0	0	0	0	0	0	**2**
	0	**2**	**2**	0	0	0	0	**4**
	0	**2**	0	**4**	0	0	0	**6**
	0	**2**	0	0	**6**	0	0	**8**
	0	0	**4**	**2**	0	0	0	**6**
	0	0	**4**	0	**2**	**2**	0	**8**
	0	0	**4**	0	0	**8**	0	**12**
	0	0	0	**6**	**2**	**2**	**2**	**12**
	0	0	0	**8**	0	**2**	0	**10**
	0	0	0	0	**14**	0	0	**14**
	0	0	0	0	0	**16**	0	**16**

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:

   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with in-turned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Available Manufacturers:

   a. Cooper B-Line – Dura-Blok
   b. MAPA Products
   c. Mifab, Inc. – C-Port
   d. Miro Industries, Inc.
   e. OMG, Inc.
   f. PHP Systems/Design
   g. Pipe Prop
   h. Roof Top Blox

2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

E. Pipe Stand Installation: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Provide hangers and supports to allow controlled thermalmovement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Provide lateral bracing with pipe hangers and supports to prevent swaying.

J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

   a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
   b. Pipe 4": 12 inches long and 0.06 inch thick.
   c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
   d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.

5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Provide padded hangers for piping that is subject to scratching.

G. Provide thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
11. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
14. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
15. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
16. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
17. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14"if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve Schedules: For each piping system to include in maintenance manuals.

D. 1/16" = 1'-0" scale drawing showing all valve locations to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, Aluminum, 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.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. 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.

D. 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, 1/16-inch-thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. 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 cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.
2. Stencil Paint: Exterior, gloss, black, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, in colors according to ASME A13.1, unless otherwise indicated. Paint shall be low VOC and shall meet the requirements of section 09910.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick brass or
2. Material: 0.0375-inch- thick stainless steel or
3. Material: 3/32-inch- thick laminated plastic with 2 black surfaces and white inner layer.

B. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws and hangers.

2. Frame: Finished hardwood or extruded aluminum.

3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.7 VALVE PLAN

A. Valve Plan: Prepare a scale drawing. Provide the location and identity of each valve.

1. Valve Plan Frames: Glazed display frame for removable mounting on masonry walls for each page of valve plan. Include mounting screws and hangers.

2. Frame: Finished hardwood or extruded aluminum.

3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 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 and permanently fasten equipment nameplates on each major item of plumbing equipment that does not have nameplate or has a nameplate that is damaged or located where

not easily visible. Locate nameplates where easily visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units.
2. Pumps, compressors, and other motor-driven equipment.
3. Heat exchangers and similar equipment.
4. Water heaters and storage tanks.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    b. Meters, gages, and thermometers.
    c. Fuel-burning units.
    d. Pumps, compressors, and other motor-driven equipment.
    e. Heat exchangers and similar equipment.
    f. Water heaters and storage tanks.

C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where easily visible.

1. Identify mechanical equipment with equipment markers in the following color codes:
    a. Green: For cooling equipment and components.
    b. Yellow: For heating equipment and components.
    c. Orange: For combination cooling and heating equipment and components.
    d. Brown: For energy-reclamation equipment and components.
    e. Blue: For equipment not listed in a through d
2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

D. Install access panel markers with screws on equipment access panels.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

1. Colors:
   a. Potable Hot and Cold Water and Domestic Hot Water Recirculation -Green
   b. Non-Potable / Make-Up Water / Grey Water - Purple (Non-Potable / Make-Up Water / Grey Water must be color coded everywhere in the project)
   c. Fire Protection – Red
   d. Natural Gas – Yellow

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Cold Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

2. Domestic Hot Water and Hot Water Return Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

   a. Domestic Cold Water: 1 ½", round.
   b. Domestic Hot Water: 1 ½", round.
   c. Domestic Hot Water Recirculation: 1 ½", round.

2. Valve-Tag Color:

   a. Domestic Cold Water: Blue.
   b. Domestic Hot Water: Red.
   c. Domestic Hot Water Recirculation: Red.

3. Letter Color:

   a. Domestic Cold Water: Black.
   b. Domestic Hot Water: White.
   c. Domestic Hot Water Recirculation: White.

3.5 VALVE SCHEDULE INSTALLATION

A. Mount valve schedules on wall in accessible location in each major equipment room and where directed by owner.

3.6 VALVE PLAN INSTALLATION

A. Mount valve plans on wall in accessible location in each major equipment room and where directed by owner.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.9 CLEANING

A. Clean faces of mechanical identification devices and glass fronts of valve schedules and plans.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Outdoor pipe: Pipe located outside the building insulation envelope.

B. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.

C. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.

D. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

E. Exposed: Visible from any angle without removal of building element or equipment.

F. Concealed: Enclosed in building element or above ceiling such that it is not visible from any angle without removal of building element or equipment.

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. Detail application of removable insulation covers.
2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
3. Detail attachment and covering of heat tracing inside insulation.
4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.

B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping installer for piping insulation, duct installer for duct insulation, and equipment installer for equipment insulation.

C. Maintain clearances required for maintenance.

D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Mineral-Fiber Insulation:
   a. CertainTeed Manson.
   b. Johns Manville
   c. Knauf FiberGlass GmbH.
   d. Owens-Corning Fiberglas Corp.
   e. Schuller International, Inc.
2. Flexible Elastomeric Thermal Insulation:
   a. Armstrong World Industries, Inc.
   b. Rubatex Corp.
3. Polyolefin Insulation:
   a. Armstrong World Industries, Inc.
   b. IMCOA.
4. Closed-Cell Phenolic-Foam Insulation:
   a. Kooltherm Insulation Products, Ltd.

5. Removable Insulation Covers:
   a. Advance Thermal Corp.

6. Acoustic Piping Wrap:
   a. Acoustical Solutions.
   b. All Noise Control
   c. Industrial Noise Control Products.
   d. Kinetics Noise Control.

2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.

G. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.

H. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 5.0
   c. Minimum installed R value assuming 25% compression: 4.0
2. Thickness: 2"
   a. Density: 1.0 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0
3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
   a. Density: 0.75 pcf

b. Minimum uncompressed R value: 7.4
c. Minimum installed R value assuming 25% compression: 6.0

4. Thickness: 3"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 10.0
   c. Minimum installed R value assuming 25% compression: 8.3

I. Medium Temperature Mineral-Fiber Blanket for Operating Temperatures from 250 to 850 deg F: Glass fibers bonded with a thermosetting resin. 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.

J. High Temperature Mineral-Fiber Blanket for Temperatures above 850 deg F: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

K. Mineral-Fiber Pipe 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. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

O. Acoustic Duct and Piping Wrap: Composite material including a flexible two-pound per square foot reinforced foil faced loaded vinyl noise barrier bonded to a 1" thick quilted fiberglass sound absorber. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Acoustical performance shall meet or exceed the table below. Utilize accessories as indicated in manufacturer's instructions. Accessories include foil lag tape, stick pins, welding pins, and banding.

	Octave Band Frequencies (Hz)						
Product	125	250	500	1000	2000	4000	STC

B-20 Lag/QFA-3 (BOD)	20	23	28	37	48	56	32

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.

C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

D. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 milsthick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Duct Jacket Color: White or gray.
3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

E. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled 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.

F. Stainless-Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A 666, Type 304 or 316; 0.10 inchthick; and roll stock ready for shop or field cutting and forming to indicated sizes.

1. Moisture Barrier: 1-mil-thick, heat-bonded polyethylene and kraft paper.
2. Elbows: Gore type, for 45- and 90-degree elbows in same material, finish, and thickness as jacket.
3. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

G. Heavy PVC Pipe 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.

H. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-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.

2.4 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

2.5 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, 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 inchthick.
2. Galvanized Steel: 0.005 inchthick.
3. Aluminum: 0.007 inchthick.
4. Brass: 0.010 inchthick.
5. Nickel-Copper Alloy: 0.005 inchthick.

C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lbfor direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.6 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

2.7 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL 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 piping, and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each 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 multiple layers of insulation with seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the minimum number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. 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.

M. 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.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to pipe joints and fittings.

O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

P. Install vapor-retarder mastic on pipes and equipment.

1. Pipes and equipment with vapor retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
2. Pipes and equipment without vapor retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Pipes: Secure blanket insulation with adhesive, and anchor pins with speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of pipe surfaces.
2. Apply adhesive to entire circumference of pipes and to all surfaces of fittings and transitions.

3. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
4. Impale insulation over anchors and attach speed washers.
5. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inchesfrom one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inchstaples, 1-incho.c., and cover with pressure-sensitive tape having same facing as insulation.
7. Overlap unfaced blankets a minimum of 2 incheson longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 incheso.c.
8. Apply insulation on pipe fittings and transitions with a full insulation segment for each surface. Apply insulation on pipe elbows with individually mitered gores cut to fit the elbow.
9. Insulate pipe hangers and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 incheso.c.
10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
2. Apply adhesive to all surfaces of fittings and equipment.
3. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inchesfrom one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inchstaples, 1-incho.c., and cover with pressure-sensitive tape having same facing as insulation.
5. Insulate equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6"wide strips of the insulating material. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 incheso.c.
6. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the 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 duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inchintervals and tighten without deforming the insulation materials.

2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inchintervals. Secure outer layer with stainless-steel bands at 12-inchintervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inchoverlap 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.

3.8 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as indicated.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all pipe and equipment:

1. Insulate pipe in accordance with the application schedule(s) below.
2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   a. Vibration-control devices.
   b. Testing agency labels and stamps.
   c. Nameplates and data plates.
   d. Manholes.
   e. Handholes.
   f. Cleanouts.
   g. Plastic Condensate Drain piping.
   h. Factory-insulated equipment.
   i. Flexible connectors.

3.10 ACOUSTICAL DUCT & PIPING WRAP

A. Install acoustical pipe and duct lagging in locations indicated. Comply with manufacturers written instructions for installation by using type of mounting accessories indicated or, if not indicated, as recommended by the manufacturer.

3.11 INDOOR APPLICATION SCHEDULE (ABOVE GRADE):

A. Service: Domestic hot water and domestic circulated hot water.

1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
2. Insulation Thickness: Apply the following insulation thicknesses:
   a. Copper Pipe, ½" through 1½" in diameter: 1"
   b. Copper Pipe, 1½" through 3" in diameter: 1 ½"
   c. Copper Pipe, larger than 3" in diameter: 2"
3. Vapor Retarder Required: No.
4. Finish: Exposed = Painted, concealed = none.

B. Service: Domestic cold water.

1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
2. Insulation Thickness: ½"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

C. Service: Exposed piping:
1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

D. Service: Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Drainage from any Equipment. Measurement shall be pipe length.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

E. Service: Condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

F. Service: Equipment Non-condensate Drains, & Traps.
1. Insulation Material: Mineral fiber preformed pipe insulation with Factory Applied FSK Jacket.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

3.12 INDOOR APPLICATION SCHEDULE (IN CRAWL SPACE):

A. Service: Domestic hot water and domestic circulated hot water.

1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
2. Insulation Thickness: Apply the following insulation thicknesses:

a. Copper Pipe, ½" through 1½" in diameter: 1-1/2"
b. Copper Pipe, 1½" through 3" in diameter: 2"

3. Vapor Retarder Required: No.
4. Finish: Exposed = Painted, concealed = none.

B. Service: Domestic cold water.

1. Insulation Material: Mineral fiber preformed or flexible elastomeric pipe insulation.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Exposed = Painted, concealed = none.

END OF SECTION 220700

SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 01 91 13 – Commissioning General Requirements

C. Section 25 08 00 – Commissioning of Integrated Automation Systems

D. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 22 responsibilities and participation in the commissioning process. All contractors responsible for Division 22 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Plumbing Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 01 91 13 Section 1.3 – Definitions. The mechanical trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Plumbing Contractor(s) are responsible for plumbing system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 22 specification sections. Plumbing Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 01 91 13. Neither Section 01 91 13 - Commissioning General Requirements nor Section 22 08 00 – Commissioning of Plumbing systems shall relieve the Plumbing Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 22 08 00 – Commissioning of Plumbing systems shall not relieve the Electrical Contractor(s) or Controls Contractor(s) from any obligations set forth within Division

1, Division 25, Division 26, including Section 01 91 13 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Plumbing Contractor(s): The term Plumbing Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 22 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 22 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 22 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Plumbing Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Plumbing Contractor(s) shall be required to fulfill all requirements set forth within Specification 22 08 00 Section 1.5 – Roles and Responsibilities. Additionally, the Plumbing Contractor(s) shall be required to fulfill all requirements set forth within Specification 01 91 13.

B. Through the Commissioning Process, the Plumbing Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Plumbing Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 22 of the specifications. See Specification 01 91 13 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Plumbing Contractor(s) shall be required to fulfill all requirements described within Specification 01 91 13 Section 1.4 – Roles and Responsibilities.

D. Plumbing Contractor(s)

1. General Requirements:

a. Include all cost to complete commissioning requirements for plumbing systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 01 91 13 Section 2.2 – Schedule of Values.

b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.

c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.

d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule

a. Prepare a Preliminary Schedule for plumbing systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests. Coordination of the commissioning activities and their integration into the schedule shall be conducted within the Commissioning Meetings.

b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, TAB, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

a. Comply with all Submittal requirements as outlined within Specification 01 91 13 Section 2.3 – Submittals.

b. Comply with all requirements as outlined within Specification 01 91 13 Section 2.5 – Start-Up and Test Reports.

c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

1) General construction progress and status reports

2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs

3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent

4) Pre Start-Up and Start-Up procedures

5) Value Engineering Proposals and a list of all accepted VE items

6) Pressure Test Reports, Flushing Reports and Start-Up Reports

7) Construction document changes resulting from mechanical Requests for Information

4. Pre-Functional Checklist Requirements:

a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 01 91 13 Section 2.4 – Pre-Functional Checklists.

b. Complete Pre-Functional Checklists on all mechanical equipment and system components installed or provided by the Mechanical Contractors(s).

c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, of the time for start of the TAB work.

d. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, so that witnessing Equipment and System Start-Up can begin.

e. Provide written notification to the Commissioning Agent for each system listed in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up

a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

b. Perform all pressure tests, weld tests, vibration analysis and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist

c. Perform all Test, Adjustment and Balance requirements for hydronic piping systems and air distribution systems. Submit copies of the TAB Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. Also, submit a copy of the preliminary TAB documentation including the TAB Plan, Forms and Report format to the Commissioning Agent for review and approval. The TAB Contractor shall assist as the TAB Report is spot-checked by the Commissioning Agent. See the Specification 22 08 00 Section 1.5 – Roles and Responsibilities, Subsection E for additional TAB Contractor Requirements.

d. Perform all equipment, system and component cleaning and flushing as required by the specifications and Equipment Manufacturer's recommendations. Provide full documentation of all cleaning and flushing procedures and test results (i.e. pH test results, ect.) Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist

6. Functional Performance Test Requirements:

a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 01 91 13 Section 2.6 – Functional Performance Tests.

b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 01 91 13 Section 2.8 – Test Equipment.

c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)

d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.

e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.

f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness plumbing testing. These additional tests shall be treated in accordance with Specification 01 91 13 Section 3.6-A.

7. Training Requirements:

a. Comprehensive training of O&M personnel shall be performed by the Plumbing Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems. Training shall be coordinated by the Commissioning Agent via review and approval of the Contractor(s) Training Plan, Forms and Schedule. Alternately, the Commissioning Agent may provide a Training Plan including all forms for completion by the Plumbing Contractor(s).

b. The Training Schedule is to be coordinated and completed by the Plumbing Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner. A copy of the Training Schedule and all updates shall be provided to the Commissioning Agent.

c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.

d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.

b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.

c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.

d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Test, Adjust, and Balance Contractor(s):

1. Comply with all requirements as outlined within Specification 22 08 00 Section 1.5 Sub-Section D – Plumbing Contractor(s).

2. Submit the TAB procedures to the Commissioning Agent and Design Professional for review and acceptance. TAB procedures must include the TAB Plan, TAB Forms and TAB Report Format. These documents must be approved prior to proceeding with the Test, Adjustment and Balance.

3. Attend the TAB review meeting scheduled by the Commissioning Agent. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.

4. Issue a statement that TAB work has been completed. Submit through the Contractor(s) a copy of the preliminary version of the Test and Balance Report to the Commissioning Agent and System Design Professional. Submit for review, a Final Version of the Test and Balance Report to the Commissioning Agent and System Design Professional within the amount of time allotted within the Specifications. The Commissioning Agent and Systems Design Professional must both accept the Final TAB Report.

5. The Commissioning Agent shall be provided with a copy of the Test, Adjustment and Balance Report a minimum of two weeks (14 days) prior to the scheduled spot check of the balanced system. The report may be a Preliminary or Final version. A representative of the Test and Balance firm shall be required to assist with the spot check. The Test and Balance firm shall provide calibrated testing equipment as per Specification 01 91 13 Section 2.8 - Test Equipment. Equipment shall be similar in style and type as used to initially perform Test, Adjustment and Balance procedures.

6. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes.

F. Automatic Controls and Building Automation System Contractor(s):

1. Comply with all requirements as outlined within Specification 22 08 00 Section 1.5 Sub-Section D – Plumbing Contractor(s).

2. Review design for controllability with respect to selected equipment:

3. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.

4. Verify proper safeties and interlocks are included in design.

5. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.

6. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.

7. Verify proper selection of sensor ranges.

8. In addition to all other submittal requirements outlined with in Specifications 01 91 13 and 22 08 00, provide the following submittals to the Commissioning Agent:

    a. Hardware and software submittals

    b. Control panel construction shop drawings

    c. Narrative description of each control sequence for each piece of equipment controlled.

    d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.

    e. Logic diagrams showing the logic flow of the system.

    f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.

    g. A complete control language program listing, including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.

    h. Application software and project applications code manuals.

    i. Operations and Maintenance Staff comments on the BAS Graphics Submittal. Include all Controls Contractor responses

9. Verify proper installation and performance of controls / BAS hardware and software provided by others.

10. Issue a Statement of Calibration for each system which states that all system points and interfaces have been properly calibrated and adjusted.

11. Provide controls graphics submittals to the Commissioning Agent and to the Owner and Owner's Maintenance Personnel for approval. Do not proceed with controls graphics programming without integration of the Owner's Maintenance Personnel comments.

12. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system.

13. Demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency).

14. Provide control system technician for use during system verification and functional performance testing.

15. Provide system modifications as required.

16. Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operator's terminals, for TAB use in completing TAB procedures.

17. The Controls Contractor(s) shall provide trending as required to confirm, disconfirm or correct any deficiencies identified during Commissioning. The Commissioning Agent will provide the list of systems and points for trending.

G. Fire Protection Contractor(s):

1. Comply with all requirements as outlined within Specification 22 08 00 Section 1.5 Sub-Section D – Plumbing Contractor(s).

2. Fire Protection Contractor shall demonstrate operation of all dynamic components of the Fire Protection System. These shall include but not be limited to the operation of Valve Tamper Switches, Flow Switches, Deluge Valves, Air Compressors for Dry Pipe Systems, Pressure Switches, manually operated valves, etc.

3. Testing may be required up to three times based upon Test Coordination. The first test shall be performed by the Fire Protection Contractor(s). The Fire Protection Contractor(s) shall verify the functionality of systems internally. The second test shall be a demonstration to the Commissioning Agent. The system must also be demonstrated to the Authority Having Jurisdiction which shall be either concurrent to the second test as witnessed by the Commissioning Agent, or shall be a third test performed specifically for the Authority Having Jurisdiction.

4. Review installation for manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

5. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

6. Demonstrate performance of equipment as required within Functional Performance Tests.

H. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 22 08 00 Section 1.5 Sub-Section D – Plumbing Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component tests (i.e. Weld Test Reports, Cleaning & Flushing Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Test, Adjustment and Balance Report: The approved Final Report shall be provided to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

6. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall

be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 01 91 13 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Plumbing Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Plumbing Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Plumbing Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Plumbing Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Plumbing Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 22. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Plumbing Contractor(s). Plumbing Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Plumbing Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Mechanical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC's or FPT's at a rate of $85/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager or General Contractor's Application for Payment. The Construction Manager or General Contractor will then back charge the party responsible for the test's failure. It is the Mechanical Contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Plumbing Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 01 91 13-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 01 91 13-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Plumbing Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

2. Controls Contractor - provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.

3. Electrical contractor - provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

D. Documentation and Reporting Requirements

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager or General Contractor, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. The Commissioning Agent shall direct and witness the field verification of the Final TAB report. The TAB Contractor shall perform measurements as directed by the Commissioning Agent.

1. The Commissioning Agent shall select report data for verification at random.

2. The TAB contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB contractor must use the same instruments (by model and serial number) that were used when the original data were collected.

3. Failure of an item is defined as:

   a. For all readings other than sound, a deviation of more than 10 percent.

   b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).

4. A failure of more than 10 percent of the selected items shall result in the rejection of the TAB report.

F. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 22 08 00

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 01 Specification Sections, apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing domestic water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
   1. Domestic Water Service Piping: 160 psig.
   2. Domestic Water Distribution Piping: 125 psig.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Domestic water piping.
   2. HVAC hydronic piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. NSF/ANSI Compliance:
   1. NSF/ANSI 14, "Plastic Piping System Components and Related Materials"
   2. NSF/ANSI 61, "Drinking Water System Components – Health Effects"
   3. NSF/ANSI 372, "Drinking Water System Components – Lead Content"

C. ASTM Compliance:
   1. ASTM F 876, "Standard Specification for Crosslinked Polyethylene (PEX) Tubing"
   2. ASTM F 877, "Standard Specification for Crosslinked Polyethylene (PEX) Hot-Water and Cold-Water Distribution Systems"

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
   1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
   2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
   4. 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.
   5. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Conex Banninger
         2) Elkhart Products Corporation; Industrial Division.
         3) Mueller Industries
         4) NIBCO INC.
         5) Viega; Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
   1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   2. Copper Pressure-Seal-Joint Fittings:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Conex Banninger
         2) Elkhart Products Corporation; Industrial Division.
         3) Mueller Industries
         4) NIBCO INC.
         5) Viega; Plumbing and Heating Systems.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
1.

E. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to other sections for excavating, trenching, and backfilling.

3.2 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. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Fitting Options:
1. Mechanically formed tee-branch outlets (T-Drill) and brazed joints may be used on aboveground copper tubing.
2. Press Fittings: Mechanically crimped fittings with neoprene gasket.

E. Underground Domestic Water Service Piping: Match civil materials to first flange.

F. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
1. 2" and Smaller:
a. Hard copper tube, Type L copper pressure fittings; and soldered joints.

G. Underground Domestic Water Piping: Use the following piping materials for each size range:
   1. 2" and Smaller:
      a. Soft copper tube, Type Kcopper pressure fittings; and soldered joints with no joints permitted below concrete slabs.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water-Piping, Balancing Duty: Use automatic flow control valves.
   4. Drain Duty: Hose-end drain valves.

B. Grooved-end valves may be used with grooved-end piping.

3.4 PIPING INSTALLATION

A. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.

B. Install underground ductile-iron piping according to AWWA C600, and AWWA M41. Install buried piping inside building between wall and floor penetrations and connection to water service piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.

C. Install underground copper according to CDA's "Copper Tube Handbook."

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight.

E. Install water-pressure regulators downstream from shutoff valves.

F. Install aboveground domestic water piping level and plumb.

G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

H. Perform the following steps before operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.

5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.

I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

J. Check plumbing specialties and verify proper settings, adjustments, and operation.
1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.

K. Energize pumps and verify proper operation.

L. Store and protect plastic piping and fittings in packaging with labeling in place.
1. Pipe and fittings shall be kept in original packaging until required for installation.
2. Do not expose pipe and fittings to ultraviolet (UV) light beyond exposure limits recommended by manufacturer.
3. Protect products from exposure of contaminating materials. Install suitable plugs in open pipe ends until installation when necessary.
4. Piping shall not be dragged across the ground or other surfaces and shall be stored on a flat surface with no sharp edges.
5. Pipe and fittings shall be protected from other trades, oil, grease, paint, direct sunlight, and other elements as recommended by the manufacturer.

3.5 JOINT CONSTRUCTION

A. 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.

B. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

D. Mechanically crimped fittings shall be installed in accordance with manufacturer's installation instructions and by factory accredited installer.

3.6 VALVE INSTALLATION

A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.

C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.7 HANGER AND SUPPORT INSTALLATION

A. Refer to Section 220529 "Hangers and Supports for Plumbing Piping" for pipe hanger and support devices.

B. Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

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 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.
   7. NPS 8: 10 feet with 3/4-inch rod.

F. Where hangers for piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.

G. Install supports for vertical copper tubing every 10 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

I. Where bends in the pipe occur, place hangers 1/3 of the maximum allowed spacing distance of the bend (i.e. is the maximum span is 12 feet, the hanger shall be 4feet from the bend. Pipe shall be supported from both sides of the bend.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

3.9 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
   4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

3.10 ADJUSTING

A. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   1. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.

3.11 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in AWWA C651, AWWA C652 or as described below:

      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:

         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities to authorities having jurisdiction.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

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 proposed.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

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 Compliance:

1. Comply with NSF 61, "Drinking Water System Components – Health Effects"
2. Comply with NSF 372, "Drinking Water System Components – Lead Content"
3. Comply with NSF 14, "Plastic Piping System Components and Related Materials"

C. Water Management Installation:

1. Installer Qualifications: An installer who is authorized by the equipment manufacturer for both installation and maintenance of submitted equipment.
2. Provide documentation demonstrating previous experience and successfully completing projects of similar size and scope.
3. Provide a list of installations that the Installer has specifically installed for verification by the Owner. Similar installations from other vendors and/or Installers shall be accepted. The Installer's employees must meet these qualifications.

4. The Installer shall demonstrate to the satisfaction of the Architect/Engineer that he has:
   a. Adequate plant and equipment to pursue the work properly and expeditiously.
   b. Adequate staff and technical experience to implement the work.

c. Suitable financial status to meet the obligations of the work.
d. Technical capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.

5. A contractor intending to bid on this work, not meeting the requirements of this section, may employ the services of an "Installer" meeting the requirements of this section. A "subcontractor" so employed must be acceptable to the Architect. The "Installer" shall be identified by submittal for acceptance by the Architect.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type (Anti-siphon) Vacuum Breakers:

1. Available Manufacturers:

a. Ames Co.
b. Apollo Valves - Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.

3. Sizes: ¾" thru 3" as required to match connected piping.

4. Body: Brass or Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Rough bronze or chrome plated.

B. Pressure Vacuum Breakers:

1. Available Manufacturers:

a. Ames Co.
b. Apollo Valves - Conbraco Industries, Inc.
c. Watts Industries, Inc.; Water Products Div.
d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

C. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers:

a. Apollo Valves - Conbraco Industries, Inc.
b. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1056.

3. Operation: Continuous-pressure applications.

4. Sizes: ¾" thru 1" as required to match connected piping.
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.2 WATER PRESSURE-REDUCING VALVES

A. Available Manufacturers:
1. CLA-VAL Automatic Control Valves.
2. Flomatic Corporation.
3. OCV Control Valves.
4. Watts Industries, Inc.; Ames Fluid Control Systems.
5. Watts Industries, Inc.; Watts ACV.
6. Zurn Plumbing Products Group; Wilkins Div.

B. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.

C. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

D. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
1. Sizes: 1¼" thru 10" as required to match connected piping.
2. Pattern: Angle or Globe-valve design.
3. Trim: Stainless steel.

2.3 AUTOMATIC FLOW CONTROL VALVES

A. Manufacturers:
1. Bell & Gossett
2. Flow Design, Inc.
3. Griswold Controls
4. Hays Fluid Controls
5. Nexus
6. Pro Hydronic Specialties

B. Valves shall be factory set to maintain constant flow with plus or minus 10 percent. Each valve shall have an identification tag attached by chain, and be factory marked with the zone or equipment identification, valve number, and flow rate. Valve shall be line size and as follows:
1. Body:
   a. Gray-iron or brass, designed for 175psig at 200ºF.
   b. Brass or ferrous-metal, designed for 300psig at 250ºF.
2. Cartridge: Stainless steel or nickel chrome plated brass, tamperproof, self-cleaning, piston-spring assembly, or polyphenylsulfone orifice seat with polymer diaphragm (Hays) removable for inspection or replacement.
3. Adjustment: Flow and pressure differential shall be adjustable by cartridge replacement.

4. Configuration: "Y" or other permitting cartridge replacement without valve removal for sizes 2" and smaller.
5. Sizes: Match connecting pipe.
6. Accessories:
   a. Provide unions and isolation valves or other configuration permitting cartridge replacement with valve removal for sizes larger than 2."
   b. Minimum pressure differential shall not exceed 2 psi (unless otherwise indicated)
   c. Maximum pressure differential shall not be less than 32 psi (unless otherwise indicated).
   d. Flow rates shall be as indicated on equipment schedules on the drawings.
   e. Valves shall be installed in return piping.
   f. Ball valves and unions included as part of the valve package may be used in place of ball valves and unions specified and indicated on the drawings only when in positions indicated. Ball valves shall be provided with a solid stainless steel or chrome plated brass ball.
   g. Provide a #20 mesh Y-strainer with blow-down valve and garden hose connection between the supply side valve and equipment.
   h. Valves may be provided as part of a "hose kit."

2.4 CALIBRATED BALANCING VALVES

A. Available Manufacturers:
   1. Armstrong Pumps, Inc.
   2. Caleffi
   3. Flow Design, Inc.
   4. Griswold Controls
   5. ITT Bell & Gossett; ITT Fluid Technology Corp.
   6. Jomar Valves
   7. Nexus Valve
   8. NIBCO
   9. NuTech Hydronic Specialty Products
   10. Taco, Inc.

B. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded 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.

C. 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 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.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Thermostatic Master Mixing Valves:
   1. Refer to drawing schedule for manufacturer and operating requirements.
   2. Available Manufacturers:

a. Lawler Manufacturing Company, Inc.
b. Leonard Valve Company.
c. Powers; a Watts Industries Co.
d. Symmons Industries, Inc.

3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: union inlets and outlet.
7. Accessories:

a. Check stops on hot- and cold-water supplies.
b. Handle.
c. Dial thermometer on inlets and outlet.
d. Pressure gauges on inlets and outlet.

8. Pressure Rating: 125 psig, unless otherwise indicated.

B. Individual-Fixture, Water Tempering Valves:

1. Refer to drawing schedule for manufacturer and operating requirements.
2. Available Manufacturers:

a. Apollo Valves - Conbraco Industries, Inc.
b. Lawler Manufacturing Company, Inc.
c. Leonard Valve Company.
d. Powers; a Watts Industries Co.
e. Watts Industries, Inc.; Water Products Div.
f. Zurn Plumbing Products Group; Wilkins Div.

3. Standard: ASSE 1070, thermostatically controlled water tempering valve.
4. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Body: Bronze body with corrosion-resistant interior components.
6. Temperature Control: Adjustable.
7. Inlets and Outlet: Threaded. Provide unions and valves.
8. Finish: Chrome-plated bronze.

2.6 STRAINERS

A. Pattern: "Y"

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron or steel 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: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 WATER HAMMER ARRESTERS

A. Available Manufacturers:
1. AMTROL, Inc.
2. Josam Company.
3. MIFAB, Inc.
4. PPP Inc.
5. Sioux Chief Manufacturing Company, Inc.
6. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
7. Tyler Pipe; Wade Div.
8. Watts Drainage Products Inc.
9. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Standard: ASSE 1010 or PDI-WH 201.

C. Type: Metal bellows or copper tube with piston.

D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 TRAP GUARD

A. Available Manufacturers:
1. ProSet Systems, Model TG
2. SureSeal Manufacturing, Inline Floor Drain Trap Sealer

B. General:
1. Comply with ASSE 1072-2007.
2. ProSet Systems: Smooth, soft, flexible, elastomeric PVC material molded into shape, open on top with curl closure at bottom. SureSeal: ABS plastic body with neoprene rubber diaphragm and sealing gasket with 80 durometer compression fit sealing gasket on gravity drain outlet connection.
3. Allows wastewater to open and adequately discharge floor drain through its interior.
4. Closes and returns to original molded shape after wastewater discharge is complete.
5. Size shall be as required to match drain in which it is installed.

2.9 HOSE BIBBS

A. Refer to plumbing fixture rough-in schedule on drawings.

2.10 WALL HYDRANTS

A. Refer to plumbing fixture rough-in schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers where indicated: If not indicated on 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 with-in 12" of ceiling at access door or tile where they can be reached with-out obstruction.

D. Install thermostatic mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and pressure gauges.
2. Install cabinet-type units recessed in or surface mounted on wall as indicated.

E. Install strainers where indicated.

F. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Section "Rough Carpentry."

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting.

J. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1/8" per foot, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

K. Install trap guards in accordance with manufacturer's instructions.

L. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

M. Fasten recessed-type plumbing specialties to reinforcement built into walls.

N. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

O. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Section "Valves" for general-duty ball valves.

P. Install air vents at water piping high points. Include ball valve in inlet.

Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

R. 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.

S. Specific trap primer assembly and primer pipe routing not always indicated on plans to provide contactor field flexibility in selecting option best suitable for field conditions, where alternative options may be acceptable. Contactor shall coordinate and provide any necessary items to facilitate proper installation and operation of the preferred and approved primer system; to include, but not limited to, electrical conduit and circuitry to the panelboard for electronic systems.

3.2 LABELING AND IDENTIFYING

A. Indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section "Plumbing Identification"

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principal backflow preventer, double-check backflow-preventer and double-check, detector-assembly according to authorities having jurisdiction and the device manufacturer's recommendations.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 ADJUSTING

A. Set field-adjustable pressure set points.

B. Set field-adjustable flow set points.

C. Set field-adjustable temperature set points.

END OF SECTION 221119

SECTION 221125 - CIRCULATING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

A. BAS Building Automation System

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Operation and Maintenance Data: For domestic water pumps to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect against damage.

C. Comply with pump manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 CIRCULATING PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Grundfos Pumps Corp.
2. TACO Incorporated.
3. Bell & Gossett Domestic Pump; ITT Corporation.
4. Armstrong Pumps Inc.

B. Description: Factory-assembled and -tested, in-line, wet rotor or system lubricated, close-coupled, 100% lead free, overhung-impeller, designed for circulating domestic hot water.

C. Pump Construction:

1. Pump and Motor Assembly: Hermetically sealed, cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
2. Motor: Non-overloading at all points on the pump curve
3. Casing: Bronze, with companion-flange connections.
4. Impeller: Plastic.
5. Motor: Single speed, unless otherwise indicated.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.3 CONTROLS

A. BAS: Electric, adjustable for control of water-supply pump.

1. Type: Start/Stop
2. Operation of Pump: Refer to Section "Sequence of Operation".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

B. Verify installation and location of automatic flow control valve(s). Record actual location(s) on as-built drawings.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, centrifugal pumps with shaft horizontal unless otherwise indicated.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps.

D. Install suction and discharge piping.

E. Install indicated valves &devices.

F. Comply with Division 26 Sections for electrical connections.

G. Connect controls.

H. Interlock pump with water heater to deactivate water heater when pump is deactivated..

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Check operation of controls for automatic starting and stopping operation of pumps.

5. Perform the following startup checks for each pump before starting:
   a. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   b. Verify that pump is rotating in the correct direction.
6. Prime pump.
7. Close discharge valve.
8. Start motor.
9. Open discharge valve slowly.
10. Adjust temperature settings on thermostatic mixing valves if included in design.
11. Adjust balancing valves if required by thermostatic mixing valve manufacturer.
12. Check and record pressure on inlet and outlet of pump.

END OF SECTION 221125

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are industry abbreviations for plastic and rubber piping materials:

1. EPDM: Ethylene-propylene-diene terpolymer.
2. NBR: Acrylonitrile-butadiene rubber.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.
5. TPE: Thermoplastic elastomer.
6. USGBC: United States Green Building Council

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of testing agency.

B. Cast iron soil pipe shall be clearly marked with the manufacturer's name, county of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of third part certifier.

1. Third party certifier shall be IAPMO, ICC, NSF, or other organization that is accredited as an ANSI – Guide 65 organization. Reference www.ansi.org.

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 Non-Pressure 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 CAST-IRON SOIL PIPING

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Hub-and-Spigot Gaskets: ASTM C 564, rubber.

C. Hub-less Couplings:

1. All hub-less couplings shall bear the NSF trademark.

2. General: CISPI 310 and ASTM C 1277 assembly of stainless steel corrugated shield, stainless steel bands and fasteners, and ASTM C 564 rubber sleeve with integral, center pipe stop.

1) Heavy-Duty, Type 304, Stainless-Steel Couplings: ASTM C 1540, Type 304, stainless-steel shield; stainless-steel bands; and ASTM C 564, rubber sleeve.

a) NPS 1-1/2 to NPS 4: 3-inch- wide shield with 4 bands.
b) NPS 5 to NPS 10: 4-inch- wide shield with 6 bands.

b. Heavy-Duty, Cast-Iron Couplings: ASTM A 48/A 48M, 2-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

D. Manufacturers:

1. AB&I Foundry
2. Charlotte Pipe & Foundry Co.
3. Tyler Pipe & Coupling

2.3 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground, Soil, Waste, and Vent Piping: Hub-less cast-iron soil piping with heavy duty couplings.

C. Underground, Soil, Waste, and Vent Piping:PIPING INSTALLATION

A. Refer to Section "Facility Sanitary Sewers" for Project-site sanitary sewer piping.

B. Refer to Section "Common Work Results for Plumbing" for basic installation.

C. Install seismic restraints on piping when indicated. Seismic-restraint devices are not required in zones A & B. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment".

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install seismic restraints on piping when indicated. Seismic-restraint devices are specified in Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

G. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

H. 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.

I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

J. 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 drainpipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the minimum slopes required by authorities having jurisdiction.

M. Install all drainage pattern fittings and piping in accordance with all applicable federal, state, and local codes.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete and masonry walls and slabs. Comply with requirements for sleeve seals specified in Section "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section "Escutcheons for Plumbing Piping"

3.3 JOINT CONSTRUCTION

A. Refer to section "Common Work Results for Plumbing" for basic piping joint construction.

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-less cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hub-less-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

A. Refer to Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices in zones other than A & B.

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. 1 ½" and 2": 60" with 3/8"rod.

2. 3": 60" with ½"rod.

3. 4" and NPS 5: 60" with 5/8" rod.

4. 6": 60" with ¾" rod.

5. 8" to 12": 60" with 7/8" rod.

6. 15": 60" with 1" rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Where required or indicated prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.8 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. RPZ Reduced Pressure Zone

B. FOG Fats, oils, and greases.

1.3 DEFINITIONS

A. Withstand: Units shall remain in place without separation of any parts when subjected to seismic forces indicated. "Essential facility" units shall be fully operational after the seismic event.

1.4 SUBMITTALS

A. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

B. Coordinate accessories, extensions, collars, flashing clamps, etc… for field conditions and installation requirements for roof assemblies and other construction assemblies to provide final and proper compliant installation.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. General:

1. Available Manufacturers:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification

2. Standard: ASME A112.36.2M.
3. Size: Same as connected drainage piping
4. Closure Material: Match pipe, brass, PVC, or ABS

B. Floor Cleanouts:

1. Housing: threaded, adjustable.
2. Type: Threaded, adjustable housing.
3. Body: Cast iron.
4. Outlet Connection: Inside calk, Spigot, or Threaded.
5. Adjustable Housing Material: Cast iron with threads.
6. Frame and Cover Material and Finish: Satin finish nikaloy.
7. Frame and Cover Shape: Round or Square (Contractors Option).
8. Top Loading Classification: Extra Heavy Duty.
9. Riser: ASTM A 74, Service weight, cast-iron drainage pipe fitting and riser to cleanout.
10. Carpet Ring: Yes for carpeted floors.
11. Tile Recess: Yes for tiled floors.
12. Terrazzo: Yes for terrazzo floors

C. Wall Cleanouts:

1. Wall access: Yes
2. Body: Match connected piping.
3. Closure: Countersunk or raised-head, drilled-and-threaded plug.
4. Closure Plug Size: Same as cleanout size but not larger than four inches in diameter.
5. Wall Access: Round, flat, chrome-plated brass, nickel-bronze, copper-alloy, or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product 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; Light Commercial Operation.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3
3. Pattern: As indicated.
4. Clamping Flange: Required.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Plastic Stack Fitting (For Use Where Plastic Stacks Are Indicated): ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating (For Use Where Plastic Laboratory Stacks are Indicated: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.5 MOTORS

A. General requirements for motors are specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

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.

C. Install cleanout deck plates with top flush with finished floor.

D. For wall cleanouts located in concealed piping, install cleanout access covers, with cover tight to 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 as indicated. If indication is not clear, position for easy access and maintenance.
2. Set floor drains at elevations indicated.
3. Install floor-drain flashing 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.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Install through-penetration firestop assemblies in plastic conductors and stacks at rated penetrations.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains indicated to receive trap-seal primer.

I. Install air-gap fittings on RPZ backflow preventers and where indicated.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.

L. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect. Coordinate oil-interceptor storage tank and gravity drain with Division 22 Section "Facility Fuel-Oil Piping."

M. Install solids interceptors according to authorities having jurisdiction, manufacturer's recommendations/instructions, and as indicated. In case of a conflict, consult architect.

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 PROTECTION

A. Protect drains during construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of open pipes at end of each day or when work stops.

END OF SECTION 221319

SECTION 223300 - ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 BASIS OF DESIGN PRODUCT: As scheduled on the drawings or as otherwise indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For each type and size of water heater. Include electrical data, rated capacities, operating weights, furnished specialties, and accessories.

B. Shop Drawings: Detail water heater 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. Differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.

D. Warranties: Special warranties specified in this Section.

1.5 ABBREVIATIONS

A. AFF Above Finished Floor

B. EWH Electric Water Heater

C. WC Water Column

1.6 DEFINITIONS

A. Potable: Consumable, drinkable, or domestic.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1 unless otherwise indicated.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.8 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 water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Begins on date of Beneficial Occupancy:
b. Heating Elements: One year.
c. Storage Tanks: Three years.
d. Heat Exchangers: Three Years
e. Compressors: Three years.
f. Controls: One year.

PART 2 - PRODUCTS

2.1 SMALL EWH's (Base Bid)

A. Description: Small storage capacity units (2.50-50.00 Gallons) with limited heating capacity (6.00 kW maximum)

B. Manufacturers:

1. A.O. Smith.

2. Hubbell

3. Rheem Manufacturing Co.; Rheem Water Heater Div.
4. Rheem Manufacturing Co.; Ruud Water Heater Div.
5. State Industries.
6. Bradford White Corp.
7. Lochinvar Corp.

C. Standards:

1. Comply with UL 174.
2. ASHRAE/IESNA 90.1
3. Listed by manufacturer for commercial applications.

D. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls. Attach tappings to tank before testing and labeling.
2. 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.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

E. Pipe Thread: ASME B1.20.1

F. Heating Element: Electric, replaceable, immersion type.

1. Temperature Control: Adjustable thermostat.

G. Anode Rod: Factory installed.

H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

2.2 Heat Pump Electric Water Heaters (Alternate #9)

A. Description: Small storage capacity units (2.50-50.00 Gallons) with limited heating capacity (6.00 kW maximum). Water heater contains self-contained air source heat pump and backup electric resistance heater.

B. Manufacturers:

1. A.O. Smith.
2. Hubbell
3. Rheem Manufacturing Co.; Rheem Water Heater Div.
4. Rheem Manufacturing Co.; Ruud Water Heater Div.

5. State Industries.
6. Bradford White Corp.
7. Lochinvar Corp.

C. Standards:

1. Comply with UL 174.
2. ASHRAE/IESNA 90.1
3. Listed by manufacturer for commercial applications.

D. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls. Attach tappings to tank before testing and labeling.
2. 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.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

E. Heat Pump:

1. Water heater shall be capable of operating in heat pump mode, hybrid, or electric resistance only. Heat pump shall be self-contained and mounted on the top of the tank.

F. Pipe Thread: ASME B1.20.1

G. Heating Element: Electric, replaceable, immersion type.

1. Temperature Control: Adjustable thermostat.

H. Anode Rod: Factory installed.

I. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

2.3 NON-ASME COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory installed butyl-rubber diaphragm.

B. Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. State Industries.

4. Taco, Inc.
5. Wessels Co.
6. Zurn Industries, Inc.; Wilkins Div.

C. Diaphragm: Butyl-rubber FDA approved for use with potable (domestic) water

D. ASME-code label: No

E. Working Pressure: 150 psig.

F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

G. Pipe Thread: ASME B1.20.1

H. 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.

I. Tank Exterior Finish: Manufacturer's standard, unless indicated otherwise.

J. Air Pre Charge Valve: Factory installed Schrader type (standard tire valve).

2.4 ASME COMPRESSION TANKS

A. Description: ASME-code Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm.

B. Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. State Industries.
4. Taco, Inc.
5. Wessels Co.
6. Zurn Industries, Inc.; Wilkins Div.

C. Diaphragm: Butyl-rubber FDA approved for use with potable (domestic) water

D. ASME-code label: Yes

E. Working Pressure: 150 psig.

F. Tappings: Factory-fabricated steel, welded to tank before testing and labeling.

G. Pipe Thread: ASME B1.20.1

H. 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.

I. Tank Exterior Finish: Manufacturer's standard, unless indicated otherwise.

J. Air Pre Charge Valve: Factory installed Schrader type (standard tire valve).

2.5 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated, ASME stamped, and complying with ASME PTC 25.3.

1. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping
2. Minimum Relieving Capacity: Equal to heat input.
3. Minimum Pressure Setting: Equal to water heater working pressure rating.
4. Sensing Element: Extends into tank.
5. Temperature Setting: 20° F Higher than water heater set point temp

B. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.

1. Exception: Omit if water heater has integral vacuum-relieving device.

C. Water Heater Mounting Brackets: Steel bracket for wall mounting and capable of supporting water heater and water.

D. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater plus four (4) inches, dimensions not less than two to four (2-4) inches vertical, and include drain outlet not less than NPS ¾ in diameter with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

E. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

G. Plug and cord:
1. Where water heaters require 120 volt single phase power, provide a plug and cord, for connection to a standard grounded outlet.
2. Cord length: As required to reach outlet, 6'-0" maximum.
3. Plug and cord ampacity shall be approved by the water heater manufacturer.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters on housekeeping pads unless otherwise indicated.

B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install temperature and pressure relief valves in top portion of storage tanks. Extend relief valve outlet with water piping in continuous downward pitch. Discharge in the following order:

1. Closest floor drain.
2. Mop sink.
3. Drain Pan.

D. Install vacuum relief valves in cold-water-inlet piping.

E. Install thermometers on outlet piping of water heaters. Comply with requirements for thermometers specified in Division 22 Section "Meters and Gages for Plumbing Piping."

F. Install pressure gauges on outlet piping of water heaters. Comply with requirements for pressure gauges specified in Division 22 Section "Meters and Gages for Plumbing Piping."

G. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks.

H. Fill water heaters with water.

I. Charge compression tanks to indicated pressure.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. For water heaters in excess of 200 gallons or 40 kW Engage a factory-authorized service representative to perform startup service.

B. In addition to manufacturer's written installation and startup checks, perform the following:

1. Verify that piping system tests are complete.
2. Check for piping connection leaks.

3. Operate relief valve and confirm proper operation of relief valve, outlets, and drain piping.
4. Check operation of circulating pumps.
5. Energize electric circuits.
6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
7. Adjust temperature settings to indicated temperature.

3.5 DEMONSTRATION

A. When a factory-authorized service representative is required to perform startup service engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals.

END OF SECTION 223300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. PMMA: Polymethyl methacrylate (acrylic) plastic.

D. PVC: Polyvinyl chloride plastic.

E. RFI: Request for information.

F. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

G. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

H. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

I. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, showerheads and tub spouts, drains and tailpieces, and traps and waste pipes.

J. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

K. Other Manufacturers: Use one of those listed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and security anchors for security plumbing fixtures.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Submittals:

1. Product Data:
   a. Documentation indicating flow and water consumption requirements.
   b. WaterSense labeling for all applicable and eligible fixtures and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For security plumbing fixtures and components to include in maintenance manuals.

B. Faucet Cartridges, washers, aerators and O-Rings: Equal to five percent (5%) of amount of each type and size installed but not less than five (5) of each type and size.

C. Water-Closet Tank, Repair Kits: Two (2).

D. Flushometer Valve Repair Kits: Two (2).

E. Provide Minimum number of key operators (wrenches/tools) for loose key stops, wall hydrants, aerators, security fasteners and any fixture where a key, security fastener, or special tool is required:

1. One (1) for ten percent (10%) of each size or ten (10), whichever is less.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Electrical components, devices, and accessories shall be 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. EPA WaterSense: Provide fixtures with WaterSense labeling for all applicable and eligible fixtures and accessories.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following standards and other requirements where applicable:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Slip-Resistant Bathing Surfaces: ASTM F 462.
4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
6. Stainless-Steel Residential Sinks: ASME A112.19.3.
7. Vitreous-China Fixtures: ASME A112.19.2M.
8. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
9. Water-Closet, Flushometer Tank Trim: ASSE 1037.

10. Whirlpool Bathtub Fittings: ASME A112.19.8M.
11. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
12. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
13. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
14. Faucets: ASME A112.18.1.
15. Hose-Connection Vacuum Breakers: ASSE 1011.
16. Hose-Coupling Threads: ASME B1.20.7.
17. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
18. NSF Potable-Water Materials: NSF 61.
19. Pipe Threads: ASME B1.20.1.
20. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
21. Supply Fittings: ASME A112.18.1.
22. Brass Waste Fittings: ASME A112.18.2.
23. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
24. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
25. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
26. Faucets: ASME A112.18.1.
27. Hand-Held Showers: ASSE 1014.
28. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
29. Hose-Coupling Threads: ASME B1.20.7.
30. Manual-Control Antiscald Faucets: ASTM F 444.
31. Pipe Threads: ASME B1.20.1.
32. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
33. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
34. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
35. Atmospheric Vacuum Breakers: ASSE 1001.
36. Brass and Copper Supplies: ASME A112.18.1.
37. Dishwasher Air-Gap Fittings: ASSE 1021.
38. Manual-Operation Flushometers: ASSE 1037.
39. Plastic Tubular Fittings: ASTM F 409.
40. Brass Waste Fittings: ASME A112.18.2.
41. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
42. Disposers: ASSE 1008 and UL 430.
43. Dishwasher Air-Gap Fittings: ASSE 1021.
44. Flexible Water Connectors: ASME A112.18.6.
45. Floor Drains: ASME A112.6.3.
46. Grab Bars: ASTM F 446.
47. Hose-Coupling Threads: ASME B1.20.7.
48. Hot-Water Dispensers: ASSE 1023 and UL 499.
49. Off-Floor Fixture Supports: ASME A112.6.1M.
50. Pipe Threads: ASME B1.20.1.
51. Plastic Shower Receptors: ANSI Z124.2.
52. Plastic Toilet Seats: ANSI Z124.5.
53. Supply and Drain Protective Shielding Guards: ICC A117.1.
54. Whirlpool Bathtub Equipment: UL 1795.

1.6 COORDINATION

A. Coordinate all accessories. Ensure items fit and work together as an assembly. Provide additional accessories to accommodate final installed field conditions; to include, but not limited to, offsets and other items required for ADA compliance. Provide necessary accessories and components for complete installation.

B. Coordinate roughing-in and final plumbing fixture locations and verify that fixtures can be installed to comply with design.

C. Model numbers are intended to identify families of fixtures and may be incomplete. Refer to other contract documents for hand.

D. Where fixtures or its associated components are installed in rated floors, walls, or ceilings; provide rated fixtures, accessories, and components of equal rating.

E. Where the flush valve assembly height would conflict with the rear grab bar installation (including the minimum 1-1/2" clearance to the bottom of the grab bar), the vacuum breaker flush tube shall be shortened. Shortening of the vacuum breaker flush tube shall not exceed the manufacturer's requirements for maintaining proper operation, including the CL (critical line) markings on the flush tube if provided by the manufacturer to indicate shortening limitations.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Cartridges, washers, aerators and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 5 of each type and size.
2. Water-Closet Tank, Repair Kits: 2 of each type.
3. Flushometer Valve, Repair Kits: 2 of each type.

PART 2 - PRODUCTS

2.1 WC-1 (FLOOR MOUNTED WATER CLOSET (ACCESSIBLE)) WITH MANUAL DIAPHRAM TYPE FLUSH VALVE

A. Manufacturer & Model Number: Zurn Z5665 (1.28 Gallon Flush)

B. Material: Vitreous china

C. Color: White

D. Flush Valve: Sloan Model 111-1.28 (1.28 Gallon Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection
2. Provide:
   a. Accessible handle located on wide side of approach.
   b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

E. Seat: Church 9500SSCT (White)

1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

F. Manufacturers:

1. Water Closet
   a. American Standard
   b. Eljer
   c. Crane
   d. Gerber
   e. Sloan
   f. Zurn
2. Flush Valve:
   a. Delany
   b. Zurn
   c. Moen
   d. Sloan
3. Seat
   a. Olsonite
   b. Centoco

2.2 WC-2 & 3 (WALL MOUNTED WATER CLOSET (ACCESSIBLE)) WITH DIAPHRAM TYPE MANUAL FLUSH VALVE

A. Manufacturer & Model Number: Kohler K-4330 (Wall Mounted 1.6 Gallon Flush)

B. Material: Vitreous china

C. Color: White

D. Fixture Carrier: Select Josam, Smith or other manufacturer's fixture carrier to suit installation in terms of clear space available in the chase, waste pipe configuration, and waste piping location.

E. Flush Valve: Sloan Regal Model 111 (1.6 Gallon Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection
2. Provide:
   a. Accessible handle located on wide side of approach.
   b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.

F. Seat: Church 9500SSCT (White)

1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

G. Manufacturers:

1. Water Closet
   a. American Standard
   b. Eljer
   c. Crane
   d. Gerber
2. Flush Valve:
   a. Delany
   b. Zurn
   c. Moen
   d. Sloan

3. Seat
    a. Olsonite
    b. Centoco

2.3 WC-4 (FLOOR MOUNTED WATER CLOSET (ACCESSIBLE)) WITH FLUSH TANK

A. Manufacturer & Model Number: Kohler No. K-3427 (1.6 Gallon Flush)\

B. Handle: Polished, chrome plated, mounted on wide side of access.

C. Material: Vitreous china

D. Color: White

E. Seat: Church 9500SSCT (White)

1. Elongated extra heavy weight seat with stainless steel self-sustaining check hinge.

F. Supplies: McGuire Part Number 2166-N3-F

1. ½" IPS x 3/8" OD
2. ½" IPS x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Contractor shall coordinate supply connection to faucet

G. Manufacturers:

1. Water Closet
    a. American Standard
    b. Eljer
    c. Crane
    d. Gerber
2. Seat
    a. Olsonite
    b. Centoco

2.4 UR-1 (URINAL (ACCESSIBLE) WITH MANUAL FLUSH VALVE

A. Manufacturer & Model Number: Kohler No. K-4960-ET (0.5 Gallon Flush)

B. Material: Vitreous china

C. Color: White

D. Flush Valve: Sloan Model 186-0.5 (0.5 Gallon Flush)

1. Supply Rough-in Elevation: 11-1/2" above spud connection
2. Provide:
    a. Accessible handle located on wide side of approach.
    b. Sweat Solder Adapter and Cast Wall Flange with Set Screw.
    c. Vandal Resistant Stop Cap with Set Screw.

E. Carrier: Josam Series 17560-UR.

1. Options
    a. Provide components for thicker walls when required.
    b. Provide valve plate for attaching to upright.

F. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Urinal
   a. American Standard
   b. Eljer
   c. Crane
   d. Gerber
2. Flush Valve
   a. Delany
   b. Zurn
   c. Moen
   d. Sloan

2.5 LA-1 (LAVATORY (ACCESSIBLE))WITH STANDARD FAUCET

A. Manufacturer & Model Number: Kohler No. K-2005

B. Material: Vitreous China

C. Color: White

D. Faucet: Chicago Model Number 802-317CP

1. 4" Spout
2. 0.5 GPM (8.3 L/min.) Maximum Flow
3. Chrome plate
4. All Brass Body
5. Renewable Seat and Washers
6. Wrist Blade Handles

E. Drain: McGuire Part Number 155A

F. Trap: McGuire Part Number 8902C-F

1. 1-1/4"x 1-1/2" cast brass polished chrome trap with cleanout plug and brass slip nuts.
2. 17-gauge seamless tubular chrome plated brass wall bend.
3. Forged brass chrome plated wall flange with setscrew.

G. Supplies: McGuire Part Number 2165-N3-F

1. ½" IPS x 3/8" OD
2. ½" x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Contractor shall coordinate supply connection to faucet.

H. Insulation: Tru-Bro Lav Guard #102

1. Color: White
2. Insulate P-trap, hot and cold angle valves, hot and cold risers.

I. Carrier: Josam Series 17100

1. Floor mounted with rectangular uprights.

J. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Lavatory
   a. American Standard
   b. Eljer
   c. Gerber
2. Faucet:
   a. Speakman
   b. Cambridge Brass
   c. T&S Brass
   d. Moen
3. Drain:
   a. Kohler
   b. Cambridge Brass
   c. Chicago
4. Trap:
   a. Kohler
   b. Cambridge Brass
5. Supplies:
   a. Cambridge Brass
   b. Kohler
6. Insulation:
   a. McGuire
7. Carrier:
   a. JR Smith

2.6 SK-1 (SINK (ACCESSIBLE))

A. Manufacturer & Model Number: Elkay LRADQ-221955

1. Overall Length (left to right):22.00"
2. Overall Width (front to back): 19.50"
3. Inside Bowl Depth: 5.5"
4. Material: 18 Gauge Stainless Steel
5. Number of Bowls: 1
6. Drain location: Off-center, rear.
7. Mounting: Inside hole ratchet system equal to Elkay Quick-Clip® mounting system. Systems requiring access from below shall not be permitted.
8. Deck Hole drilling configuration:
   a. 4 holes, 4"apart, centered.

B. Faucet: Chicago 1100-317XKABCP

1. Hole configuration: 3 Hole installation, 4" centers.
2. Spout: 8" long swing spout.
3. Handles: 4" wristblade.
4. Aerator: Vandal resistant, pressure compensating, 2.2 gpm
5. Cartridges: Ceramic or compression ¼ turn.
6. Meets ADA requirements: Yes
7. Other:
   a. Red & blue temperature indicators. Red = Hot, blue = cold.

C. Basket Strainer & Tail Piece: McGuire Part Number 151

1. Material: Forged brass, chrome plated.
2. Tailpiece: 1-1/2" x 4" 20 gauge seamless brass, chrome plated.
3. Nuts: Cast brass lock, slip, and coupling, chrome plated

D. Trap: McGuire Part Number 8912-C-F

1. Size:1-1/2"x 1-1/2"
2. Material: Polished chrome plated cast brass.
3. Cleanout plug: Yes
4. Nuts: Polished chrome plated brass.
5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where pipe protrudes from wall contractor may provide deep flange.

E. Supplies: McGuire Part Number 2167-N3-F

1. Inlet: ½" IPS
2. Outlet: ½" OD compression.
3. Nipple: ½" x 3" chrome plated brass.
4. Wall flange: Heavy brass chrome plated with set-screw.

F. Insulation: Tru-Bro Lav Guard #102

1. Insulate P-trap, hot and cold angle valves, hot and cold risers.

G. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Sink
   a. Advance Tabco
   b. Kohler
   c. Just
   d. Eagle Group
   e. Elkay
2. Faucet:
   a. Chicago
   b. T&S
   c. Speakman
   d. Moen
3. Basket Strainer & Tail Piece:
   a. Kohler
   b. Cambridge Brass
4. Trap:
   a. Kohler
   b. Cambridge Brass
5. Supplies:
   a. Chicago
   b. Cambridge Brass
   c. T&S

2.7 EWC-1 (BI-LEVEL WATER COOLER w/ BOTTLE FILLER (ACCESSIBLE))

A. Manufacturer & Model Number: Elkay Model LZSTL8WSSP

1. Self-contained wall hung electric refrigerated water cooler
2. Push bar activation on front, left, & right of unit.
3. Built-in flow regulator
4. Connect to water supply using dielectric coupling.
5. Polyester elastomer flexible bubbler.
6. Provide non-metallic strainer.
7. Provide quick connect fittings.
8. Provide cane apron on upper fountain.
9. Material: Stainless steel.
10. Color: Manufacturer's standard.
11. Electrical: 115V, 1 PH, 60 HZ, 4.0 Full load amps, 370 Watts.

B. Supply: McGuire Part Number 2165-N3-F

1. ½" IPS x 3/8" OD
2. ½" x 3" chrome plated brass nipple.
3. Heavy brass chrome plated wall flange with set-screw
4. Provide dielectric connection.

C. Provide 1½"diameter plastic tailpiece extension. Electrically isolate cooler from drainage and vent system.

D. Trap: McGuire Part Number 8912-C-F

1. Size:1-1/2"x 1-1/2"
2. Material: Polished chrome plated cast brass.
3. Cleanout plug: Yes
4. Nuts: Polished chrome plated brass.
5. Wall bend: 17-gauge seamless tubular chrome plated brass.
6. Wall flange: Chrome plated brass with setscrew. Where drain pipe connection protrudes from wall contractor may provide deep flange.

E. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Drinking Fountain:
   a. Halsey Taylor
   b. Haws Corp
   c. Oasis
2. Trap:
   a. Kohler
   b. Cambridge Brass

2.8 MB-1 (SERVICE BASIN (24"X24")

A. Manufacturer & Model Number: Stern-Williams Serviceptor Model SB-902

B. Shoulders shall not be less than 9" high inside measurement, and not less than 1" wide. The tiling flange shall be cast integral to the unit and shall extend 1" above the shoulder on 2 sides. Basin shall be composed of marble chips and Portland cement ground smooth and sealed to resist stains. A one piece, 20 gauge, type 302 stainless steel stainless steel cap shall be integrally cast into the unit on four sides.

C. Fixture:

1. Dimensions: 24" x 24" x 12".
2. Cap: Stainless steel on 4 sides.
3. Tiling Flange: Yes on two sides.
4. Material: Terrazzo
5. Color: Manufacturer's standard

D. Faucet: Chicago Model 952-1/2CP

1. 8" center
2. Vacuum breaker spout
3. #369 2-3/8" Lever Handles
4. Integral supply stops
5. Pail hook
6. Wall support

E. Drain: Cast brass with stainless steel strainer or equal as furnished with sink.

F. Trap: 3" (Provide additional pipe and material transition as required make connection to sink)

G. Stainless utility shelf with mop/broom holders and rag hooks: Bobrick Model B-239

H. Provide the following other Accessories

1. Hose Hook
2. 36" long hose

I. Other Manufacturers: Provide products, features, and accessories equal to those specified above.

1. Service Sink
   a. Fiat
   b. Just
   c. Florestone
2. Faucet:
   a. T&S
   b. Water Saver
   c. Royal Brass
   d. Speakman
   e. Moen

2.9 WSB-1 (ICE MAKER OUTLET BOX)

A. Manufacturer & Model Number: Guy Gray BIM875QTSAB

B. General: Recessed-mounting, 20 gauge steel, outlet box& faceplate with supply fitting complying with ASME A112.18.1M. Include box with faceplate, supply valve, and reinforcement

C. Supply valve: ½" IPS (or copper sweat) x 3/8" OD

D. Available Manufacturers

1. Oatey
2. Water-Tite
3. LSP Products Group.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Manufacturer's roughing-in data overrides all other indicated data.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

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

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. For wall-hanging fixtures, install off-floor supports affixed to building substrate.

C. Install back-outlet, wall hanging fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-hanging fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounted fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valve if stops are not specified with fixture. Refer to Section "Valves".

J. Install trap and waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. 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.

R. Install shower, flow-control fittings with specified maximum flow rates in shower arms.

S. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

T. Install disposer in outlet of sinks indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

U. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

V. Install escutcheons at piping wall-ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Common Work Results For Plumbing" for escutcheons.

W. Set service basins in leveling bed of cement grout. Refer to Division 22 Section "Common Work Results For Plumbing" for grout.

X. Refer to Section "Joint Sealants" for sealant and installation requirements.

Y. Provide connection to automatic lavatories & flush valves as required via low-voltage transformer(s). Mount transformer(s) above accessible ceiling. Connect to local 120V receptacle circuit with disconnect switch adjacent to transformer. All circuitry (including low voltage) shall be run concealed & in conduit. Coordinate connection requirements.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use sizes required to match fixtures. Connect to plumbing piping.

E. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

F. Ground equipment: 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 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed 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.

3.5 ADJUSTING

A. Replace washers and seals or cartridges of leaking and dripping faucets, stops, and valves.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 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.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.4 QUALITY ASSURANCE

A. Equipment and appliances comprising portions of the mechanical systems regulated by the applicable building codes shall be listed and labeled in accordance with the current edition of those codes.

B. Equipment and appliances comprising portions of the mechanical systems shall be installed in accordance with the listing, manufacturer's installation instructions, and the applicable building codes. Manufacturer's installation instructions shall be available on the job site for use and inspection.

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

D. 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.

E. 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.

1.5 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.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC 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 HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.7 INTENT OF CONTRACT DOCUMENTS

A. Mechanical and HVAC drawings are diagrammatic, indicating general locations and arrangements of pipe, duct, and equipment. Not necessarily indicating all offsets, conditions, and appurtenances required to provide clearances for maximum practical accessibility to perform maintenance.

B. Coordinate work in order to achieve proper operation and to provide a maintainable installed condition.

C. Notify the Architect's representative immediately of conditions which do not comply or will not produce this result.

D. Indicated configurations were used to size pipes, pumps, expansion tanks and other devices. Install piping, duct, and equipment generally as indicated. Minor deviations are permitted in the course of necessary coordination. Major changes shall be submitted for approval by the Architect's representative. Additional fittings and offsets not indicated are expected, anticipated by the design, and shall be provided. If more than 5% of the indicated number of fittings are required or if one change in direction is within six inches of another change in direction and this "Z" shape is not indicated notify the Architect's representative immediately. Provide necessary additional fittings and offsets. Changes in pipe size shall be made only with written approval from the Architect's representative.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to Section "Hydronic Piping" for additional 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 joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions inside & outside pipe and:

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

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

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

C. Solder Filler Metals: ASTM B 32, lead-free (95% Tin, 5% Antimony) alloy. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg-5, silver alloy for refrigerant piping, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL GROOVED JOINT COUPLINGS

A. Manufacturer: Victaulic

B. Description: Pipe joint consisting of a grooved pipe, EPDM gasket, steel housing, two bolts and two nuts.

C. Gasket Material: Grade "E" EPDM suitable for use up to 250°F.

D. Housing: Carbon steel

2.4 DIELECTRIC FITTINGS

A. Where piping of dissimilar metals is joined together use yellow brass unions or as below.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.6 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.

E. Molded PE: Reusable, PE, tapered cup-shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

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

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

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

1. Finish: Polished chrome-plated.

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

1. Finish: Polished chrome-plated.

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

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

2.8 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, 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 HVAC DEMOLITION

A. Refer to Sections "Cutting and Patching" and "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Remove equipment and associated piping back to main unless otherwise indicated. Cap services.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap services. Remove, clean, and store equipment. When appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Remove equipment and associated piping back to main unless otherwise indicated. Cap services. Remove equipment, clean, and store as directed (May be off-site). Make available to owner at time of the owner's choosing.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following and Division 23 Sections specifying piping systems.

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

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

D. Install piping above accessible ceilings allowing sufficient space for ceiling panel removal.

E. Install piping to permit valve operation & servicing.

F. Install condensate drain piping at 1% slope.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections unless otherwise indicated.

I. Install piping leaving room for installation of insulation.

J. Install system components with pressure rating equal to or greater than system operating pressure.

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

1. Exposed, Interior Installations/Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Exposed, Interior Installations/Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish and set-screw.
3. Exposed, Interior Installations/Insulated Piping: One-piece, cast-brass type with polished chrome-plated finish.
4. Exposed, Interior Installations/Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with finish to match surrounding surfaces.
5. Exposed, Interior Installations/Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with finish to match surrounding surfaces.

6. Exposed, Interior Installations/Piping in Unfinished Service Spaces: None, provide sealant.
7. Exposed, Interior Installations/Piping in Equipment Rooms: None, provide sealant.
8. Exposed, Interior Installations/Piping at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces: None - provide sealant and sleeve extending 2" above floor to prevent liquid leaking to floor below.

L. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.

M. Sleeves are not required for core-drilled holes.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.
1. Exception: Exposed, Interior Installations at Floor Penetrations in Equipment Rooms, Fan Rooms, or similar wet spaces.

O. Install sleeves for pipes passing through walls, floors, or roofs.

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

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

2. Install sleeves as walls and slabs are constructed.

a. PVC Pipe Sleeves: Permitted for pipes smaller than 6" except aboveground, exterior-walls.
b. Steel Sheet Sleeves: Permitted for pipes 6" and larger, penetrating gypsum-board partitions except aboveground, exterior-walls.
c. Seal space outside sleeve fittings with grout and sealant.

3. Except for penetrations where mechanical sleeve seals are used, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section "Joint Sealants".

P. Aboveground Exterior Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer 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.
4. Sleeves from an approved sleeve seal manufacturer shall be acceptable.

Q. Underground Exterior Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for annular clear space required by the mechanical sleeve seal manufacturer between pipe and sleeve for installing mechanical sleeve seals.

R. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply water-flushable flux, unless otherwise indicated, to tube end. Construct joints using lead-free solder alloy.

E. Brazed Joints: Construct joints using copper-phosphorus brazing filler metal.

F. Threaded Joints: Thread pipe with tapered pipe threads. 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 otherwise indicated.

G. Welded Joints: Construct joints using qualified processes and welding operators.

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

I. Mechanical Joints: Prepare pipe ends and fittings, apply coupling, and join according to joint manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2" and smaller, one adjacent to each valve and at final connections to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to final connections to each piece of equipment.
3. Install dielectric unions or flanges for connections of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are 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 service side of equipment.

D. Install equipment to allow space for other systems.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 HOUSEKEEPING PADS AND EQUIPMENT PADS

A. Housekeeping pads and equipment pads: Anchor equipment to concrete according to equipment manufacturer's written instructions and according to seismic codes at project location.

1. Construct concrete pads in accordance with drawing details.
2. Details may be found on structural drawings. If details are not provided comply with the following:
    a. Housekeeping pads inside the building shall be 6" thick and 6" larger all around than supported equipment. Provide #4 rebar at 12" on center each way at mid-depth of slab. Provide a 3/4" chamfer on all edges.
    b. Equipment pads outside the building shall be 8" thick with a 12" deep and 20" wide turndown (footing) all around the outside edge of the pad. Provide #5 rebar at 16" on center each way at mid-depth of slab. Pad shall be 6" larger all around than supported equipment.
    c. Install epoxy-coated anchor bolts. For equipment on housekeeping pads bolts shall extend through housekeeping pad, and anchor into structural concrete floor.

d. Place and secure anchor bolts using supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions for placement.
e. Install anchor bolts to elevations required for proper attachment to supported equipment.
f. Install anchor bolts according to anchor bolt manufacturer's written instructions.
g. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section "Cast-in-Place Concrete".

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to 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.

3.9 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. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 EXCAVATION AND BACKFILL

A. Excavation and backfill shall be as indicated in Division 1 specifications and on the drawings. If excavation and backfill is not otherwise indicated the following shall apply:
1. Excavate trenches to indicated gradients, lines, depths, and elevations.
   a. Beyond the building perimeter, excavate trenches to allow installation of top of pipe below frost line.
2. Excavate trenches to uniform widths to provide twelve inches clear on each side of pipe. Excavate trench walls vertically from trench bottom.
3. Trench Bottoms: Excavate trench bottoms to provide flat surface. Place and compact six inches of sand. Excavate and shape sand to provide uniform bearing and support of

pipes. Shape sand to provide continuous support for bells, joints, fittings, and barrels of pipes. Sand shall be free of projecting stones and sharp objects.

4. Backfill and hand tamp to 95% proctor to six inches above the top of the pipe.
5. Backfill and machine tamp the remainder of the trench to 95% proctor in twelve inch lifts.

END OF SECTION 230500

SECTION 230513 – MOTORS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Manufacturer's catalog and efficiency data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with NFPA 70.

1.4 COORDINATION

A. All motors are required to be equipped with overload protection located near the motor.

1. Overload protection shall:

   a. Be located between the circuit breaker or fuse provided under Division 26 and the motor windings.
   b. Meet one of the options specified in the following paragraph.

2. Overload protection may be:

   a. Located in the motor installed by the motor manufacturer. (preferred)
   b. A separate device located near the motor.
   c. Located in, or with, a disconnect switch provided by the equipment manufacturer. Provision of this switch shall not modify, change, or eliminate any Division 26 requirement. This means some equipment shall be provided or specified with two disconnecting means.

B. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with controller
2. Matched to torque and horsepower requirements of the load.
3. Matched to ratings and characteristics of supply circuit and required control sequence.

C. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

D. Belt tension must be wrench and socket adjustable.

E. Belt tensioning device must accommodate adjustable sheaves.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply except as follows:

1. Ratings, performance, or characteristics for a motor are specified in another Section or are scheduled on the drawings.
2. Motor manufacturer requires ratings, performance, or characteristics, other than those specified to meet indicated performance.

2.2 MOTOR CHARACTERISTICS

A. Frequency Rating: 60 Hz.

B. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

C. Duty: Continuous at 105 deg F and 3300 feet above sea level.

D. Capacity and Torque sufficient to:

1. Start, accelerate, and operate connected load.
2. Maintain designated speeds.
3. Operate at installed altitude and environment.
4. Operate with indicated operating sequence.
5. Operate without exceeding nameplate ratings.
6. Operate without utilizing service factor.

E. Enclosure: Open drip-proof unless otherwise indicated.

F. Minimum Service Factor: 1.15 unless otherwise indicated.

G. Internal Heaters: For motors located outdoors, provide internal motor space heaters which energize upon motor shutdown to prevent internal motor condensation.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Motor efficiency shall conform to the standard for integral horsepower motors under 10 CFR Part 431 as published by the US Department of Energy.

C. Efficiency: NEMA Premium

D. Stator: Copper windings, unless otherwise indicated.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Double-shielded, pre-lubricated ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation: NEMA starting Code F or G.

J. Enclosure: Cast iron.

K. Finish: Gray enamel.

L. 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.

M. Motors Used with Variable Speed Drives: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters. Comply with NEMA MG1, Part 31 inverter duty rating.

2. Premium Efficiency Motors: Class B temperature rise, Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise, Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally-protected motors.

5. Shaft Grounding: Provide AEGIS bearing protection ring or approved equal.

a. 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.
b. Motors up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor.
c. Grounding rings shall be provided and installed by the motor manufacturer in accordance with the shaft grounding ring manufacturer's recommendations.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform the following:

1. Run each motor with its controller at load.

2. Demonstrate correct rotation, alignment, and speed.

3. Test interlocks and control features for proper operation.

4. Verify that current in each phase is within nameplate rating.

5. Verify RPM is in accordance with nameplate.

6. Where a generator is provided, run each motor on the generator with its controller and load. Demonstrate correct rotation, alignment, and speed.

3.2 ADJUSTING

A. Align motors, bases, and shafts.

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.

END OF SECTION 230513

SECTION 230514 – VARIABLE SPEED DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Factory Installed Variable Speed Drive: A drive installed by motorized-equipment manufacturer as a component of equipment utilized to control the speed of a motor.

B. Field-Installed Variable Speed Drive: A drive installed in the field by the contractor to control the speed of a motor not equipped with a factory installed drive.

C. VSD: Variable Speed Drive

1.3 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions
2. Conduit entry locations
3. Weight.

B. Customer connection and power wiring diagrams.

C. Technical product description including but not limited to a complete list of options.

D. All VFDs shall include a minimum of 5% impedance reactors.

1.4 QUALITY ASSURANCE

A. VSDs and options shall be UL listed as a complete assembly.

B. The base VSD shall be UL listed for 100 KAIC without the need for input fuses.

C. The VSD shall be tested by the manufacturer.

D. All optional features shall be functionally tested at the factory for proper operation.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. Comply with UL 508C.

F. Referenced standards:

1. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. UL508C
3. ICS 7.0, AC Adjustable Speed Drives
4. IEC 16800 Parts 1, 2 and 3NEC 430.120, Adjustable-Speed Drive Systems
5. IBC 2012 Seismic – referencing ASC 7-05 and ICC AC-156

G. All VSDs installed on this project shall be from the same manufacturer.

1.5 WARRANTY

A. The VSD shall be warranted by the manufacturer for a period of 2 Years from Date of Beneficial Occupancy. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VSD manufacturer.

1.6 COORDINATION

A. Coordinate features of VSDs with motors, installed units, and accessory devices. Provide VSDs that meet the requirements indicated in this and other equipment specific specification sections.

B. Confirm that motors controlled by VSDs, provided under this section are designed and labeled for use with variable speed drives, and suitable for use throughout speed range without overheating.

C. Coordinate VSD support with requirements for maintenance and replacement; and installation of accessories.

PART 2 - PRODUCTS

2.1 FACTORY INSTALLED VARIABLE SPEED DRIVES

A. The VSD shall be enclosed in a UL Listed enclosure.

B. Refer to equipment specific specification sections.

C. Where equipment specific specification sections do not indicate variable speed drive requirements comply with 2.2 below.

2.2 FIELD-INSTALLED VARIABLE SPEED DRIVES

A. Manufacturers

1. ABB.
2. Cutler Hammer.

3. Danfoss-Graham.
4. Honeywell.
5. Square D.

B. General

1. Furnish complete variable speed drives (VSDs) as indicated.
2. Drawing schedules, sequences of control, control diagrams, details, or other specification sections may indicate variable speed requirements.
3. All standard and optional features shall be included within the VSD enclosure, unless indicated otherwise. Each VSD shall be housed in a NEMA 1 enclosure, or other NEMA type according to installation and operating conditions.
4. Provide NEMA 3R weatherproof enclosures for drives mounted outside.
5. The UL listing shall allow mounting in a plenum or other air handling compartment. If a NEMA 12 enclosure is required for the plenum rating, the manufacturer shall supply a NEMA 12 rated VSD.

C. The VSD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current. Operation shall be suitable for centrifugal pump and fan control and shall eliminate the need for motor de-rating.

D. Refer to the Division 26 Electrical Equipment Connection Schedule and Division 26 specifications for wire between the VSD and the motor it serves. The VSD shall accept quantity, type, and size of wire(s) indicated in the schedule.

E. With the motor's rated voltage applied to the VSD input, the VSD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VSDs utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

F. The VSD shall include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

G. The VSD and options shall be tested to ANSI/UL Standard 508. The complete VSD, including all specified options, shall be assembled by the manufacturer and shall be UL-508 certified for the building and drive assembly including options. Assembly of the options by a third-party panel shop is not acceptable. The appropriate UL stickers shall be applied to both the VSD and option panel, in the case where these are not contained in one panel.

H. The VSD shall have DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VSDs without DC link reactors shall provide a minimum 5% impedance line reactor.

I. The VSD's full load amp rating shall meet or exceed NEC Table 430-150. The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

J. The VSD shall be able to provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.

K. An automatic energy optimization selection feature shall be provided standard in the VSD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

L. Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VSD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

M. An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

N. Galvanic and/or optical isolation shall be provided between the VSD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VSDs not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

O. VSD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VSD efficiencies while reducing motor noise.

P. Provide a separately housed manual 3 contactor bypass consisting of a door interlocked main fused disconnect pad lockable in the off position, a built-in motor starter, and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the drive. In the OFF position, the motor and the drive are disconnected. In the LINE position, the motor is operated at full speed from the AC line power and the power is disconnected from the drive, so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. Customer supplied normally closed dry contact shall be interlocked with the drive's safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault. The use of microprocessor-based bypass control shall not be allowed.

Q. Protective Features:

1. Disconnect with drive fusing.
2. A minimum of Class 20 I^2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.
3. Protection against input transients, loss of AC line phase, output short circuit, output ground fault, overvoltage, undervoltage, VSD overtemperature and motor overtemperature. The VSD shall display all faults in plain English. Codes are not acceptable.
4. Protect VSD from sustained power or phase loss. The VSD shall provide full rated output with an input voltage as low as 90% of the nominal. The VSD will continue to

operate with reduced output with an input voltage as low as 164 V AC for 208/230 volt units, and 313 V AC for 460 volt units.

5. The VSD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.
6. VSD package shall include semi-conductor rated input fuses to protect power components.
7. To prevent breakdown of the motor winding insulation, the VSD shall be designed to comply with IEC Part 34-17. Otherwise, the VSD manufacturer must ensure that inverter rated motors are supplied.
8. VSD shall include a "signal loss detection" circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.
9. VSD shall function normally when the keypad is removed while the VSD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.
10. VSD shall catch a rotating motor operating forward or reverse up to full speed.
11. VSD shall be rated for 100,000 amp interrupting capacity (AIC).
12. VSD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VSD will identify which of the output phases is low or lost.
13. VSD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VSDs, and 539 V AC on 460 volt VSDs.

R. Interface Features:

1. Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VSD and determine the speed reference.
2. The VSD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VSD is in Auto/Remote mode.
3. The VSD shall provide potentiometer speed control. Electronic speed controls are not acceptable.
4. Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.
5. The keypads for all sizes of VSDs shall be identical and interchangeable.
6. To set up multiple VSDs, it shall be possible to upload all setup parameters to the VSD's keypad, place that keypad on all other VSDs in turn and download the setup parameters to each VSD. To facilitate setting up VSDs of various sizes, it shall be possible to download from the keypad only size independent parameters.
7. Display shall be programmable to display in 9 languages including English, Spanish and French.
8. The display shall have four lines, with 20 characters on three lines and eight large characters on one line.
9. A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VSD when the keypad is removed.
10. A quick setup menu with factory preset typical HVAC parameters shall be provided on the VSD eliminating the need for macros.
11. The VSD shall include a standard RS-485 communications port.
12. As a minimum, the following points shall be controlled and/or accessible:

    a. VSD Start/Stop

b. Speed reference
c. Fault diagnostics
d. Meter points
e. Motor power in HP
f. Motor power in kW
g. Motor kW-hr
h. Motor current
i. Motor voltage
j. Hours run
k. Feedback signal #1
l. Feedback signal #2
m. DC link voltage
n. Thermal load on motor
o. Thermal load on VSD
p. Heat sink temperature

13. Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VSD.
14. LonWorks communication shall be available for factory or field installation within the VSD.
15. Two set-point control interface (PID control) shall be standard in the unit. VSD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.
16. Floating point control interface shall be provided to increase/decrease speed in response to contact closures.
17. Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VSDs unable to show these four displays simultaneously shall provide panel meters.
18. Sleep mode shall be provided to automatically stop the VSD when its speed drops below set "sleep" level for a specified time. The VSD shall automatically restart when the speed command exceeds the set "wake" level.
19. The sleep mode shall be functional in both follower mode and PID mode.
20. Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VSD does not start until dampers or other auxiliary equipment are in the proper state for VSD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VSD to start.
21. The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kW-hr, Output Voltage, DC Bus Voltage, VSD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VSD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.
22. The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (^{o}F) for a cooling tower application.
23. VSD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.
24. If the temperature of the VSD's heat sink rises to 80°C, the VSD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VSD shall automatically reduce its output frequency to the

motor. As the VSD's heat sink temperature returns to normal, the VSD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

25. The VSD shall have temperature controlled cooling fans for quiet operation and minimized losses.
26. The VSD shall store in memory the last 10 faults and related operational data.
27. Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.
28. Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VSD status.
29. Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.
30. Two programmable 0 to 20 mA analog outputs shall be provided for indication of VSD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.
31. Under fire mode conditions, the VSD shall be able to be programmed to automatically default to a preset speed.

S. Adjustments

1. VSD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VSD to the motor.
2. Sixteen preset speeds shall be provided.
3. Four acceleration and four deceleration ramps shall be provided. Acceleration and deceleration times shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.
4. Four current limit settings shall be provided.
5. If the VSD trips on one of the following conditions, the VSD shall be programmable for automatic or manual reset: undervoltage, overvoltage, current limit and inverter overload.
6. The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.
7. An automatic "on delay" may be selected from 0 to 120 seconds.

T. Service Conditions

1. Ambient temperature, -10 to 40°C (14 to 104°F).
2. 0 to 95% relative humidity, non-condensing.
3. Elevation to 3,300 feet without derating.
4. AC line voltage variation, -10 to +10% of nominal with full output.
5. No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Examination

1. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VSD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.
2. The VSD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VSD shall not be operated while the unit is covered.

B. Start-up Service

1. The manufacturer shall provide start-up commissioning of the VSD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VSD, its options and its interface wiring to the building automation system.

3.2 CLEANING: After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

END OF SECTION 230514

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Maintenance Data: For expansion joints to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Rubber, Expansion-Compensator Packless Expansion Joints:

1. Available Manufacturers:

a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
b. Flex-Hose Co., Inc.
c. Flexicraft Industries.
d. Mason Industries, Inc.; Mercer Rubber Co.
e. Unaflex.

2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
4. End Connections for 2" and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints:

1. Available Manufacturers:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Flex Pression Ltd.
   d. Metraflex, Inc.
   e. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing 2-1/2" to 4": Copper-alloy fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping 2" and Smaller: Carbon-steel fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping 2-1/2" to 6": Carbon-steel fittings with flanged end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.

8. Expansion Joints for Steel Piping 8" to 12": Carbon-steel fittings with flanged end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Available Manufacturers:

   a. Adsco Manufacturing LLC.

b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Flex-Weld, Inc.
f. Hyspan Precision Products, Inc.
g. Metraflex, Inc.
h. Unisource Manufacturing, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-NMEJ-702.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Connect risers and branch connections to mains with a minimum of 5 (five) pipe fittings including tee in main.

B. Connect risers and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in riser.

C. Connect mains and branch connections to terminal units with a minimum of 4 (four) pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four Insert number pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

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

2.2 STACK-SLEEVE FITTINGS

A. Available Manufacturers:

1. Smith, Jay R. Mfg. Co.
2. Wade
3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Available Manufacturers:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Link Seal
4. Metraflex Company (The).
5. Pipeline Seal and Insulator, Inc.
6. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM or Nitrile rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

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

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants.

E. Fire Ratings: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide ¼" clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire Rating: Maintain indicated fire rating at pipe penetrations. Seal pipe penetrations with firestop materials.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building unless otherwise indicated. They are not required at sanitary and storm piping exits unless otherwise indicated.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade, below Grade, Concrete Slabs-on-Grade, and Concrete Slabs above Grade:
    a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

END OF SECTION 230517

SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. AFF Above Finished Floor.

B. BAS Building Automation System

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 THERMOMETERS

A. Manufacturers: Subject to compliance with the requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. FNW.
2. Weiss Instruments, Inc.
3. Winters Instruments.

B. Standard: ASME B40.3.

C. Solar powered, variable angle digital thermometer.

D. Case: Hi-impact ABS

E. Sensor: Glass passivated thermistor

F. Display: ½" LCD digits.

G. Stem:

1. Duct Installation: Aluminum ventilated.
2. Pipe Installation: Brass.

H. Thermowell Connector for Pipe Installation: 1¼" with ASME B1.1 threads.

I. Accuracy: 1% of reading or 1°F whichever is greater.

J. Scale Range: Suitable for service.

2.2 DUCT THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Manufactured by thermometer manufacturer, pressure-tight, socket-type fitting made for insertion into piping tee.
3. Material:
   a. Copper Tubing/Piping: Brass.
   b. Steel Piping: Type 316 stainless steel
4. Type: Stepped shank unless straight or tapered shank is recommended by manufacturer.
5. Bore: Diameter required to match thermometer stem.
6. Insertion Length: Length required to match thermometer stem and to reach center of pipe.
7. Lagging Extension: Include for insulated piping and tubing.
8. Heat transfer medium: As available and recommended by manufacturer.

2.4 PRESSURE GAUGES

1. Available Manufacturers:
   a. Ernst Flow Industries.
   b. Flo Fab Inc.
   c. Palmer Wahl Instrumentation Group.
   d. Tel-Tru Manufacturing Company.
   e. Trerice, H. O. Co.
   f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   g. Weiss Instruments, Inc.

2. Application Standard: ASME B40.100.
3. Case: Dry, field liquid fillable, satin finished, type 304 stainless steel, stem mounted, flangeless.
4. Pressure-Element Assembly: Bronze tube.

5. Pressure Connection: Brass, with 1/4" or 1/2" ASME B1.20.1 pipe threads and bottom-outlet unless back-outlet is indicated.
6. Movement: Stainless steel.
7. Dial Size: 4-1/2"
8. Dial Face: Nonreflective aluminum with permanently etched black scale markings graduated in psi. Two PSI maximum per graduation.
9. Pointer: Adjustable black metal.
10. Window: Glass.
11. Ring: 304 stainless steel.
12. Accuracy: Grade 1A, plus or minus 1 percent of full scale.
13. Units: PSI
14. Scale range: Suitable for service.

2.5 GAUGE ATTACHMENTS

A. Pulsation Dampener: ASME B40.100, brass; with 1/4" or 1/2", ASME B1.20.1 pipe threads and piston type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass for copper, and stainless steel for steel, pipe filled with water with 1/4" or 1/2" pipe threads to prevent live steam from entering gauge. Provide on all gauges serving steam systems.

C. Valves: Brass needle for copper pipe, or stainless-steel needle for steel pipe, with 1/4" or 1/2", ASME B1.20.1 pipe threads.

2.6 TEMPERATURE/PRESSURE PLUG

A. Available Manufacturers:

1. Flow Design, Inc.
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
4. Weiss Instruments, Inc.

B. Description: Test fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: 1/2", ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psi at 200°F.

F. Core Inserts: EPDM self-sealing rubber.

2.7 TEMPERATURE/PRESSURE PLUG KITS

A. Available Manufacturers:
   1. Flow Design, Inc.
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   4. Weiss Instruments, Inc.

B. Provide one temperature/pressure plug kit containing two thermometers, one pressure gauge, pressure gauge adapter, and carrying case. Thermometer sensing elements, pressure gauge, and gauge adapter probes shall be of a diameter to fit temperature/pressure plugs and of length to project into piping.

C. Low Range Thermometer: Small, bimetallic insertion type with 1" to 2" diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125°F.

D. High Range Thermometer: Small, bimetallic insertion type with 1" to 2" diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220°F.

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2" to 3" diameter dial and probe. Dial range shall be at least 0 to 200 PSI.

F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Thermowells:
   1. In all locations install so thermometer will be easily visible.
   2. In horizontal piping install with socket extending to center of pipe and in vertical position in piping tees.
   3. In vertical piping install with socket extending to center of pipe and in horizontal position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors.

C. Install thermowells with lagging extension on insulated piping.

D. Fill thermowells with heat-transfer medium as recommended by manufacturer.

E. Install thermometers in thermowells and adjust vertical and tilted positions so they are with-in 15' (Measured from 6' above the floor) of an easily accessible location and the window is perpendicular to that location.
   1. Exception: Where installed in piping or ductwork located in excess of 20' AFF.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install thermometers in the following locations:
   1. Where indicated
   2. Inlet and outlet of each hydronic zone.
   3. Inlet and outlet of each hydronic boiler.
   4. Inlet(s) and outlet(s) of each chiller.
   5. Inlet and outlet of each hydronic coil in air-handling units.
   6. Inlet(s) and outlet(s) of each hydronic heat exchanger.
   7. Inlet and outlet of each thermal-storage tank.
   8. Outside, return, and supply air ducts.

H. Install pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

I. Install pressure gauges in the following locations:

   1. Inlet an outlet of each pressure-reducing valve.
   2. Inlet and outlet of each chiller.
   3. Inlet and outlet of each boiler.
   4. Inlet and outlet of each coil.
      a. Exceptions (Install test plugs instead):
         1) Fan coil units.
         2) Variable volume terminal units.
         3) Blower coil units.
   5. Inlet of each thermal-storage tank.
   6. Suction and discharge of each pump.

J. Install valve in piping for each pressure gauge.

K. Install snubber in piping for each pressure gauge for fluids (except steam).

L. Install siphon fitting in piping for each pressure gauge (for steam).

M. Install test plugs in piping tees where indicated and at all pipe mounted BAS pressure and temperature sensors.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service, maintenance, and cleaning of meters, gauges, machines, and equipment.

B. Connect flowmeter elements to meters.

C. Connect flowmeter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. MPTFE: Modified polytetrafluoroethylene plastic.
   4. NBR: Acrylonitrile-butadiene rubber.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. RPTFE: Reinforced polytetrafluoroethylene plastic.
   7. SWP: Steam working pressure.
   8. TFE: Tetrafluoroethylene plastic.
   9. WOG: Water Oil Gas.

1.3 SUBMITTALS

A. Product Data: For each type of valve proposed. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include proposed specialties and accessories.

1.4 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
   1. Exceptions: Domestic hot- and cold-water valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set ball valves open to minimize exposure of functional surfaces.

4. Set butterfly valves closed or slightly open.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze & Brass: Shall be dezincification resistant. (Zinc content shall be less than 15%)

C. Bronze Valves: 2" and smaller with threaded ends, unless otherwise indicated.

D. Ferrous Valves: 2-1/2" and larger with flanged ends, unless otherwise indicated.

E. Valve Pressure and Temperature Ratings: Not less than indicated for system pressure and temperature.

F. Valve Sizes: Same as the larger of the upstream or downstream pipe, unless otherwise indicated.

G. Valve Actuators:
1. As indicated in other Part 2 articles.
2. Where indicated, provide a chain actuator.
3. Chain Actuator: For attachment to valves of size and mounting height indicated.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

H. Extended Valve Stems: Provide on insulated valves.

I. Valve Flanges: Provide ASME B16.1 for cast-iron valves, ASME B16.5 for steel, and ASME B16.24 for bronze.

J. Valve Grooved Ends: AWWA C606.

K. Threaded: With threads according to ASME B1.20.1.

L. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

A. Two-Piece, Copper-Alloy Ball Valves (Full Port):
1. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem (Un-insulated piping)
2. Conbraco Industries-Apollo 77C-140 Series with stainless steel ball & stem. Provide 2 ¼" stem extension (Insulated piping)
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: Zinc plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: MPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Provide 2 ¼" stem extension for Insulated piping.
9. Thrust Washer: MPTFE or RPTFE
10. Ball: Full-port, ASTM A-276 Type 316 stainless steel.
11. Seats: MPTFE or Reinforced TFE
12. Body: Bronze ASTM B-584 for solder or threaded connection.
13. Body End Piece: Bronze ASTM B-584 for solder or threaded connection.
14. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
15. Conform To: MSS SP-110

B. Three-Piece, Copper-Alloy Ball Valves (Conventional Port or Full Port):
1. Conbraco Industries-Apollo 82 series with stainless steel ball & stem for Un-insulated piping.
2. Conbraco Industries-Apollo 82 series with stainless steel ball & stem provide 2 ¼" stem extension for Insulated piping.
3. Other Manufacturers:
   a. Milwaukee
   b. Watts
   c. Nibco
4. Handle Nut: Zinc plated steel or 300 series stainless steel.
5. Handle: plated steel, clear chromate plastic, or vinyl coated.
6. Threaded Pack Gland: Brass ASTM B-16 Alloy 360
7. Packing: RPTFE or TFE
8. Stem (Blowout Proof): ASTM A-276 type 316 stainless steel. Where piping is insulated provide 2" extended handles of non-thermal conductive material. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
9. Ball: Standard or full-port, ASTM A-276 Type 316 stainless steel solid ball.
10. O-ring Seals: Fluorocarbon rubber.
11. Seats: TFE
12. Thrust Washer: RPTFE.
13. Body: Bronze ASTM B-584.
14. Body End Pieces: Bronze ASTM B-584 for threaded, or grooved end connection.
15. Body Nuts and Bolts: ASTM A-449, grade 5, zinc dichromate plated steel.

16. Rating: 150 psig saturated steam, 600 psig non-shock cold water, oil, and gas.
17. Conform To: MSS SP-110

2.3 FERROUS-ALLOY BUTTERFLY VALVES

A. General: Butterfly valves shall provide bi-directional bubble tight dead end service without a downstream flange.

B. Wafer-lug type butterfly valves:
1. Conbraco Industries-Apollo 141(wafer)/143(lug)
2. Other Manufacturers:
   a. Stockham
   b. Demco
   c. Nibco
3. Shaft: ASTM A-582 Type 416 Stainless steel single piece through shaft.
4. Collar Bushing: ASTM B-124 Brass or PTFE.
5. Stem Seal: EPDM OR Buna-N Rubber
6. Body Seal: EPDM Rubber
7. Upper Bushing: CDA 122 Copper or PTFE
8. Liner: EPDM Rubber
9. Disc: ASTM B-148 alloy 954/955 aluminum bronze.
10. Lower Bushing: CDA 122 copper or PTFE.
11. Body Wafer: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
12. Body Lug: ASTM A-536 Ductile Iron or ASTM A-126 CL. B cast iron.
13. Ratings:
   a. 2" through 12" 200 psig CWP.
   b. 14" through 24" 150 psig CWP.
14. Conform To: MSS SP-67, MSS SP-25, API-609
15. Operator:
   a. Valves up to and including 6": Lever-lock operator.
   b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

C. Grooved-End 300 psig butterfly valves:
1. NIBCO Model GD 4765
2. Other Manufacturers:
   a. Victaulic
3. Upper Stem: ASTM A-582 Type 416 Stainless steel.
4. Upper Bearing: Split metal.
5. O-Ring: EPDM
6. Body: ASTM A-395 ductile iron with polymide coating.
7. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
8. Lower Bearing: Split metal.
9. Dust Plug: PVC
10. Rating: 300 psig CWP.
11. Conform To: MSS SP-67
12. Operator:
   a. Valves up to and including 6": Lever-lock operator.

b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

D. Flanged 200 psig butterfly valves:
1. NIBCO Model FC-2765-0
2. Upper Stem: ASTM A-582 Type 416 Stainless steel.
3. Upper Bushing: TFE over porous bronze, steel backed.
4. O-Ring: EPDM
5. Body: ASTM A-126 Class B cast iron with polymide coating.
6. Disc: ASTM A-395 ductile iron with EPDM encapsulation.
7. Lower Bushing: TFE over porous bronze, steel backed.
8. Lower Stem: ASTM A-582 Type 416 Stainless steel.
9. Dust Plug: PVC
10. Rating: 200 psig CWP.
11. Conform To: MSS SP-67 and MSS SP-25
12. Operator:
    a. Valves up to and including 6": Lever-lock operator.
    b. Valves 8" and larger: Self locking worm gear operator equipped with adjustable stops at open and shut positions.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

A. General: Resilient seated butterfly valves rated for 250 psig shut-off and shall provide bi-directional bubble tight dead end service without a downstream flange. Valve shall be full lug, compatible with ANSI 125/150 flanges. Valves shall be in accordance with MSS-SP-67. The actuator mounting flange shall be ISO 5211. Valve design shall accommodate 2" of insulation.

B. Manual butterfly valves 2"-20":

1. Manufacturer: Bray Series 31H-119 or XOMOX Tufline High Performance Butterfly Valve series.
2. Body: Cast iron ASTM A126 Class B.
3. Provide full lug pattern.
4. Double dead-end bi-directional zero leakage must exceed ANSI Class IV leakage standard.
5. Disc: Nylon 11, 15 mil thick and thermally applied over ductile iron ASTM 536, Grade 65-45-12 or 316 stainless steel.
6. Stem: Type 300 or 400 series stainless steel, one piece, and shall utilize an internal connection to the disc via a double D drive. Provide blow-out proof stem in accordance with API 609.
7. Seat: EPDM peroxide cured, rated for -40°F to +250°F.
8. Packing: Buna-N with acetal bushing.
9. Valves 2-1/2" and smaller shall be provided with 10 position lever lock handles.
10. Valves 3" and larger shall be provided with hand wheel, manual, weatherproof worm gear actuators.
11. All valves located more than seven feet above the floor shall include chain wheel weatherproof, worm gear actuators with security cable device. Size hand wheel gear operators with no more than 40 lbs rim pull at full valve pressure rating.

12. Valves shall be individually tested at the factory to 110% of rated pressure with zero leakage.

2.5 BRONZE CHECK VALVES

A. Bronze, Horizontal Swing Check Valves:
   1. NIBCO Model 413
   2. Other Manufacturers:
      a. Milwaukee Valve Company.
      b. Nibco, Inc.
      c. Stockham – Crane Energy Flow Solutions
   3. Bonnet: ASTM B-62 bronze.
   4. Body: ASTM B-62 bronze.
   5. Hinge Pin: ASTM B-140 alloy C31400 bronze, or B-134 alloy C23000 bronze.
   6. Disc Hanger:
      a. Sizes ¼" thru ¾": Type 304 stainless steel.
      b. Sizes 1" and larger: ASTM B-62 bronze.
   7. Hanger Nut: ASTM B-16 bronze.
   8. Disc Holder: ASTM B-62 bronze.
   9. Seat Disc:
      a. Water and Other Heat Transfer Fluids: ASTM B-62 bronze.
      b. Steam: TFE
   10. Seat Disc Nut: ASTM B-16 or B-62 bronze.
   11. Hinge Pin Plug: ASTM B-140 alloy C31600 bronze.
   12. Seat Disc Washer (When Provided): ASTM B-98 alloy C65500 or B-103 bronze.
   13. Rating: 125 psig SWP and 200 psig CWP.
   14. Conform To: MSS SP-80

B. Bronze, Inline Spring Loaded Check Valves:
   1. Conbraco Industries-Apollo 61-100 series
   2. Other Manufacturers:
      a. Milwaukee Valve Company.
      b. Stockham – Crane Energy Flow Solutions.
      c. Nibco, Inc.
   3. Body: ASTM B-584 alloy C84400 bronze.
   4. Retainer/Stem: ASTM B16 brass or ASTM A-582 alloy C30300 stainless steel.
   5. Ball Check: RPTFE or
   6. Disc Holder 316 Stainless steel
      a. Disc:
         1) Water, Oil, Gas: Buna-N
         2) Steam: TFE
      b. Seat Screw: ASTM A-276 alloy S43000 stainless steel.
      c. Body End: ASTM B-584 alloy C84400 bronze.
      d. Rating: 125 psig SWP and 250 psig CWP.
   7. Guide: ASTM B16 Brass
   8. Spring: Type 316 stainless steel.
   9. Rating: 125 psig SWP and 400 psig WOG.

2.6 IRON BODY CHECK VALVES

A. Iron Body, Horizontal Swing Check Valves:

1. NIBCO Model 918-B
2. Other Manufacturers:
   a. Apollo Valves – Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. Stockham – Crane Energy Flow Solutions.

3. Body Bolt: ASTM A-307 steel.
4. Bonnet: ASTM A-126 class B cast iron.
5. Body Gasket: Synthetic Fibers.
6. Body Nut: ASTM A-307 steel
7. Side Plug: ASTM B-16 alloy C36000 Brass.
8. Hanger Pin: ASTM B-16 alloy C36000 Brass.
9. Hanger: ASTM B-584 alloy C84400 cast bronze.
10. Disc: ASTM B-584 alloy C84400 cast bronze or ASTM A-536 ductile iron w/bronze face ring.
11. Seat Ring: ASTM B-584 alloy C84400 cast bronze.
12. Disc Nut: ASTM B-16 alloy C36000.
13. Body: ASTM A-126 class B cast iron.
14. Disc Bolt: ASTM B-16 alloy C36000 Brass.
15. Disc Plate: ASTM A-126 class B cast iron.
16. Disc Cage: ASTM A-126 class B cast iron.
17. Rating: 125 psig SWP and 200 psig CWP.
18. Conform To: MSS SP-71 Type 1.

B. Grooved-End, Ductile-Iron Spring Assisted Check Valves: Victaulic Series 716 with EPDM disc seal.

C. Spring Actuated Silent Check Valves:

1. NIBCO Model F-910
2. Other Manufacturers:
   a. Apollo Valves – Conbraco Industries, Inc.
   b. Milwaukee Valve Company.
   c. Stockham – Crane Energy Flow Solutions

3. Body: ASTM A48 class 35 cast iron.
4. Seat: ASTM B-584 alloy C83600 (B) bronze.
5. Disc: ASTM B-584 alloy C83600 bronze.
6. Spring: Type 302 ASTM A313 stainless steel.
7. Bushing:
   a. 6" and Smaller: ASTM B-16 brass
   b. 8" and Larger: ASTM B-584 alloy C83600 bronze.
8. Set Screws: Type 304 ASTM A-276 stainless steel.
9. Rating: 200 psig CWP.
10. Conform To: MIL-V-18436F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully- pen to fully-closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where indicated.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball and butterfly valves 4" and larger and more than 96 inches above finished floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

G. Where applicable, install an isolation valve on supply and return piping at each branch from a vertical riser to each floor served. Locate floor isolation valves in an accessible location. Multiple sets on one floor may be required to provide accessibility.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final testing and balancing. Replace valves if persistent leaking occurs.

3.4 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball or butterfly valves.
   2. Throttling Service: Ball or butterfly valves.
   3. Pump Discharge: Spring-loaded, lift-disc check valves and ball or butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water, Heating Hot Water, Condenser Water, and Heat Pump Loop Piping (Use the following types of valves):
   1. Valves, NPS 2" and Smaller: Two-Piece, Copper-Alloy Ball Valves (Full Port).
   2. Valves, NPS 2-1/2" and 3":
      a. Two-piece or three-piece, Copper-Alloy Ball Valves (Full Port).
      b. Wafer-Lug, grooved-end, or flanged butterfly valves.
   3. Valves, NPS 4" and Larger: Wafer-Lug, grooved-end, or flanged butterfly valves.
   4. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2" and Smaller: Bronze, Inline Spring Loaded Check Valves or triple duty valve.
   5. Horizontal Check Valves, NPS 2" and Smaller: Bronze, Horizontal Swing Check Valves.
   6. Vertical Check Valves, NPS 2" and Smaller: Bronze, Inline Lift Check Valves.
   7. Pump Discharge Check Valves (Horizontal or Vertical), NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves, Spring Actuated Silent Check Valves, or triple duty valve.
   8. Horizontal Check Valves, NPS 2-1/2" and Larger: Bronze, Horizontal Swing Check Valves.
   9. Vertical Check Valves, NPS 2-1/2" and Larger: Grooved-End, Ductile-Iron Spring Assisted Check Valves or Spring Actuated Silent Check Valves.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

B. Terminology as defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design Requirement: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer where using methods other than indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test medium.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following and include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.5 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

B. Trapeze Pipe Hanger Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

1. Assemble and provide according to manufacturer's written instructions. Center piping on channel to evenly distribute load.

2. Pipe sizes and numbers shall be in accordance with the following:

TRAPEZE PIPE HANGER TABLE

PIPE SIZE	4"	3"	2 ½"	2"	1 ½"	1 ¼"	1"	TOTAL # of PIPES
NUMBER OF PIPES PERMITTED IN ONE CHANNEL SUPPORT	**2**	0	0	0	0	0	0	**2**
	0	**2**	**2**	0	0	0	0	**4**
	0	**2**	0	**4**	0	0	0	**6**
	0	**2**	0	0	**6**	0	0	**8**
	0	0	**4**	**2**	0	0	0	**6**
	0	0	**4**	0	**2**	**2**	0	**8**
	0	0	**4**	0	0	**8**	0	**12**
	0	0	0	**6**	**2**	**2**	**2**	**12**
	0	0	0	**8**	0	**2**	0	**10**
	0	0	0	0	**14**	0	0	**14**
	0	0	0	0	0	**16**	0	**16**

Notes:

1. Piping larger than 4" in diameter is not permitted in a channel support system.
2. Channel support systems shall be limited to eight (8) pipes per channel and two (2) channels (levels) per support system.
3. Smaller pipes can be substituted for larger pipes. For example two ¾" pipes may be installed in lieu of two 1" pipes, or 2" in lieu of 3", etc.
4. Spacing shall be in accordance with requirements for the smallest supported pipe. Refer to other specification sections for spacing requirements. If spacing requirements are not indicated comply with MSS SP-69.

C. Metal Framing Systems:

1. Available Manufacturers:
   a. Anvil International; a subsidiary of Mueller Water Products Inc.
   b. Empire Industries, Inc.
   c. ERICO International Corporation.
   d. Haydon Corporation; H-Strut Division.
   e. NIBCO INC.
   f. PHD Manufacturing, Inc.
   g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.

4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig, or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2" beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

1. Available Manufacturers:

a. Cooper B-Line – Dura-Blok
b. MAPA Products
c. Mifab, Inc. – C-Port
d. Miro Industries, Inc.
e. OMG, Inc.
f. PHP Systems/Design
g. Pipe Prop

h. Roof Top Blox
i. Rooftop Support Systems – Eberl Iron Works, Inc.

2. Provide pipe supports for supporting gas, condensate, refrigeration lines, or hydronic piping on flat roof surfaces. Support shall rest on roof surface without penetrating the roof surface. Supports for condensate piping shall be adjustable vertically to ensure pipe slopes as required.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Curb Mounted Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.5 EQUIPMENT SUPPORTS/RAILS

A. Description: Welded, shop or field fabricated equipment support made from structural carbon-steel shapes unless indicated otherwise.

1. Available Manufacturers:

a. Curbs Plus, Inc. – CPES-X
b. Kees – Equipment Support Model SF
c. Pate Company – Equipment Support ES-2
d. Portals Plus – ER-2A
e. Roof Products and Systems – Equipment Rails ER-2B
f. Thybar Corporation – TEMS 3

2. Construction:
a. Minimum 18 gauge, G90 galvanized steel. Fully mitered and welded corners. Integral base plate. 3" Cant style support. All welds prime painted after fabrication. Full-depth internal C-channel reinforcing on 12" centers and 6" spreader channels on alternating 12" centers. 18 Gauge counterflashing factory-installed with tek-screws and neoprene washers. Factory-installed 2'x4" pressure-treated wood nailer.
b. Minimum height of 12" above finished roof or as noted.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69, MSS SP-89, and Table above. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Provide in pipe hanger or shield for insulated piping.

E. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

F. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Provide hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Provide lateral bracing with pipe hangers and supports to prevent swaying.

J. Provide building attachments within concrete slabs or attach to structural steel. Building attachments may not used on steel joists unless otherwise indicated. Provide additional attachments at concentrated loads, including valves, flanges, and strainers, 2-1/2" and larger and at changes in direction of piping. Provide concrete inserts before concrete is placed; fasten inserts to forms and provide reinforcing bars through openings at top of inserts.

K. Load Distribution: Provide hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Provide hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Provide thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Provide MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Provide MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:

    a. Pipe ¼" to 3-½": 12 inches long and 0.048 inch thick.
    b. Pipe 4": 12 inches long and 0.06 inch thick.
    c. Pipe 5" and 6": 18 inches long and 0.06 inch thick.
    d. Pipe 8" to 14": 24 inches long and 0.075 inch thick.

5. Pipes 8" and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Provide with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 ROOF EQUIPMENT SUPPORTS

A. Equipment supports must span a minimum of two structural roof members.

B. No load shall be applied to a cantilever exceeding 12" in length.

C. Fasten base flange to roof steel or deck with stitch weld or mechanical fastener not exceeding 18" on center in accordance with NRCA specifications.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Provide materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Unless otherwise indicated clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Provide same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and immediately apply galvanizing-repair paint. Paint shall comply with ASTM A 780.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Provide hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Provide nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Provide copper-plated pipe hangers and copper attachments for copper piping and tubing.

F. Provide padded hangers for piping that is subject to scratching.

G. Provide thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated provide the following:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of stationary pipes ½" to 30".
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes 4" to 14", requiring up to 4" of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes ¾" to 14", requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes ½" to 14" if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes ½" to 4", to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes ¾" to 8".
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes ½" to 8".
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes ½" to 8".
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes ½" to 8".
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes ½" to 8".
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS ½" to 3".
12. U-Bolts (MSS Type 24): For support of heavy pipes ½" to 14".
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes 4" to 14", with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes 2-½" to 14" if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes 1" to 14", from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes 2-½" to 14", from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes 2" to 14" if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes 2" to 14" if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes 2" to 14"if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated provide the following:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers ¾" to 14".
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers ¾" to 14" if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated provide the following:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
6. Flat Plate, Double Nut, and Washer as Detailed on Structural Drawings: For attaching to bar joists. Method of attachment to bar joists must be approved by the structural engineer and joist manufacturer.

K. Building Attachments: Unless otherwise indicated provide the following:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Flat Plate, Double Nuts, and Washer as Detailed on Structural Drawings: For use under roof installations with bar-joist construction to attach to bottom chord of joist.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For steel I-beams. Only allowed for open web joists if load does not exceed 50 lbs.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Provide one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
16. For sloping structure, provide clamp with swivel such that required threaded rod is vertical. Bending of threaded rod is not acceptable.

L. Saddles and Shields: Unless otherwise indicated provide the followings:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated provide the following:

1. Restraint-Control Devices (MSS Type 47): To control pipe movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Provide powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where indicated in concrete construction.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development for the State of California.

D. ASCE: American Society of Civil Engineers

1.3 RESPONSIBILITIES:

A. The manufacturer of vibration isolation systems and devices shall:

1. Determine the sizes and locations of isolators and provide equipment isolation as indicated.
2. Guarantee indicated isolation system deflections.
3. Provide installation instructions and drawings.
4. Certify correctness of installation upon completion.

B. The Contractor shall cause all vibration isolation systems, including the isolators, and flexible connectors between the isolated equipment and associated piping, ducting, and electrical work to be designed by a manufacturer experienced in this type of work.

1.4 SUBMITTALS

A. Product Data:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Wind-Restraint Details:
   a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
   b. Details: Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors.

B. Coordination Drawings: For areas indicated at ¼" = 1'0" and where sections are cut on contract drawings, indicate coordination of HVAC piping and equipment with other systems and equipment in the vicinity, include supports and restraints.

C. Qualification Data: For testing agency.

D. Shop Drawings:

1. Vibration Isolation Base Details: Detail fabrication, including anchorages, attachments to structure, and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
2. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Identify center of gravity.
3. Dimensioned Outline Drawings for Each Scheduled Piece of Equipment: Locate and describe mounting and anchorage provisions.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Mountings & Controls, Inc.
6. Vibro-Acoustics, Inc.

B. Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.
2. Durometer Rating: Minimum 30.
3. Number of Layers: 1 2 3 or 4.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Durometer Rating: Minimum 30.

2. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
3. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with wind restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to ¼" thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to ¼" thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolators.

1. Housing: Ductile-iron or steel housing to provide all-directional restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of ¼" travel up or down before contacting a resilient collar.

H. Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

L. Pipe Riser Resilient Support : All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

M. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Available Manufacturers:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.
5. Vibro-Acoustics, Inc.

B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand wind forces.

C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2" of rigid, glass-fiber insulation on inside of assembly.

D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with wind restraint.
   a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
   b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials. Provide flashing over EPDM seals to prevent sunlight exposure to EPDM and as secondary weatherproofing.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. Available Manufacturers:

B. Manufacturers:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.
3. Mason Industries.
4. Vibration Mountings & Controls, Inc.
5. Vibro-Acoustics, Inc.

C. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1" clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip-galvanize metal components for exterior use.
3. Bake enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Strength of Support and Wind Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to resist loads within loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements indicated in the Contract Documents, in codes and ordinances, by Authority Having Jurisdiction, and by Manufacturer, for installation of all devices.

3.4 FIELD QUALITY CONTROL

A. Perform tests.

B. Tests:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least two of each type and size of installed anchors and fasteners.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, fix and retest until satisfactory results are achieved then modify all installations of same type to match.

C. Prepare test reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 VIBRATION ISOLATION SCHEDULE

A. Piping and Conduit

1. All piping and conduit connected to pumps, air handling units, or other pieces of moving equipment which are isolated from the structure by spring type vibration isolators shall be isolated from these units by flexible pipe connectors and shall be suspended on isolation hangers to a point 20 feet away. Refer to Section "Hydronic Piping" for flexible pipe connectors.
2. Provide spring hangers with 1/2" deflection for suspended piping.
3. Provide spring isolators with 1/2" deflection for floor-mounted piping.

B. Ductwork

1. Flexible connectors shall be used for ductwork connections to air handling units. Refer to Section "Metal Duct Accessories." Ductwork shall be suspended with elastomeric hangers for a distance of 20 feet from air handling units.

C. Indoor Air Handling Units

1. Provide integral isolation on fans.

D. Pumps

1. Anchor and grout to 6" high concrete housekeeping pad. Refer to Section "Hydronic Pumps." No other isolation required.

E. Power Ventilators

1. Provide elastomeric hangers for units suspended from structure above ceiling.

F. Condensing Units

1. Provide elastomeric neoprene isolator mounts on equipment curb.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
2. Data:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: White or black.
3. Background Color: Black or white.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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-quarters the size of principal lettering.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch-thick, and having predrilled holes for attachment hardware.
2. Letter Color: White or black.
3. Background Color: Black or white.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

E. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

F. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled.

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: White or black.

C. Background Color: Black or white.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include equipment's drawing designation (tag) with unique equipment number as scheduled. 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 according to ASME A13.1.

B. Pretensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT 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: White or black.

C. Background Color: Black or white.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. 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-quarters the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 STENCILS

A. Stencils for Piping:

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. Craftmark Pipe Markers.
    b. Kolbi Pipe Marker Co.
    c. Marking Services Inc.
    d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Size letters according to ASME A13.1 for piping.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior gloss in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

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. Craftmark Pipe Markers.
    b. Kolbi Pipe Marker Co.
    c. Marking Services Inc.
    d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Minimum letter height of 1-1/4 inchesfor viewing distances up to 15 feetand proportionately larger lettering for greater viewing distances.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior gloss. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior. Paint may be in pressurized spray-can form.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

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. Craftmark Pipe Markers.
    b. Kolbi Pipe Marker Co.
    c. Marking Services Inc.
    d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Minimum letter height of 1/2 inchfor viewing distances up to 72 inchesand proportionately larger lettering for greater viewing distances.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior. Paint may be in pressurized spray-can form.

2.6 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.7 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

2.9 ACOUSTICAL CEILING GRID MARKER

A. General: Plastic tape a minimum of three one-thousandths of an inch thick (3.0 mils) with pressure-sensitive, permanent-type, self-adhesive back.

B. Width: three quarters of an inch (3/4") or 22 millimeters.

C. Letter Size: ¼" minimum or 8 millimeters.

D. Letter Color: Black

E. Tape Color: White.

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 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
   1. Colors:
      a. Chilled Water Piping: Dark Blue.
      b. Heating Hot Water Piping: Orange.

B. Pipe Label Locations: 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 and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings, omit intermediately spaced labels.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Condenser-Water Piping: White letters on a safety-green background.
3. Heating Water Piping: White letters on a safety-green background.
4. Refrigerant Piping: Black letters on a safety-orange background.

3.5 DUCT LABEL INSTALLATION

A. Install duct markers with permanent adhesive on air ducts in colors complying with ASME A13.1.

B. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Chilled Water: 1-1/2 inches, round.
b. Condenser Water: 1-1/2 inches, round.
c. Refrigerant: 1-1/2 inches, round.

d. Hot Water: 1-1/2 inches, round.
e. Gas: 1-1/2 inches, round.
f. Low-Pressure Steam: 1-1/2 inches, round.
g. High-Pressure Steam: 1-1/2 inches, round.
h. Steam Condensate: 1-1/2 inches, round.

2. Valve-Tag Colors:

a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
b. Flammable Fluids: Black letters on a safety-yellow background.
c. Combustible Fluids: White letters on a safety-brown background.
d. Potable and Other Water: White letters on a safety-green background.
e. Compressed Air: White letters on a safety-blue background.
f. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 FIRE AND SMOKE DAMPERS

A. Access points for fire, smoke and fire-smoke dampers shall be permanently identified on the exterior of the duct by a label or sign with letters not less than 1" in height reading: "FIRE/SMOKE DAMPER, SMOKE DAMPER, or FIRE DAMPER."

3.8 ACOUSTICAL CEILING GRID MARKER INSTALLATION

A. Attach tape with indicated text to t-bar below item of equipment.

B. Attach tape to grid.

C. Prepare surface and attach tape in accordance with manufacturer' recommendations.

D. Surfaces to receive tape shall be clean and free of scale, dirt, and grease.

E. Center tape on support grid. Tape shall be visible from within space.

F. Provide with lettering at equipment located above lay-in tile ceilings including but not limited to:
1. Valves: Text = V
2. Air Handling Units: Text = AHU
3. Air Removal Devices: Text = ARD
4. Strainers: Text = S
5. Terminal Units (VAV boxes): Text = TU
6. Fan Coil Units: Text = FCU
7. Blower Coils: Text = BC
8. Coils: Text = C
9. Heat Pumps: Text = HP
10. Cabinet Unit Heaters: Text = CUH
11. Fans: Text = F

12. Damper operators: Text = D

3.9 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.10 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.11 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.12 CLEANING

A. Clean faces of mechanical identification devices and glass fronts of valve schedules.

END OF SECTION 230553

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Outdoor duct and pipe: Duct conveying untreated outside air at ambient temperature and humidity.

B. Outdoor pipe: Pipe located outside the building insulation envelope.

C. Supply air duct: Duct conveying air on the discharge side of an air handling unit or fan which will be delivered to a space in a building through a diffuser or connection to the return duct of another unit. Ductwork on the discharge side of a 100% outside air unit is considered to be Supply air duct.

D. Return air duct: Duct conveying air from a space or plenum that will return to an air handling unit or energy transfer device. The air may be returned to the supply air duct after being conditioned, or it may be exhausted after passing through an energy transfer device. Typical examples of an energy transfer devices are plate heat exchangers, runaround coils, heat pipes, and energy wheels.

E. Exhaust air duct: Duct conveying air from a space or plenum that will be exhausted from the building without being passed through an energy transfer device.

F. Plenum: An unoccupied space or void, on the conditioned side of the building insulation and vapor barrier, being used to return conditioned air to the inlet side of a return or exhaust fan either directly or via a duct connection. An example would be a space with air handling light fixtures or openings in the ceiling used to transport air through the ceiling and then to an open duct located above the ceiling in another location.

G. Indirectly Conditioned Space: A space having no direct conditioning but, due to air movement induced by an exhaust, or return opening, is conditioned by makeup air from an adjacent space. An example would be a small toilet. Boiler rooms, fan rooms, and mechanical rooms do not qualify as indirectly conditioned spaces.

H. Inside the Building Insulation Envelope: For the purposes of this section, boiler rooms, fan rooms, and mechanical rooms are considered to be OUTSIDE the building insulation envelope.

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. Detail application of removable insulation covers.
2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
3. Detail attachment and covering of heat tracing inside insulation.

4. Detail insulation application at pipe expansion joints for each type of insulation.
5. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
6. Detail removable insulation at piping specialties, equipment connections, and access panels.
7. Detail application of field-applied jackets.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with type, grade, and maximum use temperature.

B. Ship Insulated Piping System Components on pallets and wood supports. Securely fasten and protect from damage. Store off the ground and cover with opaque waterproof tarp to protect materials from sunlight and rain.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation, duct Installer for duct insulation, and equipment Installer for equipment insulation.

C. Maintain clearances required for maintenance.

D. Coordinate installation and testing of heat tracing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Mineral-Fiber Insulation:
   a. CertainTeed Corporation.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Flexible Elastomeric Thermal Insulation:
   a. Aeroflex USA, Inc.
   b. Armacell, LLC.
   c. K-Flex USA.

3. Closed-Cell Phenolic-Foam Insulation:
   a. Kooltherm Insulation Products, Ltd.

4. Removable Insulation Covers:
   a. Advance Thermal Corp.

5. Acoustic Duct and Piping Wrap:
   a. Acoustical Solutions.
   b. All Noise Control
   c. Industrial Noise Control Products.
   d. Kinetics Noise Control.

B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Duct Liner: Refer to specification section "Metal Ducts"

H. Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, with factory applied FSK Jacket. Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin to maximum service temperature of 250°F.. Faced insulation shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E84.

I. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, & IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.

J. Mineral-Fiber Blanket with Factory Applied FSK Jacket: Meet the requirements of ASTM C 1290, Type III, inorganic glass fibers bonded by a thermosetting resin with a multi-purpose foil-scrim kraft (FSK) jacket to maximum service temperature of 250°F. FSK shall meet the requirements of ASTM C 1136, Type II, when surface burning characteristics are determined in accordance with ASTM E 84 with the foil surface of the material exposed to the flame as it is in the final composite. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Insulation properties shall be as follows:

1. Thickness: 1-1/2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 5.1

c. Minimum installed R value assuming 25% compression: 4.2

2. Thickness: 2"
   a. Density: 1.0 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0

3. Alternate to 2" 1.0 pcf: Thickness: 2.2"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 7.4
   c. Minimum installed R value assuming 25% compression: 6.0

4. Thickness: 3"
   a. Density: 0.75 pcf
   b. Minimum uncompressed R value: 10.2
   c. Minimum installed R value assuming 25% compression: 8.3

K. Mineral-Fiber Pipe 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. Semi-Rigid Mineral-Fiber Board: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136, Type I, II, III, IV with factory applied all-service jacket (ASJ) or Type II, IV with factory applied Foil Scrim Kraft (FSK) jacket.
3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
4. 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.
5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

L. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

M. Closed-Cell Phenolic-Foam: Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.

N. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

O. Acoustic Duct and Piping Wrap: Composite material including a flexible two-pound per square foot reinforced foil faced loaded vinyl noise barrier bonded to a 1" thick quilted fiberglass

sound absorber. Composite (insulation, facing and adhesive) shall not exceed 25 Flame Spread, 50 Smoke Developed when tested in accordance with ASTM E 84. Acoustical performance shall meet or exceed the table below. Utilize accessories as indicated in manufacturer's instructions. Accessories include foil lag tape, stick pins, welding pins, and banding.

	Octave Band Frequencies (Hz)						
Product	125	250	500	1000	2000	4000	STC
B-20 Lag/QFA-3 (BOD)	20	23	28	37	48	56	32

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Glass Cloth: Woven glass-fiber fabric, plain weave, minimum 8 ounces per square yard.

C. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

D. 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 Duct Jacket Color: White or gray.
3. PVC Pipe Jacket Color: Color-code piping jackets based on materials contained within the piping system.

E. Aluminum Jacket: Smooth or stucco embossed sheets manufactured from aluminum alloy complying with ASTM B 209 and having an integrally bonded moisture barrier over entire surface in contact with insulation. Factory cut and rolled 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.

F. Heavy PVC Pipe 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.

G. Standard PVC Pipe Fitting Covers: Factory-fabricated fitting covers manufactured from 20-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.

2.3 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

B. For chilled water pumps, provide min 22-gauge stainless steel box around suction diffuser and pump housing with 2" thick close cell elastomeric insulation liner adhered to inside of box. The box shall be designed to be in two (2) halves with latching clips/ latches for easy removal and re-installation. Where the two halves come together, there should be gasketing material for tight seal and along base. Alternative acceptable approaches are the use of pump insulation covers manufactured by Fit Tight Covers design for removable pump insulation covers.

2.4 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.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, plenum and breeching with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, pipes, plenums, and breechings; and to achieve a holding capacity of 100 lb. for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct, pipe, and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

G. Pipe Attachments for Flexible Elastomeric Insulation: Provide pipe support with high compressive strength material insert imbedded in closed-cell elastomeric foam to prevent condensation and insulation damage at support points. Provide friction insulation tape for connection of pipe insulation to pipe support system.

1. Manufacturers:
   a. Aeroflex – Aerofix
   b. Armacell – Armafix Ecolight
   c. Cooper B-Line, Inc. / Eaton – Armafix

d. K-Flex USA – K-Flex 360 Pipe Support
e. ZSi-Foster – Cush-A-Therm

2.5 VAPOR RETARDERS

A. Mastics: Materials that are compatible with insulation materials, jackets, and substrates.

2.6 REMOVABLE INSULATION COVERS

A. Pre-manufactured easily removable insulation cover/blanket intended for insulation of equipment and devices requiring periodic maintenance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL 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, piping, and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each 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 multiple layers of insulation with longitudinal and end seams staggered.

E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

F. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

G. Keep insulation materials dry at all times. Insulation that becomes wet or is otherwise damaged beyond repair, shall be removed immediately and replaced. Replacement material and installation shall be in accordance with these specifications.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the minimum number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. 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.

M. 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.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges, pipe joints, and fittings.

O. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

P. Install vapor-retarder mastic on ducts, pipes, plenums, and equipment.

1. Ducts, pipes, plenums, and equipment with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape and mastic to maintain vapor-retarder seal.
2. Ducts, pipes, plenums, and equipment without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

Q. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

S. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

T. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Blanket Applications for Ducts, Pipes, and Plenums: Secure blanket insulation with adhesive, and anchor pins with speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, pipe, and plenum surfaces.
2. Apply adhesive to entire circumference of ducts & pipes and to all surfaces of fittings and transitions. Adhesive may be omitted from the top of horizontal rectangular ducts.
3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
   c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not compress insulation to less than 75% of its original thickness during installation.
4. Install anchor pins and speed washers on sides, top, and bottom of horizontal pipes.
5. Impale insulation over anchors and attach speed washers.
6. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
7. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
8. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
9. Apply insulation on rectangular duct elbows, pipe fittings, and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows, and pipe elbows, with individually mitered gores cut to fit the elbow.
10. Insulate duct and pipe stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material as insulation. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

B. Board Applications for Ducts, Plenums, & Equipment: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct, plenum, & equipment surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings, transitions, and equipment. Adhesive may be omitted from top surface of horizontal rectangular ducts.
3. Space anchor pins as follows:

a. On duct & equipment sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct & equipment sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at bracing.
c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not compress insulation to less than 75% of its original thickness during installation.

4. Cut excess portion of pins extending beyond speed washers. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct and equipment stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6" wide strips of the insulating materia. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to ducts, plenums, and equipment as follows:

1. Follow the 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 duct, plenum, and equipment surface.

3.6 CLOSED-CELL PHENOLIC-FOAM INSULATION APPLICATION

A. Apply insulation as follows:

1. Secure each layer of insulation with stainless-steel bands at 12-inch intervals and tighten without deforming the insulation materials.
2. Apply two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications, finish insulation with a skim coat of mineral-fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin the finish coat to achieve smooth finish.

3.7 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, 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.

3.8 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Paints."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color shall be as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.9 DIFFUSER APPLICATIONS

A. Insulate exposed metal surfaces on top of all supply diffusers. Where diffusers are mounted in a metal pan, insulate the top of the pan.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1 inch.
3. Vapor Retarder Required: Yes.

B. Insulate slot diffuser plenums where uninsulated plenums are provided.

3.10 ACOUSTICAL DUCT & PIPING WRAP

A. Install acoustical pipe and duct lagging in locations indicated. Comply with manufacturers written instructions for installation by using type of mounting accessories indicated or, if not indicated, as recommended by the manufacturer.

3.11 APPLICATIONS

A. Insulation materials and thickness are specified at the end of this Section.

B. Insulate all ductwork, pipe and equipment:

1. Insulate ductwork in accordance with the application schedule(s) below.
2. Exceptions: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   a. Vibration-control devices.
   b. Testing agency labels and stamps.
   c. Nameplates and data plates.
   d. Manholes.
   e. Handholes.
   f. Cleanouts.
   g. Plastic condensate drain piping.
   h. Pipe-mounted condensate sensors.
   i. Return ductwork inside the building insulation envelope.

j. Indoor exposed return air ductwork.
k. Exhaust ductwork.
   1) Exception: Duct beginning 18" upstream of backdraft damper and continuing to building envelope insulation.
l. Metal ducts with duct liner.
m. Factory-insulated flexible ducts.
n. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
o. Flexible connectors.
p. Access panels and doors in air-distribution systems.
q. Ductwork used for smoke control supply and exhaust.

3.12 INDOOR APPLICATION SCHEDULE

A. Equipment: Chilled-water pumps

1. Operating Temperature: 35 to 75 deg F.
2. Insulation Material: Removable insulation cover
3. Vapor Retarder Required: Yes.

B. Service: Condensate drain piping except plastic.

1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: 1"
3. Vapor Retarder Required: Yes.
4. Finish: Finished Spaces = Painted, concealed = none.
5. Finish: White PVC jacket.

C. Service: Chilled water supply and return.

1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness:
   a. Pipe sizes up to 1½" diameter: 1-1/2 inches.
   b. Pipe sizes larger than 1½" diameter: 1-1/2 inches.
   c. In mechanical rooms and unconditioned spaces increase insulation thickness by 1".
3. Vapor Retarder Required: Yes
4. Finish: Color coded PVC jacket.

D. Service: Heating hot-water supply and return.

1. Insulation Material: Mineral fiber preformed pipe insulation.
2. Insulation Thickness: Apply the following insulation thicknesses:
   a. Pipe, Up to 1.5" diameter: 1-1/2 inches.
   b. Pipe, 2" diameter & up: 2 inches.
3. Vapor Retarder Required: No.
4. Finish: Color coded PVC jacket.

E. Refrigerant Suction and Hot-Gas Piping/Tubing:

1. Insulation Material and Thickness:
   a. Cellular Glass: 1-1/2 inches thick.
   b. Flexible Elastomeric: 1 inch thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Service: Unless otherwise indicated provide the following:

1. Concealed Ducts and Plenums:
   a. Material: Mineral-Fiber Blanket.
   b. Thickness: 2 inches.
   c. Vapor Retarder Required: Yes.

2. Ducts and Plenums in Finished Spaces:
   a. Material: Mineral-Fiber Board.
   b. Thickness: 1-1/2 inches.
   c. Field-Applied Jacket: Glass cloth.
   d. Vapor Retarder Required: Yes.
   e. Paint: Color as selected by architect. Refer to section "Painting".

G. Service: Round and flat oval, supply-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

H. Service: Round and flat oval, outside-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

I. Service: Rectangular, supply-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

J. Service: Rectangular, outside-air ducts, concealed and within the building insulation envelope.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

K. Service: Round and flat oval, supply-air ducts, concealed in vented attics and in unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 2 inches.
3. Vapor Retarder Required: Yes.

L. Service: Round and flat oval, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

M. Service: Rectangular, supply-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 2 inches.

3. Vapor Retarder Required: Yes.

N. Service: Rectangular, return-air ducts, concealed in vented attics and unvented attics with insulated ceilings.

1. Material: Mineral-Fiber Blanket Thermal Insulation with Factory Applied FSK Jacket.
2. Thickness: 1-1/2 inches.
3. Vapor Retarder Required: Yes.

3.13 OUTDOOR APPLICATION SCHEDULE

A. Insulation shall be applied after heat tracing and temperature sensors are in place and have been tested.

B. Service: Chilled water supply and return.

1. Insulation Material: Flexible elastomeric.
2. Insulation Thickness: 1 1/2".
3. Field-Applied Jacket: Aluminum.
4. Vapor Retarder Required: Yes.
5. Finish: Two coats UV protectant applied to flexible elastomeric insulation prior to installation of aluminum jacket.

C. Refrigerant Suction and Hot-Gas Piping:

1. Insulation Material and Thickness:
   a. Cellular Glass: 2 inches thick.
   b. Flexible Elastomeric: 2 inches thick.
   c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
2. Finish: Two coats of UV coating or mastic protectant recommended by the insulation manufacturer or outdoor aluminum jacket.

END OF SECTION 230700

SECTION 23 08 00 COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 01 91 13 – Commissioning General Requirements

C. Section 21 08 00 – Commissioning of Fire Suppression Systems

D. Section 25 08 00 – Commissioning of Integrated Automation Systems

E. Section 26 08 00 – Commissioning of Electrical Systems

F. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 23 responsibilities and participation in the commissioning process. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of HVAC Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 01 91 13 Section 1.3 – Definitions. The mechanical trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. HVAC Contractor(s) are responsible for mechanical system installation, start-up, testing, balancing, preparation of O&M manuals, and operator training as defined in various Division 23 specification sections. HVAC Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 01 91 13. Neither Section 01 91 13 - Commissioning General Requirements nor Section 23 08 00 –

Commissioning of HVAC Systems shall relieve the HVAC Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 23 08 00 – Commissioning of HVAC Systems shall not relieve the Electrical Contractor(s) or Telecommunications Contractor(s) from any obligations set forth within Division 1, Division 26, Division 27, including Section 01 91 13 – Commissioning General Requirements.

1.3 DEFINITIONS

A. HVAC Contractor(s): The term HVAC Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 23 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The HVAC Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the HVAC Contractor(s) shall be required to fulfill all requirements set forth within Specification 23 08 00 Section 1.5 – Roles and Responsibilities. Additionally, the HVAC Contractor(s) shall be required to fulfill all requirements set forth within Specification 01 91 13.

B. Through the Commissioning Process, the HVAC Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the HVAC Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23

of the specifications. See Specification 01 91 13 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all HVAC Contractor(s) shall be required to fulfill all requirements described within Specification 01 91 13 Section 1.4 – Roles and Responsibilities.

D. HVAC Contractor(s)

1. General Requirements:

a. Include all cost to complete commissioning requirements for HVAC Systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 01 91 13 Section 2.2 – Schedule of Values.

b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.

c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.

d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule

a. Prepare a Preliminary Schedule for HVAC Systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests. Coordination of the commissioning activities and their integration into the schedule shall be conducted within the Commissioning Meetings.

b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, TAB, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

a. Comply with all Submittal requirements as outlined within Specification 01 91 13 Section 2.3 – Submittals.

b. Comply with all requirements as outlined within Specification 01 91 13 Section 2.5 – Start-Up and Test Reports.

c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

1) General construction progress and status reports

2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs

3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent

4) Pre Start-Up and Start-Up procedures

5) Value Engineering Proposals and a list of all accepted VE items

6) Pressure Test Reports, Flushing Reports and Start-Up Reports

7) Construction document changes resulting from mechanical Requests for Information

4. Pre-Functional Checklist Requirements:

a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 01 91 13 Section 2.4 – Pre-Functional Checklists.

b. Complete Pre-Functional Checklists on all mechanical equipment and system components installed or provided by the HVAC Contractors(s).

c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, of the time for start of the TAB work.

d. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, so that witnessing Equipment and System Start-Up can begin.

e. Provide written notification to the Commissioning Agent for each system listed in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up

a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide

full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

b. Perform all pressure tests, weld tests, vibration analysis and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist

c. Perform all Test, Adjustment and Balance requirements for hydronic piping systems and air distribution systems. Submit copies of the TAB Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. Also, submit a copy of the preliminary TAB documentation including the TAB Plan, Forms and Report format to the Commissioning Agent for review and approval. The TAB Contractor shall assist as the TAB Report is spot-checked by the Commissioning Agent. See the Specification 23 08 00 Section 1.5 – Roles and Responsibilities, Subsection E for additional TAB Contractor Requirements.

d. Perform all equipment, system and component cleaning and flushing as required by the specifications and Equipment Manufacturer's recommendations. Provide full documentation of all cleaning and flushing procedures and test results (i.e. pH test results, ect.) Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist

6. Functional Performance Test Requirements:

a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 01 91 13 Section 2.6 – Functional Performance Tests.

b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 01 91 13 Section 2.8 – Test Equipment.

c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)

d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.

e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the

Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.

f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 01 91 13 Section 3.6-A.

7. Training Requirements:

a. Comprehensive training of O&M personnel shall be performed by the HVAC Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.

b. The Training Schedule is to be coordinated and completed by the HVAC Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.

c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.

d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.

b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.

c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.

d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Test, Adjust, and Balance Contractor(s):

1. Comply with all requirements as outlined within Specification 23 08 00 Section 1.5 Sub-Section D – HVAC Contractor(s).

2. Submit the TAB procedures to the Commissioning Agent and Design Professional for review and acceptance. TAB procedures must include the TAB Plan, TAB Forms and TAB Report Format. These documents must be approved prior to proceeding with the Test, Adjustment and Balance.

3. Attend the TAB review meeting scheduled by the Commissioning Agent. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the HVAC system.

4. Issue a statement that TAB work has been completed. Submit through the Contractor(s) a copy of the preliminary version of the Test and Balance Report to the Commissioning Agent and System Design Professional. Submit for review, a Final Version of the Test and Balance Report to the Commissioning Agent and System Design Professional within the amount of time allotted within the Specifications. The Commissioning Agent and Systems Design Professional must both accept the Final TAB Report.

5. The Commissioning Agent shall be provided with a copy of the Test, Adjustment and Balance Report a minimum of two weeks (14 days) prior to the scheduled spot check of the balanced system. The report may be a Preliminary or Final version. A representative of the Test and Balance firm shall be required to assist with the spot check. The Test and Balance firm shall provide calibrated testing equipment as per Specification 01 91 13 Section 2.8 - Test Equipment. Equipment shall be similar in style and type as used to initially perform Test, Adjustment and Balance procedures.

6. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes.

F. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 23 08 00 Section 1.5 Sub-Section D – HVAC Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component tests (i.e. Weld Test Reports, Cleaning & Flushing Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Test, Adjustment and Balance Report: The approved Final Report shall be provided to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

6. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 01 91 13 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The HVAC Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The HVAC Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The HVAC Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The HVAC Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The HVAC Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the HVAC Contractor(s). HVAC Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The HVAC Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The HVAC Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC's or FPT's at a rate of $85/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager's Application for Payment. The Construction Manager will then back charge the party responsible for the test's failure. It is the HVAC Contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The HVAC Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 01 91 13-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors,

manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 01 91 13-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. HVAC Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

D. Documentation and Reporting Requirements

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. The Commissioning Agent shall direct and witness the field verification of the Final TAB report. The TAB Contractor shall perform measurements as directed by the Commissioning Agent.

1. The Commissioning Agent shall select report data for verification at random.

2. The TAB contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB contractor must use the same instruments (by model and serial number) that were used when the original data were collected.

3. Failure of an item is defined as:

a. For all readings other than sound, a deviation of more than 10 percent.

b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).

4. A failure of more than 10 percent of the selected items shall result in the rejection of the TAB report.

F. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 23 08 00

SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

B. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Products Supplied but not installed under this section:
1. Control valves.
2. Flow switches.
3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
4. Automatic control dampers, where not supplied with equipment.
5. Airflow Measuring Stations.
6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
7. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or air handling units).
8. In-line meters (gas, water, power, BTU).

B. Products Not Furnished or Installed but Integrated with the Work of this Section:
1. Refrigerant monitors.
2. Smoke detectors (through alarm relay contacts).
3. Chiller Control Systems.
4. Boiler Control Systems.
5. Chemical Water Treatment.
6. High Efficiency Energy Recovery System.

C. Work Required Under Other Divisions Related to This Section:
1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a LonTalk open protocol bus. All controllers on the LonTalk bus shall be LonMark certified.

1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
4. All control devices, including configurable and fully programmable controllers, furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools shall not be acceptable.
5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
11. All JACE's provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. BAS: Building Automation System. (Used interchangeably with BMS)
6. BMS: Building Management System. (Used interchangeably with BAS)
7. DDC: Direct Digital Control.
8. Discrete: Binary or digital state.
9. DI: Discrete Input.
10. DO: Discrete Output.
11. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.

12. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
13. GUI: Graphical User Interface.
14. HVAC: Heating, Ventilating and Air Conditioning.
15. IDC: Interoperable Digital Controller.
16. ILC: Interoperable Lon Controller.
17. LAN: Local Area Network.
18. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
19. Motorized: Control device with actuator.
20. NAC: Network Area Controller.
21. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
22. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
23. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
24. Operator: Same as actuator.
25. PC: Personal Computer.
26. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
27. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
28. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
29. PICS: BACnet Product Interoperability Compliance Statement.
30. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
31. Point: Analog or discrete instrument with addressable database value.
32. WAN: Wide Area Network.

1.5 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year beginning on the date of Beneficial Occupancy.

B. Services, materials, and equipment shall include but not be limited to:
   1. The adjustment, required testing, and repair of the system including all computer equipment, transmission lines, transmission equipment, sensors and control devices.
   2. On-line support services shall be provided as follows:
      a. The local BAS representative shall have the capability to monitor and control the facility's building automation system via a dialup connection.
      b. If the problem is not resolved by local support, the national office of the building automation system manufacturer, having the same dialup capability, shall also provide online support.

1.6 SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.

D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.

E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.

F. Upon completion of the work, provide five (5) complete sets of ' as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.

G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.

B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.

C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.8 SOFTWARE OWNERSHIP

A. The Owner shall have full ownership and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Distech.
   2. Honeywell
   3. TAC I/A Series

B. Approved Installation Contractors:
   1. CMS Controls.
   2. Engineered Control Solutions.
   3. Schneider Electric.

C. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

D. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing the LonWorks technology communication protocol in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 BAS SERVER HARDWARE

A. Minimum Computer Configuration (Hardware Independent).
   1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
   2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
   3. Memory: 8 GB or more.
   4. Hard Drive: 80 GB minimum, more recommended depending on archiving requirements.

5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).

B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.4 SYSTEM NETWORK CONTROLLER (SNC)

A. Manufacturer:
1. Tridium Niagra N4 Platform (Preferred Brand Alternate No. #11)

B. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

C. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

D. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.

E. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

F. The SNC shall employ a device count capacity license model that supports expansion capabilities.

G. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
1. BACnet
2. Lon
3. MODBUS
4. SNMP
5. KNX

H. The SNC shall be capable of executing application control programs to provide:
1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.

5. Time synchronization.
6. Integration of LonWorks, BACnet, and MODBUS controller data.
7. Network management functions for all SNC, PEC and ASC based devices.

I. The SNC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
2. Two Isolated RS-485 ports with biasing switches.
3. 1 GB RAM
4. 4 GB Flash Total Storage / 2 GB User Storage
5. Wi-Fi (Client or WAP)
6. USB Flash Drive
7. High Speed Field Bus Expansion
8. -20-60°C Ambient Operating Temperature
9. Integrated 24 VAC/DC Global Power Supply
10. MicroSD Memory Card Employing Encrypted Safe Boot Technology

J. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

K. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

L. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
a. Alarm.
b. Return to normal.
c. To default.
2. Alarms shall be annunciated in any of the following manners as defined by the user:
a. Screen message text.
b. Email of complete alarm message to multiple recipients.
c. Pagers via paging services that initiate a page on receipt of email message.
d. Graphics with flashing alarm object(s).
3. The following shall be recorded by the SNC for each alarm (at a minimum):
a. Time and date.
b. Equipment (air handler #, access way, etc.).
c. Acknowledge time, date, and user who issued acknowledgement.

M. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

N. The SNC shall support the following security functions.
1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
2. Role-Based Access Control (RBAC) for managing user roles and permissions.
3. Require users to use strong credentials.
4. Data in Motion and Sensitive Data at Rest be encrypted.
5. LDAP and Kerberos integration of access management.

O. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
   1. Metadata: Descriptive tags to define the structure of properties.
   2. Tagging: Process to apply metadata to components
   3. Tag Dictionary

P. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD) shall have an associated template file for reuse on future project additions.

Q. The SNC shall be provided with a 1 Year Software Maintenance license. Labor to implement not included.

2.5 BUILDING AUTOMATION SYSTEM CONTROLLERS

A. HVAC control shall be accomplished using LonMark based devices. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
   1. Programmable Equipment Controllers - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PECs are to allow for the flexibility of custom control programming to meet the needed sequences of operation. PEC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
      a. All PECs shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
      b. The PEC shall provide LED indication of communication and controller performance to the technician, without cover removal.
      c. PEC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC or relay).
   2. Advanced Variable Air Volume Controller (AVAV) - a controller designed specifically for room-level VAV control - pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals and constant volume dual-duct terminal unit.
      a. The AVAV shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
      b. The controller shall have an internal velocity pressure sensor.

c. The AVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
d. AVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
e. The controller shall provide an integrated actuator option.

3. Configurable VAV Controller (CVAV) - the configurable VAV controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals, and constant volume dual-duct terminal unit.
   a. The CVAV shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAV shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
   b. The controller shall have an internal velocity pressure sensor.
   c. The CVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
   d. CVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).
   e. The controller shall provide an integrated actuator option.
4. Configurable Constant Volume AHU Controller (CVAHU) - the configurable constant volume AHU controller shall be designed specifically for single zone unitary AHU control –temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: unitary air handling units, fan coil units, blower coil units, unit ventilators, and heat pumps.
   a. The CVAHU controller shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAHU controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
   b. The CVAHU controller shall provide LED indication of communication and controller performance to the technician, without cover removal.
   c. CVAHU controllers shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as 0-10V, 0-10,000 ohm or, 20K NTC), analog outputs (4-20mA), and digital outputs (24 VAC TRIAC).

2.6 OTHER CONTROL SYSTEM HARDWARE

A. Control Dampers: All dampers shall be Tamco Series 9000 SW, thermally broken. (No Substitutions) Where unit manufacturer cannot factory mount dampers, contractor shall field install dampers.
   1. Outdoor Air Damper(s): Modulating opposed blade damper.
   2. Mixing Damper(s): Modulating opposed blade dampers. Dampers shall be positioned such that airflows collide to promote mixing.
   3. Damper Motors:
      a. Fail closed.

1) Exceptions:
a) Return air damper shall fail open.
b. Modulating operation unless two-position is indicated.
c. Adjustable minimum position.

B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.

C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be ' line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above).

D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing ' fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is basis of design.

E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement.

F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ±; 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F(-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all

mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range.

H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.

I. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.

J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube.

L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips.

M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.

N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of ' as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of ±1% accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.

P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

Q. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is basis of design.

R. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

S. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF.".

T. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.

U. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.

V. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

W. Lon Bus Surge Protectors: A Lon Bus Surge Protector, DITEK model # DTK-2MHLP24BWB or equivalent shall be installed on the lon bus when it leaves and enters a building.

X. Ethernet Port Surge Protector: An Ethernet Surge protector shall be installed similar to the Honeywell 14507678-004 or comparable.

Y. Airflow Monitoring Stations: Ebtron Brand Gold airflow monitoring stations shall be Lon. Controls Contractor shall verify installed duct sizes and airflows before ordering.

Z. Gas Meters: Onicon brand F-5400 Series Thermal Mass Flow Meter, D-100 display with LonWorks TP/FT-10F Output. Controls Contractor shall verify installed pipe size, meter placement sizes and flows before ordering.

AA. Domestic Water Meters:
1. Building meters: Neptune
   a. 1.5 inches and below shall be positive displacement type with matching strainer.
   b. 2 inches and above shall be compound type meter with matching strainer.
2. Irrigation meters: Neptune
   a. Minimum 2" turbine meter with matching strainer
3. Meter Register: Neptune E-Coder register w/ the potted cable. (The R900i register is NOT compatible, since it does not feature a connection wire.)

4. Meter Gateway: Scadametrics Ethermeter http://www.scadametrics.com/ The gateway device shall directly interrogate the meter register and shall calculate and relay the following parameters to the BAS:
   a. Totalized Volume
   b. Instantaneous Flowrate

BB. BTU Meters: Onicon System-10 BTU meter, LonWorks communication, F-3500 Electromagnetic Flow Meter (Alternate #11).
1. Materials of construction for wetted metal components shall be 316 SS. For installations in non-metallic pipe, install grounding rings or probes. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST*. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 1% of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. =Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty.

CC. Electric Meter: Digital Electric Meter with Modbus communication. Unit shall display and communicate totalized kWH, voltage, amps, kW

DD. Liquid Flow Meters: Onicon F-3500 Electromagnetic Flow Meter, D-100 Display with LonWorks Communication (Alternate #11).
1. Materials of construction for wetted metal components shall be 316 SS. For installations in non-metallic pipe, install grounding rings or probes. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST*. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 1% of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty.

2.7 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or

browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Window operating systems.

C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
1. Trending.
2. Scheduling.
3. Electrical demand limiting.
4. Duty Cycling.
5. Downloading Memory to field devices.
6. Real time 'live' Graphic Programs.
7. Tree Navigation.
8. Parameter change of properties.
9. Set point adjustments.
10. Alarm / event information.
11. Configuration of operators.
12. Execution of global commands.
13. Add, delete, and modify graphics and displayed data.

E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.
2. 5 Year Software Maintenance license. Labor to implement not included.
3. Embedded System Configuration Utilities for future modifications to the system and controllers.
4. Embedded Graphical Programming Tools.
5. Embedded Direct Digital Control software.
6. Embedded Application Software.

F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.

G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
   1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
   2. Groups View shall display Scheduled Groups and custom reports.
   3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
   1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
   2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
   3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
   4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
   5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
   6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
   7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web

browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.

8. Logic - Live Graphic Programs: Shall be used to display' live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.

E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
   1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
   2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
   3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
   4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
   5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
      a. Each piece of equipment monitored or controlled including each terminal unit.
      b. Each building.
      c. Each floor and zone controlled.

F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
   1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
      a. Types of schedule shall be Normal, Holiday or Override.
      b. A specific date.
      c. A range of dates.
      d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
      e. Wildcard (example, allow combinations like second Tuesday of every month).

2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their

respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.

7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
    a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
    b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
    c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
    d. Write Property: The write property reporting action updates a property value in a hardware module.
    e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
    f. Run External Program: The Run External Program reporting action launches specified program in response to an event.

H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
    1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
    2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
    3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
    4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.

5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and ' pan through' historical data by simply scrolling the mouse.
6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).

I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
   a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
   b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
   c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be

self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
   1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
   2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
   3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
   4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
   5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
   6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
   7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
   8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
   9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
   10. Live Graphical Programs: The Graphic Programming software shall support a ' live' mode, where all input/output data, calculated data and set points shall be displayed in a ' live' real-time mode.

2.10 LONWORKS NETWORK MANAGEMENT

A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.

D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Site Network Controller (SNC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule
2. On-site coordination with all applicable trades and subcontractors
3. Authorized to accept and execute orders or instructions from owner/architect
4. Attend project meetings as necessary to avoid conflicts and delays
5. Make necessary field decisions relating to this scope of work
6. Coordination/Single point of contact.

3.2 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that power supply is available to control units and operator workstation.

D. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.3 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.4 GENERAL

A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.

D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.5 WIRING

A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.

B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

C. Excess wire shall not be looped or coiled in the controller cabinet.

D. Incorporate electrical noise suppression techniques in relay control circuits.

E. There shall be no drilling on the controller cabinet after the controls are mounted inside.

F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

G. Use manufacturer-specified wire for all network connections.

H. Use approved optical isolation and lightning protection when penetrating building envelope.

I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.6 ACCEPTANCE TESTING

A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 OPERATOR TRAINING

A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. The Control System Contractor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.8 WARRANTY PERIOD SERVICES

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.

C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage.

D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.

E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.9 WARRANTY ACCESS

A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.10 OPERATION & MAINTENANCE MANUALS

A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:

B. As-built control drawings for all equipment.

C. As-built Network Communications Diagram.

D. General description and specifications for all components.

E. Completed Performance Verification sheets.

F. Completed Controller Checkout/Calibration Sheets.

3.11 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Beneficial Occupancy.

END OF SECTION 230900

SECTION 230993 - SEQUENCES OF CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. BAS Building Automation System

B. CFM Cubic Feet per Minute

C. CRAC Computer Room Air Conditioner

D. DDC Direct-digital controls

E. °F Degrees Fahrenheit

F. ECM Electrically-commutated motor

G. RTU Rooftop unit

H. VAV Variable-air volume

I. VSD Variable Speed Drive

J. NCSBC North Carolina State Building Code

K. W Wire

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. Head End: Main temperature control computer system storing data accessible to the internet for WEB accessible systems and storing data accessible to the building system backbone for non-WEB accessible systems.

C. Modulating: Able to electrically vary and stop in any position.

D. Occupied Mode: Occupied or "design" operation.

E. Outdoor air: Air outside the building or taken from outdoors and not previously circulated through the building.

F. Outdoor air measurement: Reporting of the volume of outdoor air taken into the building by RTU and reported to the building operator in CFM.

G. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations.

H. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

I. Record: Maintain in writing on paper and maintain an electronic copy (Portable Document Format (*.PDF) is acceptable). Make paper copy available for inspection upon request by Owner, Owner's representative, Architect, or Architect's representative. Email electronic copy to requested email address when request is made by the Owner, Owner's representative, Architect, or Architect's representative.

J. Set Point: An operating parameter adjustable at the head end by the operator.

K. Supply-Air Fan: Fan providing supply air to conditioned space.

L. Supply air: Air entering a space from air-conditioning, heating, or ventilating equipment.

M. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

N. Two-Position: Able to electrically move and stop in only two positions. Usually open or closed.

1.4 Submittals:

A. Submit the following:

1. Proposed control sequences.

2. Freezestat manufacturer's data and wiring diagrams indicating all components required to execute the indicated sequence.

1.5 Trending:

A. Unless otherwise indicated where trending is indicated the BAS shall measure or record each point value every 1.0 seconds and shall save results for a minimum of 30 days.

1.6 Coordination

A. Refer to Section 019110 "General Commissioning Requirements" for Commissioning Plan requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (OPERATING SEQUENCES)

3.1 REFER TO SEQUENCES ON CONTROLS DRAWINGS FOR ALL EQUIPMENT

3.2 SET POINTS: Unless indicated otherwise all set points shall be adjustable from the head end.

3.3 TRENDING: Unless indicated otherwise all points shall have the ability to be recorded for trending every 5 minutes (adjustable).

3.4 OPTIMUM START/STOP:

A. The BAS shall institute optimum start strategies for morning warm up and cool down functions. Equipment shall start early enough to restore occupied temperature set points 30 minutes prior to occupancy. Morning warm up and cool down must look at outside conditions and building historic thermal loading data at a minimum to determine optimum start/stop of the building to save energy and keep the building at set back temperatures as long as possible during unoccupied periods.

3.5 OUTSIDE AIR SENSORS:

A. Graphics:
   1. A system graphic similar to the control diagram on the drawings shall be developed and shall be readable from the BAS head end.
   2. Sensed points shall be shall be displayed on the graphic and shall readable from the BAS head end.

B. Temperature: The BAS shall monitor outside air temperature as sensed by the outside air temperature sensor.

C. Relative Humidity: The BAS shall monitor outside air relative humidity as sensed by the outside air humidity sensor.

D. Web Bulb:
   1. Web bulb temperature shall be calculated based on outside dry bulb temperature and relative humidity.

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Pre-submittal meeting: The contractor performing work under this section of the specifications shall attend a meeting for the purpose of coordinating with the control system. The meeting shall be held on the project site in the contractor's trailer or other location acceptable to the contractor. The contractor shall be responsible for arranging the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Product Data: For each type of the following:
   1. Valves-Include flow and pressure drop curves/information based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow control valves.
   2. Air control devices.
   3. Chemical treatment.
   4. Hydronic specialties.

C. Maintenance Data: For hydronic specialties, balancing valves, automatic flow control valves, and special-duty valves to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

D. Coordinate pipe fitting pressure classes with products specified in related Sections.

E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Penetration Firestopping Systems" for fire and smoke wall and floor assemblies.

1.5 BUILDING AUTOMATION SYSTEM COORDINATION:

A. If indicated, all wells, valves, taps, dampers, flow stations, etc. furnished under Section "Building Automation System" shall be installed under this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping, components, and installation shall withstand the following minimum working pressure and temperature unless otherwise indicated: 150 psig at 200 degrees F.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 POLYPROPYLENE (PP-R) PIPE AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
1. Aquatherm.
2. Nupi.

B. Polypropylene Pipe: Pipe shall be manufactured from PP-R resin (Fusiolen or similar) meeting the short-term properties and long-term strength requirements of ASTM F 2389. Pipe shall contain no rework or recycled materials except that generated in the manufacturer's plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Hot water pipe shall contain a fiber layer (Faser or similar) to restrict thermal expansion. All pipe shall comply with rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

C. Polypropylene Fittings: Fittings shall be manufactured from a PP-R resin (Fusiolen or similar) meeting the short-term properties and long-term strength requirements of ASTM F 2389. Fittings shall contain no rework or recycled materials except that generated in the manufacturer's plant from resin of the same specification from the same raw material. All

fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

D. Underground Piping: Shall comply with ASTM D2774

E. Heating Hot Water Piping Pressure Ratings:

Temperature (°F)	Working Pressure (psi)
50	305
140	140
180	95

F. Chilled Water Piping Pressure Ratings:

Temperature (°F)	Working Pressure (psi)
50	195
80	170

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

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

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

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for CPVC Piping: ASTM F 493.

H. Solvent Cements for PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:
1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.6 VALVES

A. Valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Refer to Part 3 "Valve Applications" Article for applications of each valve.

C. Calibrated Balancing Valves:

1. Available Manufacturers:

a. NIBCO
b. Armstrong Pumps, Inc.
c. Flow Design, Inc.
d. Griswold Controls.
e. ITT Bell & Gossett; ITT Fluid Technology Corp.
f. Nexus Valve.
g. NuTech Hydronic Specialty Products
h. Taco, Inc.

2. NPS 2 and Smaller: Bronze body, ball type, 125-psig working pressure, 250 deg F maximum operating temperature, and having threaded 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.
3. 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 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.

D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

E. Pressure Relief Valves and Temperature & Pressure Relief Valves:

1. Available Manufacturers

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Conbraco Industries, Inc.
d. ITT McDonnell & Miller Div.; ITT Fluid Technology Corp.
e. Kunkle Valve Division.
f. NuTech Hydronic Specialty Products
g. Spence Engineering Company, Inc. Pressure-Reducing Valves:
h. Watts Industries, Inc.; Watts Regulators.

2. Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.

2.7 AIR CONTROL DEVICES

A. Available Manufacturers:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Nexus Valve.
5. NuTech Hydronic Specialty Products
6. Taco.

B. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2
5. Discharge Connection: NPS 1/8
6. CWP Rating: 150 psig
7. Maximum Operating Temperature: 225 deg F

C. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.

2.8 HYDRONIC PIPING SPECIALTIES

A. Compression/Expansion Tanks:

1. Available Manufacturers:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Taco, Inc.

2. Welded carbon steel rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and tap for air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
3. Charge: Charge tank without applying system pressure to a pressure equal to that indicated for the domestic cold water makeup pressure reducing valve.

B. Air Separators:

1. Available Manufacturers

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. ITT Bell & Gossett; ITT Fluid Technology Corp.
   d. Taco, Inc.

2. Tangential-Type Air Separators: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; tangential inlet and outlet connections; threaded connections for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.

C. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

D. Basket Strainers: 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.

E. Flexible Connectors:
1. Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch misalignment.

2. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig.

F. Pressure temperature test (P/T) port

1. Manufacturers:

a. NuTech Hydronic Specialty Products
b. Petersen
c. Sisco Manufacturing Co.
d. Omega
e. Watts Water Technologies, Inc.

2. Body: Brass.
3. Core: Nordel
4. Cap: Brass
5. Provide extension to allow insulation installation.

2.9 ROOF PIPING PENETRATIONS

A. Available Manufacturers:
1. The Pate Company (Model PHA-2)
2. Roof Penetration Housings, LLC (Vault Models with Exit Seals)
3. Roof Products, Inc. (Model RPPC-90).

B. Provide pipe hood assembly for pipe penetrations through a roof that are not installed within a roof curb. Provide pipe hood assembly for single or multiple pipes to match application.

C. Pipe hood assembly shall consist of heavy-gauge aluminum construction and removable water-tight top cover, faceplate and 3-sided body for access to interior. Provide separate, fully-welded and insulated aluminum mounting base to isolate hood from galvanized roof curb. Field insulate hood interior and caulk all exposed joints after installation of piping.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Heating Hot Water Piping:
1. Inside building and aboveground:
a. SDR-11 Polypropylene pipe and fittings and heat-fused joints with reinforcing layer (Aquatherm blue pipe, Nupi Niron Clima).
2. Belowground and below slabs:
a. SDR-11 Polypropylene pipe and fittings and heat-fused joints with reinforcing layer (Aquatherm blue pipe, Nupi Niron Clima).

B. Chilled Water Piping:
1. Inside building and aboveground:

a. SDR-11 Polypropylene pipe and fittings and heat-fused joints. (Aquatherm green pipe, Nupi Niron CoolPro)

2. Belowground and below slabs:
   a. SDR-11 Polypropylene pipe and fittings and heat-fused joints. (Aquatherm green pipe, Nupi Niron CoolPro)

C. Chilled Water, Heat Pump Loop Water, and Condenser Water 2-1/2" and Larger Outside Building: As specified for Inside Building,

D. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

E. Air-Vent Piping:
   1. Inlet: Same as service where installed.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

G. Miscellaneous: Same materials and joining methods as connecting service.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
   1. Shutoff Duty: Ball, and butterfly valves.
   2. Throttling Duty: Ball, and butterfly valves.

B. Install shutoff duty valves at each branch connection to supply mains, unless only one piece of equipment is connected in the branch lines, and at supply connections to each piece of equipment. Install manual flow control device where indicated at branch piping.

C. Install Automatic Flow Control Valves in the return water line of each heating or cooling coil, and as indicated.

D. For parallel chillers or boilers without dedicated primary pumps, provide manual balancing valves in the return line at full piping size and with low pressure drop. Do not use automatic flow control valves in these applications.

E. Install check valves at each pump discharge and elsewhere to control flow direction.

F. Install safety valves on hot-water generators and as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping without valves. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

G. Install pressure-reducing valves on makeup water piping to regulate system pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved in writing on Coordination Drawings.

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

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

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

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

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

I. Install piping to allow application of insulation.

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

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and 8" NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

O. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

P. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

Q. Install all wells, valves, taps, flow stations, etc. furnished under Section "Building Automation System."

R. Install exterior piping at a uniform grade of 0.2 percent upward in direction of flow. Interior piping may be installed level.

S. Install condensate drain piping at a minimum uniform slope of 1" in 10'-0"in the direction of flow.

T. Reduce pipe sizes using concentric reducers, or eccentric reducers installed with level side up.

U. Provide branch connections with the takeoff coming off the top of the main.

V. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and as indicated. Install 3/4" diameter by 8" long nipple and ball valve in blowdown connection of strainers 3/4" and larger. Match size of strainer blow-down connection for strainers smaller than 3/4".

W. Provide seal around piping penetrations of full height interior walls, both rated and non-rated, that occur above ceilings. Refer to Section 079200 Joint Sealants.

X. Where piping penetrates a non-fire-resistance-rated floor or floor/ceiling assembly or ceiling membrane of a non-fire-resistance-rated roof/ceiling assembly, provide the following:

1. For noncombustible piping that connects not more than five stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion or with a tested and classified through-penetration firestop system.
2. For piping that connects not more than two stories, protect the annular space around the piping with an approved, noncombustible material to resist the free passage of flame and the products of combustion.
3. For piping that penetrates a non-rated wall, protect the annular space around the penetrating piping with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.4 PIPE 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 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.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are damaged.
3. Damaged Welds: Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

H. PP-R Heat Fused Joints: Joints shall be fusion heat fuse welded in accordance with manufacturer's instructions.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. ¾": Maximum span, 7'-0"; minimum rod size, ¼".
2. 1": Maximum span, 7'-0"; minimum rod size, ¼".
3. 1½": Maximum span, 9'-0"; minimum rod size, 3/8".
4. 2": Maximum span, 10'-0"; minimum rod size, 3/8".
5. 2½": Maximum span, 11'-0"; minimum rod size, 3/8".
6. 3": Maximum span, 12'-0"; minimum rod size, 3/8".
7. 4": Maximum span, 14'-0"; minimum rod size, ½".
8. 6": Maximum span, 17'-0"; minimum rod size, ½".
9. 8": Maximum span, 19'-0"; minimum rod size, 5/8".
10. 10": Maximum span, 20'-0"; minimum rod size, ¾".
11. 12": Maximum span, 23'-0"; minimum rod size, 7/8".
12. 14": Maximum span, 25'-0"; minimum rod size, 1".
13. 16": Maximum span, 27'-0"; minimum rod size, 1".
14. 18": Maximum span, 28'-0"; minimum rod size, 1¼".
15. 20": Maximum span, 30'-0"; minimum rod size, 1¼".

C. Where hangers for steel piping are to be suspended from open-web steel joists, install hangers at maximum spacing that will result in hanger loads that comply with the requirements on the structural drawings.

D. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
1. ¾": Maximum span, 5'-0"; minimum rod size, ¼".
2. 1": Maximum span, 6'-0"; minimum rod size, ¼".
3. 1½": Maximum span, 8'-0"; minimum rod size, 3/8".
4. 2": Maximum span, 8'-0"; minimum rod size, 3/8".
5. 2½": Maximum span, 9'-0"; minimum rod size, 3/8".
6. 3": Maximum span, 10'-0"; minimum rod size, 3/8".

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 Where changes in direction or tees occur, place hangers 1/3 of the maximum allowed spacing distance from the change in direction or tee (i.e. if the maximum span is 12 feet, the hanger shall be 4feet from the change in direction or tee). Pipe shall be supported from both sides of a change in direction.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at coils, and elsewhere as required for system air venting.

B. Install in-line air separators in pump suction lines. Install piping to compression tank with a 2 percent minimum upward slope toward tank.
   1. Install drain valve on units NPS 2 and larger.

C. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be ¾" or match equipment connection size or as indicated on the drawings, whichever is greater.

B. Install control valves in accessible locations near connected equipment.

C. Install ports for pressure and temperature gages at equipment and coil inlet and outlet connections.

3.9 CHEMICAL TREATMENT

A. Flush system with fresh clear water until it drains clear.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Provide initial water treatment.

3.10 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during testing.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.11 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:
1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils and equipment are calling for full flow.
6. Check and set equipment operating temperatures to design requirements.
7. Lubricate motors and bearings.

3.12 CLEANING

A. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data:

1. Provide certified performance curves, rated capacities, final impeller dimensions, and operating weights of proposed pumps. Indicate pump operating points on curves.
2. Provide specialties, and accessories for each type of product indicated.

B. Maintenance Data:

1. Provide maintenance manuals for pumps.

1.3 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Pumps manufactured by listed manufacturers with equal performance characteristics may be considered.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

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. Mechanical Seals: One set for each pump.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

A. Pumps: Factory assembled and tested centrifugal.

B. Motors: Meet requirements of Section "Motors for HVAC Equipment."

2.2 SPLIT COUPLED, VERTICALLY MOUNTED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Fluid Technology.
2. Bell & Gossett - Xylem.
3. Grundfos.
4. Patterson Pump Co.
5. Taco Comfort Solutions.

B. Source Limitations: Obtain pumps from single source from single manufacturer.

C. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted vertically.

D. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gauge tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange connections.
2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps that are not frequency-drive controlled, trim impeller to match specified performance.
3. Pump Shaft: Type 316 stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless steel spring, and EPDM bellows and gasket.

E. Shaft Coupling: Interlocking frame with interconnecting springs capable of absorbing vibration.

F. Motor: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure: Totally enclosed, fan cooled.
2. NEMA Premium Efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Variable-speed motor.
6. Provide integral pump motor variable-speed controller.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175 PSIG pressure rating, cast iron body and end cap, pump-inlet fitting; with bronze startup strainer and bronze or stainless steel permanent strainer. Provide bronze or stainless steel straightening vanes, drain plug, and factory or field fabricated support.

B. Silent Check Valve:

1. Wafer style, class 125, 200 PSIG non-shock cold working pressure, or 250, 400 PSIG non-shock cold working pressure, iron body, spring actuated, renewable Buna-N bonded to bronze seat, bronze disk, stainless steel spring, and stainless steel set screw.
2. Twin disc wafer style, class 125, 200 psi non-shock cold working pressure, iron body, spring actuated, Buna-N seat, bronze disk, stainless steel spring, stainless steel hinge and stop pins, stainless steel thrust bearing, and steel hinge pin and stop pin retainers.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Provide pumps so they are specified or scheduled with ECM.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.

1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

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

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps. Inline pumps may be supported by piping only when in accordance with manufacturer's installation instructions.

D. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction.

E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

F. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

G. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

3.3 ALIGNMENT

A. The following is required for horizontal flexible coupled shafts:

1. Engage a factory-authorized service representative to perform alignment service.
2. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.
3. Comply with pump and coupling manufacturers' written instructions.
4. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
5. After alignment is correct, tighten foundation bolts evenly without altering alignment. Completely fill base with non shrink nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

E. Install pressure gauges on pump suction and discharge or at integral pressure-gauge tapping, or install single gauge with multiple-input selector valve.

F. Install check valve on each condensate pump unit discharge unless unit has a factory-installed check valve.

G. Install electrical connections for power, controls, and devices.

H. Electrical power and control wiring and connections are specified in Division 26 Sections.

I. 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.

3.5 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:

1. Lubricate bearings.
2. Remove grease lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag.
5. Check piping connections for tightness and leaks. Do not operate pumps with loose or leaking piping connections.
6. Clean strainers.
7. Verify that pump controls are in compliance with contract documents.

D. Starting procedure shall be as recommended by manufacturer. If manufacturer chooses not to provide recommendations the starting procedure shall be as follows:

1. Ensure shafts have been aligned where applicable.
2. Prime pumps by opening suction valves and closing drains.
3. Open cooling water supply valves in cooling water supply to bearings, where applicable.
4. Open sealing liquid-supply valves if pumps are so fitted.
5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
6. Open suction valves.
7. Start motors.
8. Open discharge valves slowly.
9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.
10. Check general mechanical operation of pumps and motors.
11. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING FOR HVAC" to obtain detailed requirements for testing, adjusting, and balancing of hydronic systems.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
2. Review data in maintenance manuals.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 232123

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:

1. Seal all longitudinal joints.
2. Seal all transverse joints.
3. Seal all penetrations.

B. Seal Class: A

C. Test pressure:

1. 3.0" WC for round and flat oval duct.
2. 6.0" WC for rectangular duct.
3. Un-tested: NA

D. Test pressure and maximum leakage for smoke control ductwork:

1. 1.5 times the maximum design pressure and measured leakage not to exceed 5% of design airflow.

E. Testing: Leak test all medium pressure ductwork (From AHU to terminal units).

F. Duct Construction: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" and performance requirements and design criteria indicated in "Duct Schedule" Article.

G. Liner Airstream Surfaces: Liner surfaces in contact with the airstream shall comply with ASHRAE 62.1-2007, paragraph 5.5.

H. Cleanliness: All factory fabricated duct shall be cleaned with a non-toxic, biodegradable cleaner/degreaser and shall be shrink wrapped prior to shipment.

I. Structural Performance: Smoke removal duct hangers, supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005 and ASCE/SEI 7.

1.3 ABBREVIATIONS

A. BAS Building Automation System

B. NRTL Nationally Recognized Testing Laboratory

C. SMACNA Sheet Metal and Air Conditioning Contractors' National Association

D. WC Water Column

1.4 DEFINITIONS:

A. Duct System: For the purposes of this section "duct system" shall mean all metal supply, return, and exhaust duct and fittings between the air moving device and the space.

B. Low Pressure: Plus two (2.0) inches WC to minus one (1.0) inches WC

C. Medium Pressure: More than two (2.0) inches WC to plus ten (10.0) inches WC or more than minus one (1.0) inch to minus ten (10.0) inches WC

D. High Pressure: More than plus or minus ten (10.0) inches WC.

1.5 SUBMITTALS

A. Product Data / Documentation: For each of the following:

1. Sheet metal thicknesses.
2. Liners and adhesives.
3. Pre-manufactured ductwork.
4. Sealants and gaskets.
5. VOC content for adhesives and sealants.

B. CAD-generated Shop Drawings:

1. Provide coordination shop drawings with all trades for entire building including kitchen, laundry and water/mechanical rooms. Include
2. Show fabrication and installation details for metal ducts.
3. 1/4" = 1'-0" scale minimum including duct layout indicating sizes and pressure classes for the following areas:

a. Areas indicated on the drawings at 1/4" = 1'-0" scale.
b. Areas where sections are cut.
c. Finished spaces with exposed ductwork.

1) Exceptions:
a) Janitors closets
b) Storage Rooms

2) Include:

a) Plans, elevations and sections.
b) Elevations of top and bottom of ducts.
c) Dimensions of main duct runs from building grid lines.

4. 3/4" = 1'-0" scale minimum for the following:
a. Hangers and supports, including methods for duct and building attachment, vibration isolation**.**
b. Duct accessories, including access doors and panels.
c. Equipment installation based on approved equipment submittals.
d. Penetrations through fire-rated and other partitions.
e. Fittings.

f. Components.

C. Submittals during construction:

1. Leakage Test Report: Documentation of work performed for compliance with ASHRAE/IESNA 90.1-2007, Section 6.4.4.2.2 - "Duct Leakage Tests."
2. Duct-Cleaning Test Report: Documentation of work performed for compliance with ASHRAE 62.1-2007, Section 7.2.4 - "Ventilation System Start-Up."

1.6 QUALITY ASSURANCE

A. Provide work in compliance with applicable Building Code requirements.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

C. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

D. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

E. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

F. ASHRAE/IESNA Compliance: Comply with applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-1, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-2, "Rectangular Duct/Longitudinal Seams" for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

2.2 LOW PRESSURE SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS – CONCEALED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on specified static-pressure class unless otherwise indicated.

B. Snap-Lock Round Pipe

1. Meet SMACNA Class 3 Leakage standards and SMACNA Seal Class A with external, mastic duct sealant. Provide ASTM A653 galvanized steel, 26 gauge, G-60 coating. Product shall meet pressure rating of -1" wg to +2" wg.
2. Available Manufacturers:
   a. GreenSeam Industries (GreenSeam Plus)

C. Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

D. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

E. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Greater than 48": Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter or Flat Oval with a Major Dimension Less than 48".
3. Flanges may be substituted in ducts smaller than 48" in diameter or Flat Oval with a Major Dimension Greater than 48".

F. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

G. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

H. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90º Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's

"HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

I. All round duct shall not be less than 26-gauge.

2.3 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS –CONCEALED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter: Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
3. Flanges may be substituted in ducts smaller than 48" in diameter.

E. Duct support intervals, and other provisions: In accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

F. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

G. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-5, "90º Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

H. All seam types in Figure 3-2 are acceptable where approved by SMACNA.

I. All round duct shall not be less than 26-gauge.

2.4 LOW PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS - EXPOSED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.

B. Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"

E. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." And the following:

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
3. Flanges may be substituted in ducts smaller than 48" in diameter.

F. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, " Round Duct Longitudinal Seams"

G. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

H. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

I. Longitudinal seams shall be spiral type.

J. All round duct shall not be less than 26-gauge.

2.5 MEDIUM PRESSURE SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS -EXPOSED

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 3, "Round, Oval, and Flexible Duct," "FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS" "SPIRAL SEAM RL-1" to plus-or-minus 10" WC unless otherwise indicated.

B. Manufacturers:

1. Eastern Sheet Metal.
2. Hamlin Sheet Metal.
3. Linx Industries - Lindab.
4. McGill AirFlow LLC.
5. MKT Metal Manufacturing
6. Semco, Inc.
7. Sheet Metal Connectors, Inc.
8. Spiral Manufacturing Co., Inc.

C. Flat-Oval Ducts: Dimensions are the inside duct width (major dimension) and inside diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-1, "Round Duct Transverse Joints"

E. Static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." And the following:

1. Transverse Joints in Ducts Equal to or Larger Than 48" in Diameter or Flat Oval with a Major Dimension Equal to or Larger Than 48": Flanged.
2. Gasketed, EPDM, self-sealing Joints such as Eastern Tight or Spiro Safe may be used for ducts smaller than 48" in diameter.
3. Flanges may be substituted in ducts smaller than 48" in diameter.

F. Longitudinal Seams: Duct shall be spiral according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-2, " Round Duct Longitudinal Seams"

G. Tees and Laterals: Tees and laterals shall be created with fittings. Fabricate fittings according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005." Adjustable elbows are not permitted.

H. Static-pressure class: Applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005."

I. Longitudinal seams shall be spiral type.

J. All round duct shall not be less than 26-gauge.

2.6 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723.

1. Materials: Certified by a NRTL.

B. Tape sealing systems are not permitted.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
12. Service: Indoor or outdoor.
13. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Indoor applications: Sealant with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods: Galvanized, all-thread.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved by Architect in writing.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" unless otherwise indicated.

C. Install ducts with fewest possible joints.

D. Install factory-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically or horizontally, and parallel or perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Maintain clearances for equipment maintenance.

G. Install ducts with a clearance of 1 inch, plus allowance for installation of insulation at specified thickness.

H. Do not route ducts through transformer vaults, electrical equipment rooms, elevator equipment rooms or electrical enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal

flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Provide fire dampers where ducts pass through fire-rated interior partitions, fire-rated exterior walls, fire-rated floor assemblies, or fire-rated shaft enclosures.

K. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 PROTECTION OF WALL AND FLOOR PENETRATIONS OF NON-RATED ASSEMBLIES

A. Where ducts penetrate non-fire-resistance-rated wall or floor assemblies, protect the penetration with one of the following:

1. For a duct that connects not more than two stories vertically, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion.
2. For a duct that connects not more than three stories, protect the annular space around the penetrating duct with an approved, noncombustible material that resists the free passage of flame and the products of combustion and a fire damper at each floor line.
3. For ducts that penetrate a smoke partition without a smoke damper, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.
4. For ducts that penetrate a non-rated wall, protect the annular space around the penetrating duct with an approved, non-combustible materials that resists the free passage of flame and the products of combustion.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding. Do not weld or grind lined ductwork.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of duct, fittings, hangers, supports, accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCT SEALING

A. Seal all ducts to seal class A as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005:

1. Seal all longitudinal joints.
2. Seal all transverse joints.
3. Seal all penetrations.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Chapter 5, "Hangers and Supports."

B. Building Attachments: Unless indicated otherwise, provide 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. Do not use powder-actuated concrete fasteners for lightweight-aggregate concrete or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and channel supports.

E. Support vertical ducts with channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor or at a maximum interval of 18 feet.

F. 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.

G. Insulate hangers to structure where hangers penetrate duct insulation at duct attachment.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005" for branch, outlet, inlet, and terminal unit connections unless otherwise indicated.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply two coats of flat black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Visually inspect, for proper seal application, all ductwork not tested prior to insulation application. Prepare inspection report.

C. Leakage Test. Test ducts with operational pressures greater than 3" WC.

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Prepare a report for each test.
2. Test ducts, disassemble, reassemble, reseal, and retest until leakage class 3 (as defined in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005) is achieved.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested.
6. Give seven days' advance notice to Architect and Owner for testing.

D. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present. If visible contaminants are present, proceed to sub-paragraph 2 below. If not, no further cleaning shall be required.
2. Test sections of metal duct systems, up to one location per ten thousand (10,000) square feet of building area, or a minimum of two (2) per system, whichever is greater, chosen by the Owner's Representative, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems." Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm. Cut hole in duct and install access door at each location selected. Size shall be as indicated in Division 23 Section "Air Duct Accessories."
3. Duct system shall be considered dirty and in need of cleaning if any test location does not pass the cleanliness test. Cleaning shall be performed in accordance with this specification.

E. Prepare and submit test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct systems before testing, adjusting, and balancing.

B. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" dated 2000, for protection, cleaning, and installation methods for all ductwork. Adhere to the requirements for a duct cleanliness level of "C" (advanced level) as detailed in Section 3.11.

3.10 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-2, "Rectangular Elbows."

a. Velocity less than 1500 fpm or lower:

1) Radius Type RE 1. Centerline radius = 3W/2.
2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3) Transfer ducts indicated with mitered elbows do not require turning vanes.

b. Velocity 1500 fpm or Higher:

1) Radius Type RE 3. Centerline radius = 3w/2 and three vanes.
2) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-4, "Round Duct Elbows."

a. Minimum centerline radius-to-diameter ratio shall be 1.5 with a maximum of 5 Elbow Segments. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Table 3-1, "Mitered Elbows." Elbows with less than a 90 degree change of direction shall have segments per Table 3-1 in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005".
b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped, segmented, spiral or pleated. Adjustable elbows not acceptable.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam, segmented, or spiral.

3. Flat Oval Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-7, "Flat Oval Ducts" for elbows.

C. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 4-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Conical or bell mouth. No flanged or spin-in fittings permitted.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005," Figure 3-6, "Conical Tees."

a. Conical fitting.
b. Conical saddle taps.
c. No 90 degree taps or 90 degree saddle taps permitted.

D. Divided Flow Branches:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible, Third Edition 2005, "Figure 4-5 Divided Flow Branches."

3.12 Duct Pressure Classes:

A. Supply ducts from air handling units to terminal units: 3 inches WC.

B. Supply ducts from terminal units to air terminals: 1 inch WC.

C. Return ducts: -1 inch WC.

D. Exhaust ducts: -2 inch WC.

END OF SECTION 233113

233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Radius forming braces
2. Volume dampers.
3. Backdraft dampers
4. Fire dampers.
5. Smoke dampers.
6. Combination fire-smoke dampers.
7. Flange connectors.
8. Duct silencers.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

C. Comply with SMACNA standards for manual airflow regulators (dampers).

1.4 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed. Minimum 1 of each type used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable duct installation methods unless otherwise indicated.

C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a NO 2 finish for concealed ducts and NO 4 finish for exposed ducts.

E. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

F. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches; compatible materials for aluminum and stainless-steel ducts.

2.2 RADIUS FORMING BRACES

A. Available manufacturers:

1. Titus, FlexRight (Basis of Design)
2. Flexible Technologies, Inc., Thermaflex Division, FlexFlow
3. Hart & Cooley, Smart Flow Elbow

B. General: UL-2043 listed or NRTL approved product constructed of metal or plastic manufactured for use with flexible duct to form a kink free elbow using the flexible duct. Any flexible duct used in forming the elbow shall be included in the maximum permitted length. Resulting flexible duct shall comply with SMACNA HVAC Duct Construction Standards.

C. Duct Size: 6" through 16" in diameter.

D. Inside (Bend) Radius: Minimum of one duct diameter along centerline.

E. Attachments: Plastic zip ties or stainless steel worm gear clamps.

F. Support to Overhead: Shall meet SMACNA requirements. Use of specified attachments for support shall not be permitted.

2.3 MANUAL VOLUME DAMPERS

A. Steel, Manual Volume Dampers:

1. Manufacturers:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Elgen Manufacturing.
    d. Greenheck Fan Corporation.
    e. McGill AirFlow LLC.
    f. Nailor Industries.
    g. PCI Industries - Pottorff
    h. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Hat-shaped, 0.094-inch thick galvanized or 0.05-inch stainless-steel, match duct material.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized or stainless-steel channels, match duct material.

6. Blade Axles: Galvanized steel or stainless steel. Dampers over 12" width/diameter shall include continuous axles. Dampers 12" and less may have non-continuous axles. Comply with SMACNA HVAC Duct Construction Standards Metal and Flexible – Third Edition Figure 7-4.

7. Bearings:

    a. Molded synthetic. Provide bearing at both duct wall penetrations.

8. Tie Bars and Brackets: Galvanized steel.

2.4 CURTAIN TYPE FIRE DAMPERS (1½ HOUR)

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.

C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG

D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.

E. Fire Rating: 1½ hours.

F. Frame: Curtain type with blades outside the airstream unless otherwise indicated; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.

G. Sleeve: Factory-installed, galvanized sheet steel.

1. Minimum Thickness: Per UL requirements.
2. Minimum Length: To suit application.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.

J. Horizontal Dampers: Include stainless-steel closure spring.

K. Fusible Link: Replaceable, 165 deg F rated.

L. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing

2.5 CURTAIN TYPE FIRE DAMPERS (3 HOUR)

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by a NRTL.

C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG

D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 2000 FPM.

E. Fire Rating: 3 hours.

F. Frame: Curtain type with blades outside the airstream unless otherwise indicated; fabricated of roll-formed galvanized steel; with mitered and interlocking corners.

G. Sleeve: Factory-installed, galvanized sheet steel.

1. Minimum Thickness: Per UL requirements.
2. Minimum Length: To suit application.

H. Mounting Orientation: Vertical or horizontal as indicated.

I. Blades: Roll-formed, interlocking galvanized sheet steel. In place of interlocking blades, full-length galvanized-steel blade connectors may be used.

J. Horizontal Dampers: Include stainless-steel closure spring.

K. Fusible Link: Replaceable, 165 deg F rated.

L. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

2.6 MULTI BLADE FIRE DAMPERS (1½ HOURS)

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Pressure: Dampers shall have a minimum UL 555 differential pressure rating of 4 in. WG

D. Velocity: Dampers shall have a minimum UL 555 velocity rating of 4000 FPM.

E. Fire Rating: 1½ hours.

F. Frame: Multiple-blade type; fabricated of galvanized steel; with mitered and interlocking corners.

G. Sleeve: Factory-installed, galvanized sheet steel.

1. Minimum Thickness: Per UL requirements.
2. Minimum Length: To suit application.

H. Mounting Orientation: Vertical or horizontal.

I. Blades: Blades: Damper blades shall be galvanized steel. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction. Provide symmetrical blades of varying size as required to completely fill the damper opening.

J. Blade Stops: Locate blade stops at top and bottom of damper frame. They shall occupy no more than ½" of the damper opening area.

K. Bearings: Axle bearings shall be sintered bronze.

L. Horizontal Dampers: Include stainless-steel closure spring.

M. Fusible Link: Replaceable, 165 deg F rated.

N. Retaining Angles: Damper shall be supplied with factory retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

2.7 SMOKE DAMPERS

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.
2. Greenheck Fan Corporation. (Basis of design, provide model SMD-301)
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.

5. PCI Industries - Pottorff
6. Ruskin Company.

B. General Requirements: Rated and labeled according to UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 3000 FPM velocity.

D. Smoke Detector: Provide factory-mounted and -wired smoke detector with smoke damper or provide field-mounted smoke detector installed within five feet of damper. Detector shall be a listed and labeled. Provide normally open contacts for monitoring by the fire alarm system.

1. Minimum Velocity: Zero feet per minute.
2. Maximum Velocity: Three thousand feet per minute minimum.

E. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.

G. Blade edge seals: Silicone rubber.

H. Blade linkage: Out of air stream.

I. Leakage: Class I.

J. Mounting Sleeve: Factory-installed galvanized sheet steel; length to suit wall or floor application.

K. Damper Motor: Two-position.

L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 IN x LBF and breakaway torque rating of 150 IN x LBF.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at 0 degrees F.

M. Accessories:

1. Auxiliary switches for position indication.
2. Damper mounted momentary test switch.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Cesco Products; a division of Mestek, Inc.

2. Greenheck Fan Corporation. (Basis of design, provide model FSD-331)
3. Johnson Controls, Inc.
4. Nailor Industries, Inc.
5. PCI Industries - Pottorff
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by a NRTL.

C. Closing rating in ducts up to 4-inch WC static pressure class and minimum 2000 FPM velocity.

D. Fire Rating: 3 hours or as indicated.

E. Smoke Detector: Provide factory-mounted and -wired smoke detector with smoke damper or provide field-mounted smoke detector installed within five feet of damper. Detector shall be a listed and labeled. Provide normally open contacts for monitoring by the fire alarm system.

1. Minimum Velocity: Zero feet per minute.
2. Maximum Velocity: Three thousand feet per minute minimum.

F. Configuration: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

G. Heat-Responsive Device: Electric resettable link and switch package, factory installed and rated. Provide damper position indicator to indicate open & closed positions.

H. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

I. Bearings: Sintered bronze.

J. Blades: Roll-formed, horizontal, interlocking, 0.07 inch thick, galvanized sheet steel air foil.

K. Blade edge seals: Silicone rubber.

L. Blade linkage: Out of air stream.

M. Leakage: Class II.

N. Mounting Sleeve: Factory installed galvanized sheet steel; length to suit wall or floor.

O. Damper Motors: Two-position.

P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size shall be large enough so driven load will not require motor to operate in service factor.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section "Building Automation System" and Division 28 Sections.
3. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 IN x LBF and breakaway torque rating of 150 IN x LBF.
4. Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Provide motors with internal heaters to permit normal operation at 0 degrees F.

Q. Accessories:

1. Auxiliary switches for position indication.
2. Damper mounted momentary test switch.

2.9 FLANGE CONNECTORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Match connecting ductwork.

D. Gauge: 18, 20, or 24 as recommended by manufacturer or match connecting ductwork.

2.10 DUCT SILENCERS

A. Available Manufacturers:

1. Industrial Noise Control, Inc.
2. Kinetic Noise Control.
3. McGill AirFlow LLC.
4. Price.
5. Ruskin Company.
6. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel, 0.034 inches thick minimum.

D. Round Silencer Outer Casing: ASTM A 653/A 653M, G90, galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inches thick minimum.
2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inches thick minimum.
3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inches thick minimum.
4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inches thick minimum.
5. Inner Casing and Baffles: ASTM A 653/A 653M, G90 galvanized sheet metal, 0.034 inches thick minimum, and with 1/8 inch diameter perforations.

E. Special Construction: Provide high transmission loss to achieve STC 45.

F. Connection Sizes: Match connecting ductwork unless otherwise indicated.

G. Type: Film-lined with fill material.

1. Fill Material: Moisture-proof nonfibrous material.
2. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Flange connections.
2. Suspend units using factory installed suspension hooks or lugs attached to frame spaced to prevent deflection or distortion.
3. Provide cross or trapeze angle reinforcement for rigid suspension.

I. Accessories:

1. Factory-installed end caps to prevent contamination during shipping.

J. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

K. Capacities and Characteristics: Refer to "Duct Silencer Schedule" on drawings

2.11 MANUFACTURED TURNING VANES

A. Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 REMOTE DAMPER OPERATORS

A. Manufacturers:

1. Metropolitan Air Technology.
2. PCI Industries – Pottorff.
3. Ruskin Company.
4. Ventfabrics, Inc.
5. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Operator Mounting Location: As indicated. If not indicated;

1. In airstream terminating at face of diffuser.
2. Outside airstream terminating at round ceiling cup.

3. If multiple diffusers are affected, then in nearest diffuser.

2.13 DUCT-MOUNTED ACCESS DOORS

A. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. Kees
5. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   d. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.14 FLEXIBLE CONNECTORS

A. Do not use on smoke control/management fans. Install on all other fans and fan equipped units even when provided with internal isolation.

B. Available Manufacturers:

1. Ductmate Industries, Inc.
2. Duro Dyne Corporation.
3. Ventfabrics, Inc.
4. Hart & Cooley, Inc.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Connector: Factory fabricated with a fabric strip 3½ to 4½ inches wide attached to 2 strips of 2½ to 4½ inches wide, 23 to 25 gauge "0.0269 to .0209 inch thick" galvanized sheet steel, stainless sheet steel, or aluminum sheets. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double-coated with neoprene.

1. Minimum Weight: 26 oz/sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

G. Outdoor System, Flexible Connector Fabric: Glass fabric double-coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz/sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

H. Thrust Limiters:

1. Field fabricated cable restraints on equipment producing greater than 4.0" WC of positive pressure.
2. Field fabricated cable restraints as detailed. If not detailed; Provide restraint consisting of a 1/16 inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, ½" of movement in the flexible connection is preserved. If flanges are not used, contractor may provide steel, stainless steel, or aluminum angles for attaching cables. Match duct material. Cables shall attach to screw or fastener holding angle to duct and shall be routed through a 3/16" diameter hole in the bracket offset approximately 1" from duct.
3. Direction of connector movement: Parallel with airflow, perpendicular to connector.

2.15 FLEXIBLE AIR DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc. (Basis of design, Provide Type 1M)
2. Thermaflex
3. Hart & Cooley, Inc.

B. Provide bead on connecting duct for sizes greater than 12" in diameter.

C. Maximum Length: 6'-0" unless noted otherwise.

D. Insulated, Flexible Duct: UL 181, Class 1 air duct with vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch WC positive and 1.0-inch WC negative.
2. Maximum Air Velocity: 5000 fpm.
3. Vapor Barrier Permeance: 0.05 perm
4. Temperature Range: Minus 10 to plus 160 deg F.
5. Insulation R-value: 6.0

E. Flexible Duct Connection Accessories:

1. Low pressure (Not up stream of terminal units):
   a. Clamps: Nylon strap in sizes 3 through 20", to suit duct size.
   b. Sheet metal screws: No
   c. Liquid adhesive: No
   d. Tape: Yes

2.16 ACCESSORY HARDWARE

A. Temporary Test Holes: Drilled in duct as required.

B. Permanent Test Holes: Cast iron, or cast aluminum, to suit adjacent material, including cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit wall + insulation thickness.

C. Adhesives: High strength, quick setting, waterproof, and resistant to grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Radius Forming Braces:

1. Connect flexible ducts to diffusers using a radius forming brace or rigid elbow. If using radius forming brace, deduct four duct diameters from the indicated maximum flexible duct length.

D. Volume Dampers:

1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Locate at least two duct diameters from fittings and as far as possible from air outlets.
2. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
3. Set dampers to fully open position before testing, adjusting, and balancing.
    a. Install steel volume dampers in steel ducts.
    b. Install aluminum volume dampers in aluminum and stainless steel ducts.

E. Install fire and smoke dampers where indicated according to UL listing and manufacturer's written instructions.

F. Connect ducts to duct silencers with flexible duct connectors.

G. Turning Vanes:

1. Install turning vanes in all duct elbows larger than 12" in height or width.
2. Exceptions:
    a. Where prohibited by the applicable code, laws, ordinances or local requirements.
    b. Where specifically eliminated by Contract.

H. Provide remote damper operator where manual volume dampers are indicated above inaccessible ceilings.

I. Duct-Mounted Access Doors:

1. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   a. On both sides of duct coils.
   b. Upstream or downstream of duct filters.
   c. At outdoor air intakes and mixed air plenums.
   d. Downstream of control dampers and backdraft dampers.
   e. Adjacent to fire or smoke dampers to allow reset and reinstallation of fusible links. Access doors for fire or smoke dampers having fusible links shall be pressure relief access doors and shall have outward operation for access doors installed upstream of dampers and inward operation for access doors installed downstream of dampers.
   f. Upstream or downstream of duct silencers.
   g. At control devices requiring inspection.
   h. Elsewhere as indicated.

2. Install access doors with swing against duct static pressure except at fire, smoke, and combination fire and smoke dampers.
3. Access Door Size: Largest of the following permitted by duct dimensions:
   a. One-Hand or Inspection Access: 8 by 5 inches.
   b. Two-Hand Access: 12 by 6 inches.
   c. Head and Hand Access: 18 by 10 inches.
   d. Head and Shoulders Access: 21 by 14 inches.
   e. Body Access: 25 by 14 inches.
   f. Body plus Ladder Access: 25 by 17 inches.

4. Label access doors to indicate purpose in accordance with Section 230553 "Identification for HVAC Piping and Equipment."

J. Flexible Connectors

1. Install flexible connectors to connect ducts to equipment- except smoke control/management equipment.
2. Where required, install thrust limiters at all flexible connectors consisting of a 1/16-inch diameter vinyl coated steel cable at 24" maximum on center, attached to flange bolts on each side of flexible connector. Cable length shall be such that, when in tension, 1/2" of movement in the flexible connection is preserved. If flanges are not used, provide steel, stainless steel, or aluminum angles for attaching cables. Match angle material to duct material. Cables shall attach to screw or fastener holding angle and shall be routed through a 3/16" diameter hole in the angle offset approximately 1" from duct.

K. Connect flexible ducts to metal ducts as follows:

1. Low pressure (Not upstream of terminal units):
   a. Clamps: Install in accordance with manufacturer's recommendations.
   b. Tape: Install in accordance with manufacturer's recommendations.
   c. Cable Ties (18 lb. strength): Install in accordance with manufacturer's recommendations.

L. Flexible Ducts

1. Install flexible duct fully extended with no more than 1/2" compression or sag. Do not provide excess length for future relocation of components. Bends shall equal or exceed one duct diameter bend radius based on the inside duct diameter (no sharp corners or

kinks). Tape and mastic for sealing flexible duct to metal fittings shall be listed and labeled to UL Standard 181B. Hanging straps, if used, shall include a saddle to avoid crimping the duct. For ducts 12 inches and smaller in diameter, provide a 3" wide saddle. For ducts larger than 12 inches in diameter, provide a 5" wide saddle.

2. Connect supply ceiling diffusers and return grilles to low pressure supply and/or return ductwork where indicated on drawings with five feet maximum length of flexible duct. Provide a radius forming elbow to support flexible duct at diffuser connection unless noted otherwise. Flexible duct not permitted on exhaust systems.

M. Install rooftop duct supports for all roof-mounted ductwork.

3.2 TESTING AND BALANCING

A. Install permanent test holes at fan inlets and outlets within 6 inches of fan, where indicated, and where necessary for testing and balancing. Test holes not required at outlet of roof-mounted fans.

B. Install temporary test hole plugs in temporary test holes. Repair insulation at temporary test holes.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement without interference.
2. Inspect access doors. Verify that door can be opened and closed. Verify fire damper, and combination fire and smoke damper fusible links can be reset and changed. Verify fire damper, and combination fire and smoke damper doors open in the direction of air pressure (out on supply ducts and in on return and exhaust ducts).
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement, verify non-interference, and verify that the proper heat-response device is installed.
4. Inspect elbows for turning vanes. Verify they are installed where required.
5. Inspect turning vanes using access doors for proper and secure installation.
6. Operate remote damper operators prior to ceiling installation to verify full range of movement of operator and damper. Verify no interference with damper movement.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: Provide manufacturer's technical data for each ventilator including rated capacities, dimensions, required clearances, operating characteristics, mounting requirements, and furnished specialties and accessories. Provide power and control wiring diagrams. Also 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 with required slope and dimensions. Indicate shimming if required.
7. Fan speed controllers.

B. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are indicated and coordinated using input from installers:

1. Plan areas containing a ventilator indicated at 1/4" = 1'- 0" or greater on construction drawings.
2. Areas within 20 feet of section marks indicated on M2 series drawings where such section marks penetrate a ventilator.
3. Structural members to which ventilators will be attached.
4. Related roof openings.
5. Related roof curbs, slope, dimensions, and flashing. Include shimming if required.

C. Operation and Maintenance Data: For ventilators to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for grease (kitchen) hood exhaust shall also comply with UL 762.

1.4 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven fan. Mark belt set with fan ID and turn over to owner's representative.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATOR(S) (DOWNBLAST)

A. Manufacturers:

1. Acme Engineering & Manufacturing Corporation.
2. American Coolair.
3. Twin City Fan & Blower.
4. Greenheck Fan Corporation.
5. Loren Cook Company.

B. Housing: Removable, spun-aluminum dome top and outlet baffle, or extruded-aluminum, rectangular top to direct discharge air downward.

C. Base (Curb Cap): Square, one-piece, aluminum with venturi inlet cone.

D. Hinged Sub-Base: Galvanized steel hinged arrangement permitting service and maintenance.

E. Fan Wheels: Statically and dynamically balanced aluminum hub and wheel with backward-inclined blades matched to inlet cone.

F. Belt Drives (where indicated in Fan Schedule): Comply with the following:

1. Provide drives sized for a minimum of 150% of driven horsepower.
2. Provide resilient mounting to housing.
3. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
4. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
5. Pulleys: Cast-iron, adjustable-pitch motor pulley.

6. Fan and motor isolated from exhaust airstream
7. Belt(s): Provide grip notch belt(s). Provide belt tensioner.
8. Motors and drives:

    a. Mount on vibration isolators.
    b. Draw air for motor cooling into the motor compartment from an area free of discharge contaminants.
    c. Make readily accessible for maintenance.

G. Electrically-Commutated Motor (where direct drive indicated in Fan Schedule):

1. Motor enclosure: Open type.
2. Motor shall be DC electronic commutation type motor (ECM).
3. Motor shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and prewired to the specific voltage and phase.
4. Internal motor circuitry to convert AC power supplied to fan to DC power to operate motor.
5. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

H. Overload (Running) Protection:
1. Provide motor overload protection as a requirement of this section.
2. Provide motor overload protection as recommended by the manufacturer
3. Comply with the Section 230513 "Motors for HVAC Equipment"

I. Wind-band: Join to curb-cap with leak-proof continuously welded seam.

J. Accessories:

1. Provide disconnect switch.
2. Provide removable, 1/2-inch mesh, aluminum or brass wire bird screen.
3. Provide parallel-blade dampers mounted in fan base or duct with normally closed electric actuator wired to close when fan stops. Actuator shall not be required to fail closed.
4. Motorized Backdraft Damper(s): Provide damper(s) with electric actuator(s) wired to close when fan stops and open with fan is on. Actuator voltage shall match fan motor voltage. Where matching actuator and fan voltage is not possible, fan manufacturer shall provide transformer to produce compatible voltage to actuator. Wiring of fan and backdraft damper actuator(s) shall be by Division 26.
5. Provide roof curb. Refer to Roof Curb Paragraph below.

2.2 MOTORS

A. Refer to section "Common Motor Requirements for HVAC Equipment."

B. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Size shall be as indicated. If not indicated, provide motor large enough to drive load and avoid operation in service factor range above 1.0.

2. Controls: Provide controllers, electrical devices, and wiring to comply with requirements specified in Division 26 Sections.

C. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to 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. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

2.4 ROOF CURB:

A. Minimum Height from Top of Roof Insulation for Non-Grease Fans: 12".

B. Slope: Match structure. Top of curb shall be level and each edge shall be flush with other edges on all sides.

C. Curb Material: Match material of power ventilator located on roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install HVAC Power Ventilators level and plumb.

B. Secure roof-mounted fans to roof curbs with security fasteners. Refer to Section "Roof Accessories" for other installation requirements for roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 0.5 inches.

E. Install units with clearances for service and maintenance.

F. Label units.

G. Kitchen Hood Fans:

1. Install roof-mounted exhaust fans with fan discharge a minimum of 40" above the finished roof surface. Outlet shall be not less than 10 feet horizontally from parts of the same building and adjacent buildings. Outlet shall be not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building.
2. Install sidewall exhaust fans not less than 10 feet above adjoining grade level. Outlet shall be not less than 10 feet horizontally from or not less than 3 feet above air intake openings into any building. Termination shall not be located where protected openings are required and shall not be located within 3 feet of exterior openings.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that Shipping blocking and bracing are removed.
2. Verify that unit is secure and 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. For belt drive units 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 belts, adjust belt tension, and install belt guards.
5. Adjust damper linkages & operators for proper damper operation.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control, fire, smoke, and fire/smoke dampers in connected ductwork systems are in a fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm.
9. 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.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.3 TESTING, ADJUSTING, BALANCING, AND LUBRICATION

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section "Testing, Adjusting, and Balancing for HVAC".

C. Replace fan and motor pulleys to achieve design airflow.

1. Disable automatic temperature-control operators, energize motor and adjust fan to required rpm.
2. Measure and record RPM.
3. Measure and record motor voltage and amperage.

D. Re-lubricate bearings.

END OF SECTION 233423

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

1. Seismic Hazard Level A: Force to weight ratio = 0.48.
2. Seismic Hazard Level B: Force to weight ratio = 0.30.
3. Seismic Hazard Level C: Force to weight ratio = 0.15.

1.3 ABBREVIATIONS

A. BAS Building Automation System.

B. CFM Cubic Feet per Minute.

C. ECM Electronically Commutated Motor.

D. PSIG Pounds per Square Inch Gauge.

E. PSC Permanent Split Capacitor

F. SCR Silicon Controlled Rectifier.

G. VA Volt Amps. (A measure of transformer power)

1.4 SUBMITTALS

A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.
4. Seismic restraint devices.

C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.
3. Hangers and supports, including methods for duct and building attachment, bracing, and vibration isolation.

D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 SHUTOFF AIR TERMINAL UNITS

A. Manufacturers:

1. Anemostat Products.
2. MetalAire, Inc.
3. Nailor Industries, Inc.
4. Price Industries.
5. Titus.
6. Trane.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

Casing: Double wall galvanized sheet steel.

1. Sheet Metal Thickness: Manufacturer's standard.
2. Insulation: Adhesive attached 1", fiberglass liner having a maximum flame spread index of 25 and a maximum smoke developed index of 50.
3. Lining: Manufacturer's standard galvanized steel inner liner.
4. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment. Provide flexible connector.
5. Air Outlet: S-slip and drive connections. Provide flexible connector.
6. Access: Removable panels with airtight gaskets for access to parts requiring service, adjustment, or maintenance.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Damper Position: Normally open.

D. When indicated provide a Hydronic Heating Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1", tested at 300 PSIG and rated for a minimum working pressure of 200 PSIG at a maximum entering-water temperature of 220° F. Include manual air vent and drain valve.

E. Factory mounted and wired components:

1. Electrical components mounted in control box with removable cover. Incorporate single point electrical connection to power source.
2. Control Transformer: 50 VA minimum factory mounted transformer for control voltage. Input voltage shall match the circuit provided. Coordinate output voltage with contractor performing work under Section "Building Automation System". Provide terminal strip in control box and field wiring of BAS unit controller to terminal strip. Wiring shall be as indicated.
3. Wiring Terminations: Fan and controls to terminal strip. Terminal lugs to match quantities, sizes, and materials of branch-circuit conductors and BAS requirements. Enclose terminal lugs in terminal box sized according to NFPA 70.
4. Disconnect Switch: Factory mounted fused.

F. Control Sequence:

1. As indicated in Section "Sequences of Control."

2.2 HANGERS AND SUPPORTS

A. Hanger Rods: Cadmium-plated steel rods, neoprene 1/8" thick washers and nuts.

1. Vibration isolation washers should be used on both sides of threaded rod attachment to box to prevent vibration transmission to structure.

B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

A. Label each air terminal unit with tag, nominal airflow, maximum and minimum factory-set airflows, coil type if coil is included, and ARI certification seal.

B. For hydronic coils include hose kit and control valve shrink wrapped and labeled with terminal unit tag.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. 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 equal to or more than 4" thick.
4. Do not use powder actuated concrete fasteners for lightweight aggregate concretes and for slabs less than 4" thick.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Install piping adjacent to air terminal unit 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. Connect ducts to air terminal units according to division 23 duct specification sections for metal and flexible ducts.

D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with tag, nominal airflow, and maximum and minimum factory set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs/labels.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, mounting details, and performance data including throw, drop, static pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, AND REGISTERS

A. Manufacturers:

1. Anemostat.
2. Carnes.
3. Krueger.
4. MetalAire, Inc.
5. Nailor Industries.
6. Price Industries.
7. Titus.
8. Tuttle & Bailey.

B. General:

1. All trim pieces shall be mechanically fastened. Friction fit trim rings/frames shall not be provided or shall be mechanically fastened in the field. Fasteners shall not be visible.
2. Finish:
    a. Powder-coated or baked enamel, white, unless noted otherwise.
    b. For sidewall-mounted inlets and outlets, provide finish suitable for field painting where indicated (color shall be selected by Architect) or provide anodized clear finish where indicated.
    c. Finish for Exposed Ductwork: Where ductwork is exposed, inlets and outlets mounted in exposed ductwork shall be factory primed for field painting.

3. Filter Grille Mounting Frame: Shall accept a 2" deep MERV 8 (30%) pleated media filter. Refer to Section "Particulate Air Filtration" for filter requirements. Provide two sets of filters for each filter grille.
4. Mounting: As indicated in schedule or match condition indicated.

C. Linear Slot Diffuser Plenums

1. Linear slot diffuser plenums shall be fully insulated. Provide one of the following:
   a. Factory-installed, internal fiberglass insulation on sides and end caps.
   b. Factory-installed, external aluminum foil-backed insulation.
   c. Field-installed external insulation on plenums not factory-insulated. Refer to Section 230700 HVAC Insulation.

D. Ceiling Diffusers

1. Ceiling diffuser backpans shall be externally insulated. Provide one of the following:
   a. Factory-installed with foil/scrim vapor barrier insulation with an R-value of six.
   b. Field-installed external insulation on backpans not factory-insulated. Refer to Section 230700 HVAC Insulation.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Install diffusers, registers, and grilles flush with ceiling unless otherwise indicated.

C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Install in locations indicated as much as practical. For units installed in lay-in ceiling panels, center units

in both directions in panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

D. Linear Slot Diffuser Installation: Adjust each slot diffuser so half the slots throw horizontally along the ceiling in each direction unless indicated otherwise. For linear slot diffusers above windows at building perimeter, one half of the total slots at each diffuser shall be adjusted to throw air vertically downward to wash window, and the other half of the slots shall be adjusted to throw air horizontally across ceiling unless indicated otherwise.

E. Diffusers, registers and grilles shall be supported independently of the ceiling system and shall not be supported from conduit, piping or unrelated ductwork.

F. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233723 - HVAC GRAVITY 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. Section Includes:

1. Louvered-penthouse ventilators.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on wind speeds as indicated on Structural Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

E. Tested in accordance with and passes TAS 201 (Large Missile Impact), TAS 202 (Uniform Static Air Pressure) and TAS 203 (Cyclic Wind-Loading).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of louvered-penthouse ventilator indicated, in manufacturer's standard size.

F. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

D. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVERED-PENTHOUSE VENTILATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acme Engineering & Mfg. Corporation.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry.
5. Twin City Fan Co.

B. Construction: All-welded assembly with louvers, mitered corners, and aluminum sheet roof.

C. Frame and Blade Material and Nominal Thickness: Extruded aluminum, of thickness required to comply with structural performance requirements, but not less than 0.080 inch (2.0 mm) for frames and 0.060 inch for blades with condensate deflectors.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.
   1. Overall Height: 12" above roof on all sides minimum.

E. Bird Screening: Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.041-inch (1.04-mm) wire Aluminum, 1/2-inch- (12.7-mm-) square mesh, 0.063-inch (1.6-mm) wire.

F. Sheet Finish:

   1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
   2. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat and an overall minimum dry film thickness of 2 mils (0.05 mm).

      a. Color and Gloss: As selected by Architect from manufacturer's full range to match roof color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723

SECTION 234100 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 DEFINITIONS

A. Construction Filter: A filter maintained during construction to protect ductwork from construction dust, dirt, and debris. Construction filters shall be removed temporarily during balancing and permanently after the building is occupied.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated include dimensions, required operating clearances, required access clearances, and weights.

B. Operating Characteristics: For each type of product indicated provide rated flow capacity, initial and final pressure drop at rated flow capacity.

C. Efficiency: For each type of product indicated efficiency/MERV rating and test method.

D. Fire Classification: For each type of product indicated provide the fire classification.

E. Specialties and Accessories: For each type of product indicated provide furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

B. Replace all permanent filters with new filters of types specified.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Comply with applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality"; Section 5 - "Systems and Equipment"; and Section 7 - "Construction and Startup."
2. Comply with ASHRAE 52.1 for arrestance and ASHRAE 52.2 for MERV for methods of testing and rating air-filter units.

C. Comply with NFPA 90A and NFPA 90B.

1.6 COORDINATION

A. Coordinate sizes and locations:
1. Within air handling units.
2. On open return ducts during construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Air Filters, and Filter-Holding Systems:

a. 3M.
b. Airguard.
c. American Air Filter Company, Inc. Flanders.
d. Camfil USA.
e. Columbus Industries, Inc.
f. Koch Filter Corp.

2. Filter Gages:

a. Airguard Industries, Inc.
b. Dwyer Instruments Inc.

2.2 GENERAL FILTERS

A. For return filter grilles, general filtration, and construction filters provide the following:

1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
2. Thickness: Unless otherwise indicated thickness shall be 2".
3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.

6. Farr 30/30 or equal.

2.3 PRE-FILTERS

A. Where pre-filters are indicated and for construction filters provide the following:

1. Media: Cotton and synthetic pleated with an average efficiency of 25-30% and an average arrestance of 90-92% in accordance with ASHRAE test standard 52.1-1992.
2. Thickness: Unless otherwise indicated thickness shall be 4".
3. Media Support Grid: Welded wire on 1" centers with 96% free area bonded to the media.
4. Filter Frame: High wet strength cardboard with diagonal support members bonded to the media on the entering side and exiting side of each pleat.
5. Holding Frame: Galvanized steel with metal grid on outlet side, polyurethane gaskets, and spring fasteners.
6. Farr 30/30 or equal.

2.4 FINAL FILTERS (PLEATED TYPE)

A. Where pleated final filters are indicated, provide the following:
1. Description: Factory-fabricated, self-supported, extended surface, pleated, panel type, disposable air filter with holding frames.
2. Obtain all filters from single source from single manufacturer.
3. Minimum Efficiency Reporting Value: MERV 13 according to ASHRAE 52.2.
4. Thickness: Match filter rack size of equipment or as indicated.
5. Cotton or synthetic fibers coated with nonflammable adhesive.
6. Frame: Cardboard frame with perforated metal retainer sealed or bonded to media.

2.5 INSTALLATION

A. Position each filter with clearance for normal service and maintenance.

B. Install filters to prevent passage of unfiltered air.

C. Do not operate fan system until filters are in place. During construction, all ductwork must be protected from dirt and debris. Remove filters used during construction and testing. Replace all filters in units with new filters of types specified.

D. Unit operation during construction:

1. Install minimum MERV 8 construction filters to protect all return ductwork from dirt and debris. Supply fan shall operate at all times.

E. Unit not operating during construction:

1. Install plastic sheet material over all supply and return openings to protect all ductwork from dirt and debris.
2. Fans shall be off.

F. Construction filter installation: Adhere all edges of filter with metal foil peel-n-stick tape having an acrylic adhesive.

2.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Check for leakage of unfiltered air while system is operating.

B. Air filter and installation will be considered defective if they do not pass.

C. Prepare a report for each filter.

2.7 TESTING AND BALANCING

A. Immediately prior to testing and balancing, install new filters of the same type that shall be permanently installed.

2.8 CLEANING

A. After construction ends and prior to occupancy, and with all interior finishes installed, clean unit filter housings and install new filters.

END OF SECTION 234100

SECTION 237313 - MODULAR INDOOR CENTRAL STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 ABBREVIATIONS

A. ABMA American Bearing Manufacturers Association. (www.abma-dc.org)

B. ANSI American National Standards Institute. (www.ansi.org)

C. AHU Air Handling Unit.

D. AHU's Air Handling Units.

E. BAS Building Automation System.

F. CFM Cubic Feet per Minute.

G. HP Horsepower.

H. PSIG Pounds per Square Inch Gauge

I. VFD Variable Speed Drive.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unit length.

1.4 SUBMITTALS

A. Pre-submittal Meeting: A representative of the manufacturer producing equipment being provided under this section of the specifications shall attend a meeting for the purpose of coordinating with the contractor performing work under section "Building Automation System". The meeting shall be held at a location of the Contractor's choosing. The Contractor shall arrange the meeting. Submittals shall be essentially complete at the time of the meeting so detailed coordination items can be discussed.

B. Product Data: For each air-handling unit.

1. Unit dimensions, layout, and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:
   a. Certified fan-performance curves with system operating conditions indicated.
   b. Certified fan-sound power ratings.
   c. Fan construction and accessories.
   d. Motor ratings, electrical characteristics, and motor accessories.
4. Certified coil-performance ratings with system operating conditions indicated.
5. Valves, including bodies, linkages, mounting, and operators.
6. Dampers, including housings, linkages, mounting, and operators.
7. Filters with performance characteristics. Refer to Division 23 section "Particulate Air Filtration".
8. Documentation indicating that units comply with ASHRAE 62.1-2013, Section 5 - "Systems and Equipment."

C. Shop Drawings:

1. Detail equipment assemblies, include:
   a. Internal components
   b. Dimensions
   c. Weights
   d. Loads
   e. Supports
   f. Required clearances.
2. Provide method of field assembly.
3. Indicate:
   a. Components
   b. Location
   c. size of each field connection
4. Provide Wiring Diagrams for:
   a. Power
   b. Control
5. For AHU Support comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for support selection.
   a. Calculations: Calculate requirements for selecting vibration isolation, seismic restraint where required**,** and for vibration isolation.
   b. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   c. Restraint: Detail fabrication and attachment of restraints. Indicate anchorage details, quantity, diameter, and connections.

D. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Mechanical-room layout and areas indicated on "M" drawings at ¼"=1'-0" or greater.
2. Areas where
3. Relationships between components and adjacent structural and mechanical elements.
4. Support location, type, and weight.
5. Field measurements.

E. Operation and Maintenance Data: For AHUs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," Provide the following:

1. After successful completion of testing & balancing, or commissioning provide the following:
   a. Completed Inspection & Testing form.
   b. Record copy of site-specific software on DVD.
   c. Maintenance, Inspection and Testing Records including, may not be limited to, the following:
      1) How to test installed components.
      2) Frequency of testing of installed components.
      3) Frequency of inspection of installed components.
      4) Manufacturer's user training manuals.
2. Manufacturer's required maintenance related to system warranty requirements.
3. Software and Firmware Operational Documentation:
   a. Software operating and upgrade manuals.
   b. Program Software Backup: On magnetic media or compact disk, complete with data files.
   c. Device address list.
   d. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Comply with applicable requirements of ASHRAE 62.1-2013, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2013 Compliance: Comply with applicable requirements of ASHRAE/IESNA 90.1-2013, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. NFPA 70 Compliance: Comply with NFPA 70.

G. The assembled air handling unit shall bear a label, seal, or identifying mark of a nationally recognized testing laboratory or inspection agency.

1.6 COORDINATION

A. Coordinate sizes and locations of Housekeeping Pads with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to provide labor and materials to remove and replace components of AHU's that fail in materials or workmanship within three (3) years from the date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Buffalo Air Handling.
2. Carrier
3. Daikin Applied.
4. Engineered Air.
5. Environmental Air Systems, LLC (EAS).
6. TMI Climate Solutions.
7. Trane.
8. YORK/Johnson Controls, Inc.
9. VTS America Inc.

2.2 UNIT CASINGS

A. Unit manufacturer shall ship unit in segments as specified by the contractor for ease of installation in tight spaces. The entire air handler shall be constructed of galvanized steel except for the cooling coil casing. Casing finished to meet ASTM B117 250-hour salt-spray test. The removal of access panels or access doors shall not affect the structural integrity of the unit. All removable panels shall be gasketed. All doors shall have gasketing around full perimeter to prevent air leakage. Contractor shall be responsible to provide connection flanges and all other framework that is needed to properly support the unit.

B. Casing performance:
1. Casing air leakage shall not exceed 1% leakage at 8 inches w.g.
2. Air leakage shall be determined at a casing static pressure of 8 inches w.g. Specified air leakage shall be accomplished without the use of caulk. Total estimated air leakage shall be reported for each unit in CFM, as a percentage of supply air, and as an ASHRAE 111 Leakage Class.
3. Under 55F supply air temperature and design conditions on the exterior of the unit of 81F dry bulb and 73F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available,

AHU manufacturer shall provide, in writing to the Engineer and Owner, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying units in the field should external condensate form on them. In lieu of AHU manufacturer providing a written guarantee, the installing contractor must provide additional external insulation on AHU to prevent condensation.

4. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

C. Floor panels shall be double-wall construction and designed to support a 300-lb load during maintenance activities and shall deflect no more than 0.0042 per inch of panel span.

D. Unit casing panels shall be 2-inch double-wall construction, with solid galvanized exterior and solid galvanized interior, to facilitate cleaning of unit interior.

E. Unit casing panels (roof, walls, floor) and doors shall be provided with a minimum thermal resistance (R-value) of 13 Hr*Ft2*°F/BTU.

F. Unit casing panels (roof, walls, floor) and external structural frame members shall be completely insulated filling the entire panel cavity in all directions so that no voids exist. Panel insulation shall comply with NFPA 90A.

G. The fan section shall have perforated panels for sound attenuation.

H. Casing panel inner liners must not extend to the exterior of the unit or contact the exterior frame. A mid-span, no-through-metal, internal thermal break shall be provided for all unit casing panels.

I. Access panels and/or access doors shall be provided in all sections to allow easy access to drain pan, coil(s), motor, drive components and bearings for cleaning, inspection, and maintenance.

J. Access panels and doors shall be fully removable without the use of specialized tools to allow complete access of interior surfaces. The cooling coil access door shall be provided with a UV light rated window for visual inspection of the UV light system.

K. General Fabrication Requirements for Casings:

1. Material:

   a. External Casing: Galvanized steel.
   b. Internal Casing Upstream of Cooling Coil: Galvanized steel.
   c. Internal Casing Downstream of Cooling Coil: Stainless steel.

2. Forming: Form walls, roofs, and floors with a minimum of two breaks (Bends) at each joint.
3. Casing Joints: Casing Joints shall be made with sheet metal screws or rivets.
4. Sealing: Seal all joints with water-resistant sealant.
5. Factory Finish for Casings: Apply anti-microbial coating.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements of ASHRAE 62.1-2013.

L. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071.

2. Location and Application: Encased between outside and inside casing.

M. Condensate Drain Pans:

1. Fabricated of stainless steel or other non-ferrous material (i.e. plastic) with two percent slope in a minimum of two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers to positively direct water towards drain connection.

   a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2013.
   b. Depth: Minimum 2".

2. Pans may be Formed sections or integral part of floor plating.
3. Pan shall be double-wall, stainless-steel sheet or other non-ferrous material (i.e. plastic) with space between walls filled with foam insulation. Provide a moisture-tight seal.
4. Drain Connection: Locate at lowest point of pan and size to prevent overflow. Terminate with threaded nipple.

   a. Minimum Connection Size: 1".
5. Units with stacked coils shall have intermediate drain pan(s) to collect condensate from upper coil(s).

N. Condensate Drainage: The air handling units shall use Trent Technologies model CXXBV condensate drain. Air handling unit manufacturer shall coordinate and provide factory openings in the casing to support the CXXBV condensate drain. Contractor shall provide kit and field install condensate drain in accordance with Trent Technologies installation instructions.

O. Air-Handling-Unit Mounting Frame: Formed structural steel channel supports with integral lifting lugs.

2.3 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Fan and drive shall be statically and dynamically balanced and designed for continuous operation up to the maximum-rated fan speed and motor horsepower.

1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.

   a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
   b. Designed to operate at no more than 70 percent of the first critical speed at the top of the fan's speed range.

B. Fan Housings: Formed and reinforced galvanized steel panels to form curved scroll housing with shaped cutoff and spun-metal inlet bell.

1. Bracing: Galvanized steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Horizontal-Flanged, Split Housing: Bolted construction.
3. Housing Attachment: Attach housing to fan-section casing with metal-edged flexible duct connector.

C. Plenum Fan Housings: Steel frame and panel; fabricated without fan scroll and volute housing.

2.4 FANS

A. Fan(s): Fan is direct drive plenum fan. Provide with permanently lubricated, motor installed on an adjustable fan base resiliently mounted in the casing. Provide aluminum wheel and steel scroll.

B. Fan Motor(s): Refer to section "Common Motor Requirements for HVAC Equipment."

C. Fan Shaft Bearings:

1. Prelubricated and Sealed, Ball Bearings: Self-aligning, pillow-block type with a rated life of 120,000 hours according to ANSI/ABMA 9

Or

2. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ANSI/ABMA 11.

D. Fan Sound-Power Levels:
1. Fans shall meet or create lower sound power levels than those indicated.
2. Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

E. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

F. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices.

G. Motor: Refer to Division 23, Section "Common Motor Requirements for HVAC Equipment."

2.5 VARIABLE SPEED DRIVES:

A. All motors shall be suitable for use with a variable speed drive. Variable speed drives shall be supplied by Division 230900. The AHU manufacturer shall wire the fan motors to an exterior

junction box on the AHU casing for field connection. Wiring shall have terminal connections. Wire nuts are not acceptable.

2.6 COILS

A. Water Coils: Factory tested to 300 PSIG according to ARI 410 and ASHRAE 33.

2.7 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410 & ASHRAE 62.1.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service, maintenance, and cleaning of coil(s).
3. For multizone units, provide air deflectors and air baffles to balance airflow across coils without reliance on dampers.
4. Coils shall not act as a structural component of the unit.

2.8 AIR FILTRATION SECTION

A. Required sections: Provide filter sections indicated.

B. Provide differential pressure indicator (manometer) for all filter banks. Mark on the indicator for "clean" and "replace filter" points.

C. Position: Final-filter shall be downstream of pre-filter

D. Refer to Division 23, Section "Particulate Air Filtration"

2.9 DAMPERS

A. General Requirements for Dampers: All dampers shall be Tamco Series 9000 SW, thermally broken. (No Substitutions) Where unit manufacturer cannot factory mount dampers, contractor shall field install dampers.

B. Outdoor Air Damper(s): Modulating opposed blade damper.

C. Mixing Damper(s): Modulating opposed blade dampers. Dampers shall be positioned such that airflows collide to promote mixing.

D. Damper Motors:

1. Fail closed.
    a. Exceptions:
        1) Supply air damper shall fail open.
        2) Return air damper shall fail open.
2. Modulating operation unless two-position is indicated.

3. Adjustable minimum position.

2.10 AIR FLOW MEASURING STATIONS

A. Refer to Division 23 Section "Building Automation System" for specific air flow measuring station requirements.

B. Locate airflow measuring stations as indicated. If not indicated locate airflow measuring stations as follows:

1. In the outdoor air intake duct between the intake louver and unit.

2.11 ELECTRICAL CONNECTIONS

A. General:

1. All electrical work shall be installed in full compliance with the National Electric Code and all local codes and requirements.
2. Where applicable, components shall bear UL listed, UL recognized, or ETL listing marks.
3. All wiring and components inside air handling plenums shall be weatherproof and rated for such use.

B. Routing:

1. Conduit
   a. All wiring shall be run in EMT conduit utilizing compression type fittings.
   b. All conduit in wet sections (including but not limited to outdoor air intakes and cooling coil sections) shall be rigid aluminum.
   c. All conduit penetrations in the unit housing and penetrations across air seal and insulated walls shall be internally sealed airtight with caulk to prevent the migration of water vapor in the conduit.
2. Conductors: All power conductors to be 600V rated, copper MTW, THHN, or THWN.
3. Shipping Splits:
   a. A junction box shall be provided at each shipping-split to aid in field connection of wiring.
   b. All conductors servicing circuits 300V or less shall be spliced with wire nuts at each shipping split.
   c. All conductors servicing circuits greater then 300V shall be pulled back to the shipping split nearest to the component served. Alternatively, circuits may be spliced with the aid of panel mounted terminal blocks rated for the voltage and current of the application. Other means of splicing are not permitted.
4. Boxes, Enclosures, and Cabinets:
   a. All boxes, enclosures and cabinets exposed to the outdoor environment shall be NEMA 3R rated.
   b. All boxes, enclosures, and cabinets exposed to the indoor environment shall be NEMA 1 rated.
5. Motors:

a. Each fan motor shall be wired to a VFD located on the exterior of the unit.
b. Motor wiring to each motor shall be in separate conduits. Wiring multiple motors within the same conduit, wireway, or trough is not permitted.
c. Each wheel motor shall be wired to a motor starter located on the exterior of the unit.
d. Control wiring shall not be located in the same conduit(s) as power wiring.

6. Lighting: Each access section of the unit shall be provided one vapor-proof marine light fixtures wired a common 120V feed location. Lighting shall be controlled with 20A rated, 2-way w/ pilot light switches.

2.12 ULTRAVIOLET LIGHT SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Fresh-Aire UV.
2. UV Resources.

B. General: Provide UVC lamp system to cover entire cooling coil and drain pan.

C. Door Interlock Switch: Provide door interlock switch to disable UV system if the air handler door is opened.

D. Install lamps in accordance with manufacturer's instructions for proper coverage of the entire coil and drain pan.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

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

3.2 INSTALLATION

A. Floor Mounted Units: Install air-handling units on housekeeping pads without vibration isolation devices. Secure units as indicated or required by unit manufacturer. When securing is indicated or required secure to anchor bolts installed in housekeeping pad.

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

C. Place units in locations indicated and provide access space around air-handling units for service and maintenance.

D. Do not operate unit until temporary filters are in place.

E. Provide filter gauges with static pressure taps upstream and downstream of filters. Mount filter gauges on unit filter housings or filter plenums in accessible and visible locations. Refer to Division 23, Section "Meters and Gauges for HVAC Piping" for gauge requirements.

3.3 FIELD QUALITY CONTROL

A. Whether or not use of equipment is otherwise permitted, startup service, tests, and inspections must be complete prior to running unit. Failure to perform startup service, tests, and inspections prior to running equipment shall grant the owner's representative authority to have the units/equipment removed from the site at the Contractor's expense. This paragraph shall not be construed to grant the Contractor permission to use the unit(s)/equipment specified in this section of the specifications.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. Leak Test: After installation, fill water and steam coils completely with water. Connect gauge and fill valve. Pressurize to 150 PSIG with air. Visually check for water leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
3. Charge refrigerant coils with refrigerant and connect gauges. Use light that will show refrigerant leak and visually check for leaks. Pressure shall hold with no visible loss for 120 minutes (2 hours). Fix leaks.
4. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Replace or repair faulty equipment.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. AHU's or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.4 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. Verify that unit is secure on mountings and supporting devices and connections to piping, ducts, and electrical systems are complete.
2. Verify that proper thermal overload protection is installed in motors, controllers, and switches.
3. Disconnect fan drive system. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operation. Reconnect fan drive system, align and adjust belts to proper tension.
4. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
5. Verify that the energy recovery wheels are within factory tolerances and that all seals are set to minimize air leakage.
6. Verify that dampers fully open and close.
7. Inspect dampers for proper stroke.
8. Inspect damper blades and seals for visible defects.
9. Inspect coil fins. Comb damaged coil fins for parallel orientation.
10. Verify that proper thermal overload protection is installed for electric coils.
11. Install new filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
13. Verify that smoke dampers in connected duct system fully close when unit is deactivated.
14. Inspect for visible damage to unit casing.
15. Inspect coils, and fans for visible damage.
16. Inspect internal casing for visible damage.
17. Verify that labels are clearly visible.
18. Verify that clearances have been provided for servicing.
19. Verify that controls are connected and operable.
20. Remove packing from vibration isolators.
21. Inspect fan wheel for operation without vibration and binding.
22. Start unit according to manufacturer's written instructions.
    a. Start cooling system.
    b. Do not operate below recommended ambient temperature.
    c. Complete startup sheets and attach 1 paper, and one "universally readable" electronic copy on USB flash drive, with startup report. Maintain a copy in electronic format, file type Portable Document Format (*.TXT, *.DOC, *.RTF, & *.PDF) file formats are acceptable. The file format must be one of those listed or the Owner and Architect must own a computer and software capable of reading the electronic file.
23. Inspect and record performance of interlocks and protective devices.
24. Verify sequence of operation.
25. Operate unit for an initial period as recommended or required by manufacturer.
26. Calibrate sensors including thermostats.
27. Adjust and inspect high-temperature limits.
28. With unit operating start cooling system, measure, and record the following when the ambient temperature is a minimum of 85° F:
    a. Coil leaving air, dry and wet bulb temperatures.
    b. Coil entering air, dry and wet bulb temperatures.
    c. Return air, dry and wet bulb temperatures.

d. Outdoor air, dry and wet bulb temperatures.

29. 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/exhaust air volume.
    d. Record relief/exhaust airflow station reading in CFM from BAS head end.
    e. Outdoor air intake volume.
    f. Record outdoor air intake airflow station reading in CFM from BAS head end.

C. Starting procedures for AHU's shall include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated CFM. Provide one set of pulleys (one for fan and one for motor) to achieve indicated CFM.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 CLEANING AND ADJUSTING

A. Occupancy Adjustments: Within 12 months of the date of Beneficial Occupancy, provide up to two (2) on site visits, during normal or other than normal occupancy hours as requested by owner, to assist in adjusting system.

B. After completing testing, adjusting, and balancing clean AHU's internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, filters.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237313

SECTION 238126 – DUCTLESS MINI-SPLIT AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ductless mini-split air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Evaporator fan units are designed for ceiling or wall mounting. The compressor-condenser unit shall be remote and located on the roof where indicated on the Drawings.

1.3 DEFINITIONS

A. Evaporator-Fan Unit: The part of the ductless mini-split air-conditioning unit that contains a coil for cooling and a fan to circulate air to conditioned space.

B. Compressor-Condenser Unit: The part of the ductless mini-split air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant.

1.4 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. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For ductless mini-split air-conditioning units to include in maintenance manuals specified in Division 1.

D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of ductless mini-split units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered.

B. Units shall be tested by a Nationally Recognized Testing Laboratory and shall bear the ETL label.

C. All wiring shall be in accordance with the governing version of the National Electrical Code.

D. Units shall be rated in accordance with ARI Standard 210 and bear the ARI Certification label.

E. Units shall be precharged with refrigerant for 70 feet of refrigerant tubing.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2010.

1.6 COORDINATION

A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Sheet Metal, Flashings and Roofing Accessories."

1.7 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. Warranty Period: One year from date of Substantial Completion. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. Warranty does not include labor.

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. Daikin Applied.
   2. Liebert Corporation.
   3. LG.
   4. Trane/Mitsubishi Electric.

2.2 WALL-MOUNTED, EVAPORATOR-FAN COMPONENTS

A. The evaporator section shall be designed to be wall-mounted by means of a factory supplied mounting plate. Air distribution shall be integral to the wall-mounted unit.

B. Cabinet and Chassis: Cabinet shall be high strength molded plastic with front panel access for the filter. Cabinet color shall be white. Include drain pan with drain connection. Indoor unit shall be factory assembled, wired and tested. Contained within unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wall mounted controller shall have a self-diagnostic function, three minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant piping shall be purged with dry nitrogen before shipment from the factory.

C. Refrigerant Coil: Evaporator coil shall be nonferrous construction with pre-coated aluminum fins on copper tubing. All tube joints shall be brazed with silver alloy. Coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

D. Fan and Motor: Evaporator fan shall be double inlet, forward curved, direct drive fan with a single motor. The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall have two speeds: low and high.

E. Vane: Unit shall include a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall significantly decrease downward air resistance for lower noise levels and shall close when unit stops.

F. Filters: Return air shall be filtered with a removable and washable filter.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. General: Outdoor unit shall be the same capacity as the indoor unit and include a control board that interfaces with the indoor unit to perform all necessary operation functions. Outdoor unit shall be capable of operating at 0˚F ambient temperature without additional low ambient controls. Outdoor unit shall be able to operate with a maximum height difference of 100 feet from indoor unit to outdoor unit and a maximum refrigerant tubing length of 165 feet between the indoor and outdoor unit without the need for line size changes, traps, or additional oil

B. Casing: Casing shall be galvanized steel plate coated with an electrostatically applied thermally fused acrylic or polyester powder coating. The fan grille shall be ABS plastic.

C. Compressor: The compressor shall be a DC rotary compressor with variable compressor speed inverter technology. The compressor shall be driven by inverter circuitry to control compressor speed. Compressor speed shall be varied to match space load. Outdoor unit shall include an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

D. Refrigerant Coil: Condenser coil shall be copper tubing with aluminum fins. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be controlled by a microprocessor-controlled step motor.

E. Fan: The fan motor bearings shall be permanently lubricated. The fan shall have horizontal discharge airflow. The fan shall be mounted in front of the coil. The fan shall include a raised guard to prevent contact with moving parts.

2.4 ACCESSORIES

1. Control: The control system shall be microprocessor-based and include one microprocessor on the outdoor unit and one on the indoor unit. Wall-mounted controller shall a have a liquid crystal display indicating operating status and alarm condition and shall include a temperature sensor. A membrane keypad shall be included for program control and set point adjustment.
2. The controller shall consist of On/Off button, increase/decrease set temperature buttons, a cool/dry/fan mode selector, timer menu button, timer on/off button, set time buttons, fan speed selector, vane position selector, a ventilation button, a test run button, and a check mode button.
3. The controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub-cooling and discharge super heat.
4. Normal operation of the controller shall provide individual system control in which one controller and one indoor unit are installed in the same room.
5. The control voltage from the controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.
6. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

B. Refrigerant Line Sets: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends. Pre-charge line sets in proper lengths for application. Final length shall be field verified. Refrigerant line sets shall be complete with filter dryers, sight glasses. Refrigerant line sets shall be in accordance with ASME B31.5. All tubing shall be in accordance with Section 1107 of the North Carolina Mechanical Code.

C. Refrigerant piping shall be evacuated to 29.5 inches (water) gauge for 24 hours prior to charging with refrigerant.

D. Factory-installed and –wired disconnect to be provided under this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, firmly anchored, in accordance with the manufacturer's written recommendations.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted compressor-condenser components on equipment supports specified in Division 7 Section "Sheet Metal, Flashings and Roofing Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Install compressor-condenser components on Elastomeric pads. Refer to Division 15 Section "Vibration Control for HVAC."

E. Connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect condensate drain piping. Unit drain shall be internally trapped.

C. Install piping adjacent to unit to allow service and maintenance.

D. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.

E. 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. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. 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.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 COMMISSIONING

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that units are installed and connected according to the Contract Documents.

C. Lubricate bearings, adjust belt tension, and change filters.

D. 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

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
2. Review data in maintenance manuals. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 238126

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Provisions of the Contract and of the Contract Documents apply to this Section.

1.2 SUMMARY

A. This Section includes fan-coil units and accessories.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Closeout Procedures," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

E. Warranty: Special warranty specified in this Section.

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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2007 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Coil-Unit Filters: Furnish one spare filter for each unit.
2. Fan Belts: Furnish one spare fan belt for each unit installed.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS

A. Available Manufacturers:

1. AE Air.
2. Daikin Applied.
3. Price Industries.
4. Trane.
5. York / Johnson Controls.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

D. Drain Pans: Stainless steel. Fabricate pans and drain connections to comply with ASHRAE 62.1-2007.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

H. Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
   1. Motor: Refer to Division 23 Section "Common Motor Requirements for HVAC Equipment."
      a. Type: ECM.

I. Control devices and operational sequence are specified in Division 23 Sections "Building Automation System" and "Sequence of Operations."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

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

3.2 INSTALLATION

A. Install units level and plumb.

B. Install units to comply with NFPA 90A.

C. Suspend units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

   1. Install piping adjacent to machine to allow service and maintenance.

2. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

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."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219

SECTION 25 08 00 COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 01 91 13 – Commissioning General Requirements

C. Section 22 08 00 – Commissioning of Plumbing Systems

D. Section 23 08 00 – Commissioning of HVAC Systems

E. Section 26 08 00 – Commissioning of Electrical Systems

F. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 25 responsibilities and participation in the commissioning process. All contractors responsible for Division 25 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Integrated Automation Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 01 91 13 Section 1.3 – Definitions. The trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Controls Contractor(s) are responsible for integrated automation systems installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 25 specification sections. Controls Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 01 91 13. Neither Section 01 91 13 - Commissioning General Requirements nor Section 25 08 00 – Commissioning of

Integrated Automation Systems shall relieve the Controls Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 25 08 00 – Commissioning of Integrated Automation Systems shall not relieve the Electrical Contractor(s) or Telecommunications Contractor(s) from any obligations set forth within Division 1, Division 26, Division 27, including Section 01 91 13 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Controls Contractor(s): The term Controls Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 25 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 25 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 25 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Controls Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Controls Contractor(s) shall be required to fulfill all requirements set forth within Specification 25 08 00 Section 1.5 – Roles and Responsibilities. Additionally, the Controls Contractor(s) shall be required to fulfill all requirements set forth within Specification 01 91 13.

B. Through the Commissioning Process, the Controls Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Controls Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 25

of the specifications. See Specification 01 91 13 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; HVAC, sheet metal, pipe and fitting, controls, test and balance, plumbing, chemical treatment and fire protection contractors whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Controls Contractor(s) shall be required to fulfill all requirements described within Specification 01 91 13 Section 1.4 – Roles and Responsibilities.

D. Controls Contractor(s)

1. General Requirements:

a. Include all cost to complete commissioning requirements for Integrated Automation Systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 01 91 13 Section 2.2 – Schedule of Values.

b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.

c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.

d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule

a. Prepare a Preliminary Schedule for Integrated Automation Systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional and Functional Performance Tests. Coordination of the commissioning activities and their integration into the schedule shall be conducted within the Commissioning Meetings.

b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, equipment start-up, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

a. Comply with all Submittal requirements as outlined within Specification 01 91 13 Section 2.3 – Submittals.

b. Comply with all requirements as outlined within Specification 01 91 13 Section 2.5 – Start-Up and Test Reports.

c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

1) General construction progress and status reports

2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs

3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent

4) Pre Start-Up and Start-Up procedures

5) Value Engineering Proposals and a list of all accepted VE items

6) Pressure Test Reports, Flushing Reports and Start-Up Reports

7) Construction document changes resulting from mechanical Requests for Information

4. Pre-Functional Checklist Requirements:

a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 01 91 13 Section 2.4 – Pre-Functional Checklists.

b. Complete Pre-Functional Checklists on all mechanical equipment and system components installed or provided by the Mechanical Contractors(s).

c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, so that witnessing Equipment and System Start-Up can begin.

d. Provide written notification to the Commissioning Agent for each system listed in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and Systems Start-Up

a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

6. Functional Performance Test Requirements:

   a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 01 91 13 Section 2.6 – Functional Performance Tests.

   b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 01 91 13 Section 2.8 – Test Equipment.

   c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)

   d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent, demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests.

   e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB Verification shall occur in conjunction with Functional Performance Testing.

   f. Cancellation or delays of any system tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 01 91 13 Section 3.6-A.

7. Training Requirements:

   a. Comprehensive training of O&M personnel shall be performed by the Controls Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.

   b. The Training Schedule is to be coordinated and completed by the Controls Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.

   c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.

d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-out Requirements:

a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.

b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.

c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.

d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Automatic Controls and Building Automation System Contractor(s):

1. Comply with all requirements as outlined within Specification 25 08 00 Section 1.5 Sub-Section D – Controls Contractor(s).

2. Review design for controllability with respect to selected equipment:

3. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.

4. Verify proper safeties and interlocks are included in design.

5. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.

6. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.

7. Verify proper selection of sensor ranges.

8. In addition to all other submittal requirements outlined with in Specifications 01 91 13 and 25 08 00, provide the following submittals to the Commissioning Agent:

a. Hardware and software submittals

b. Control panel construction shop drawings

c. Narrative description of each control sequence for each piece of equipment controlled.

d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access, superimposed on diagrams of the physical equipment.

e. Logic diagrams showing the logic flow of the system.

f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.

g. A complete control language program listing, including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should also explain individual math or logic operations that are not clear from reading the software listing.

h. Application software and project applications code manuals.

i. Operations and Maintenance Staff comments on the BAS Graphics Submittal. Include all Controls Contractor responses

9. Verify proper installation and performance of controls / BAS hardware and software provided by others.

10. Issue a Statement of Calibration for each system which states that all system points and interfaces have been properly calibrated and adjusted.

11. Provide controls graphics submittals to the Commissioning Agent and to the Owner and Owner's Maintenance Personnel for approval. Do not proceed with controls graphics programming without integration of the Owner's Maintenance Personnel comments.

12. Provide thorough training to operating personnel on hardware operations and programming, and the application program for the system.

13. Demonstrate system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency).

14. Provide control system technician for use during system verification and functional performance testing.

15. Provide system modifications as required.

16. Provide support and coordination with TAB contractor on all interfaces between their scopes of work. Provide all devices, such as portable operator's terminals, for TAB use in completing TAB procedures.

17. The Controls Contractor(s) shall provide trending as required to confirm, disconfirm or correct any deficiencies identified during Commissioning. Specific trend logs will be required to facilitate the commissioning process and documentation of Functional

Performance Testing. The Commissioning Agent will provide the list of systems and points for trending.

F. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 25 08 00 Section 1.5 Sub-Section D – Controls Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for Equipment Manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of Commissioning Documentation. The Commissioning Documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The Commissioning Documentation shall include the following which is to be maintained by the Contractor(s):

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component test: Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session

Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 01 91 13 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Controls Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Controls Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Controls Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Controls Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Controls Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 25. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Controls Contractor(s). Controls Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Controls Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Controls Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC's or FPT's at a rate of $85/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager's Application for Payment. The Construction Manager will then back charge the party responsible for the test's failure. It is the Contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Controls Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 01 91 13-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 01 91 13-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. HVAC Contractor(s) - provide the services of a technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

2. Controls Contractor - provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.

D. Documentation and Reporting Requirements

1. Any contractors with responsibilities related to the equipment to be installed, i.e. HVAC, electrical, TAB, controls, Construction Manager, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

E. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 25 08 00

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cerro Wire LLC.
2. General Cable; General Cable Corporation.
3. Southwire Company.
4. Encore Wiring Corporation.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M.
2. Hubbell Power Systems, Inc.
3. ILSCO.
4. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Branch Circuits Concealed in Casework: FMC conduit may be used to feed to outlet boxes fish concealed in built-in casework. Route cable supported tight in upper inside corners of casework, not in conflict with drawers or cabinet doors.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

H. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

I. Whips from Junction Box Concealed in Ceilings to Lighting Fixtures:
   1. Type FMC conduit, with minimum #12AWG copper THHN/THWN and full size equipment grounding conductor. Maximum whip length 72".
   2. FMC shall be supported within 24" of fixture connection so that whip is not in contact with ceiling or grid. Securing to fixture support wires with batwings is acceptable but not to ceiling support wires.
   3. Do not connect fixture whips from fixture to fixture (daisy chain). No more than 4 whips shall be connected to any one junction box.

J. All single-phase circuits shall include a dedicated neutral (grounded) and grounding conductor, unless specifically noted otherwise.
   1. The intent of this is to eliminate multiwire branch circuits and allow disconnection of one circuit without requiring disconnection of other(s) as would be required to comply with

NEC 210.4(B). Per NEC 310.15(B)(b) each of these neutral (grounded) conductor is not considered to be load-bearing so derating is not required.

K. Contract drawings are based upon a maximum of 3 current-carrying conductors in a conduit. Contractor may rework indicated circuitry to install a maximum of (6) L-N circuits (120 or 277V) in a single conduit. There shall be no more than 2 each A, B, C phase conductors per homerun. Each shall have dedicated neutral (grounded) conductor.
   1. Do not group L-L circuits in a homerun, unless specifically indicated on the drawings.
   2. Where there are more than 3 current-carrying conductors in a conduit, derate conductor ampacities in accordance with NEC Table 310.15(B)(2)(a).
   3. When running more than 3 ungrounded conductors in a raceway, increase size of conduits beyond those indicated in contract documents, as required to not exceed NEC Chapter 9, Table 1 conduit-fill requirements. As-built drawings shall clearly indicate which circuits are grouped in homeruns.

L. Unless otherwise indicated, minimum conductor size shall be 12 AWG.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078400 " Firestopping."

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Cables will be considered defective if they do not pass tests and inspections.

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. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Galvan Industries, Inc.; Electrical Products Division, LLC.
4. ILSCO.
5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturer's recommended material.

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 below grade.
2. Ductbank Grounding Conductor: Bury 12 inches above ductbank 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 equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches 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, and down; 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 AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.

3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. 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.

D. 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.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical

service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches 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.

D. 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.

E. 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 bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

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 apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer 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.

4. 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.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

G. 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 260529 - HANGERS AND SUPPORTS 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 the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. 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. Cooper B-Line, Inc.; a division of Cooper Industries.
b. ERICO International Corporation.
c. Thomas & Betts Corporation.
d. Unistrut; an Atkore International company.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface. These are to be used only where specifically indicated on the drawings.

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. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Hilti, Inc.
3) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Division 9 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Part 2 of this section includes material requirements for all raceways and boxes that may or may not be used on the project. Part 3 of this Section defines where a given type of product shall be or is permitted to be utilized.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allied Tube & Conduit.
2. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
3. Robroy Industries.
4. Thomas & Betts Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:

a. Material: Steel.
b. Type: Compression

2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. AFC Cable Systems, Inc.
2. Electri-Flex Company.
3. RACO; Hubbell.
4. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Fittings for LFNC: Comply with UL 514B.

I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application..

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

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. MonoSystems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EGS/Appleton Electric.
2. Erickson Electrical Equipment Company.
3. Hoffman; a brand of Pentair Equipment Protection.
4. Hubbell Incorporated.
5. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
6. RACO; Hubbell.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal.

2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

L. Gangable boxes are allowed.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

2.6 FLOOR BOXES AND SERVICE FITTINGS

A. Basis of Design: Wiremold, RFB4 Series Floor Boxes.

1. Floor boxes mounted on first floor grade shall be manufactured from cast-iron and be approved for use on grade and above grade floors. The box shall be 14 1/2" L x 11 7/8" W x 3 7/16" H. There shall be four independent wiring compartments that allow capacity for up to four duplex receptacles and/or communication services. The RFB4-CI-1 Series Box shall permit tunneling from adjacent or opposite compartments. Two of the four compartments shall have a minimum wiring capacity of 27 cu in., and two compartments shall have a minimum wiring capacity of 36 cu in.. The box shall provide the following number of conduit hubs: four 1" and four 1 1/4". The box shall be fully adjustable, providing a maximum of 1 7/8" pre-pour adjustment, and a maximum of 3/4" after-pour adjustment. Wiremold RFB4-CI-1.

2. Activation covers shall be manufactured of die-cast aluminum or die-cast zinc, and be available in a brushed aluminum finish, plated brass finish, or a powder-coated paint finish. The activation cover shall be listed by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood, and carpet covered floors. The floor box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices within the box.

3. Activation covers shall be available in flanged and flangeless versions of cast aluminum with aluminum, black, bronze, brass, nickel or gray finish. Covers shall be available with options for tile or carpet inserts, flush covers, or furniture feed. Flanged covers shall be 7 3/4" L x 6 9/16" W. Flangeless covers shall be 6 3/4" L x 5 9/16" W.
   a. Unless indicated otherwise, provide the following cover configurations:
      1) Power/Telecom Outlets: Brushed aluminum flanged with blank lid flush with floor and NO carpet/tile cutouts.
      2) Furniture Floor Feed: Brushed aluminum flanged with 1" trade size screw plug opening and one combination 1 1/4" and 2" trade size screw plug openings.

2.7 POKE-THRU ASSEMBLIES

A. Basis of Design: Wiremold, Evolution Series Poke-Thru Device

1. Recessed Outlet Poke-Thru Devices: 8AT Poke-Thru Devices.

2. Poke-thru devices provide an interface between power, communication and audio/visual (A/V) cabling in an above grade concrete floor and the workstation or activation location where power, communication and/or A/V device outlets are required. These devices provide recessed device outlets that will not obstruct the floor area.

3. 8AT Poke-Thru Assembly: Poke-thru device assemblies shall consist of an insert and an activation cover. Assembly length: 16-3/4 inches (425mm).

4. Insert: Insert body shall recess the devices a minimum of 2-3/4 inches (69mm) and have a polyester based backing enamel finished interior; ivory color. Furnish with necessary

channels to provide complete separation of power and communication services. Provide five (5) compartments that allow for up to five (5) duplex receptacles that can be wired as a standard receptacle or isolated ground and/or 22 communication ports and/or 16 AV devices.

a. Body consists of an intumescent firestop material to maintain fire rating of the floor slab. Hold intumescent material securely in place in insert body. Intumescent material will not have to be adjusted to maintain fire rating of the unit and the floor slab. Provide insert with a retaining feature to hold the poke-thru device in the floor slab without additional fasteners. Poke-thru insert shall also consist of a 3/4-inch trade size conduit stub that is connected to the insert body and a 24.5 cu in (402ml) stamped steel junction box for wire splicing and connections. Stamped steel junction box shall also contain the means necessary to electrically ground the poke-thru device to the system ground.

5. Activation Cover: Manufactured of die-cast aluminum alloy; finished in powder-coated black. Provide with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub water tightness. Activation cover is 9-1/4 inches (235mm) in diameter. Provide cover with spring-loaded slides to allow cables to egress out of the unit and maintain as small an egress opening as possible.

6. Communication Modules Mounting Accessories: Provide activation unit with three locations to mount communication connectors. Mount connectors using a mounting bracket capable of accepting up to 12 Category 6 insert modules or Category 6 discrete keystone connectors. Also provide unit with two (2) Category 6 discrete keystone connectors and two (2) industry standard keystones and accommodate a mechanism to permit protection of communication cabling. Fabricate mechanism from stamped steel construction. Mechanism shall accept both flexible and rigid 3/4-inch, 1-1/4-inch or two-inch trade size conduit.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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. Armorcast Products Company.
b. Carson Industries LLC.
c. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency accredited by the NCBCC (North Carolina Building Code Council) or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Schedule 80-PVC, direct buried, U.N.O..
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: GRC.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

    a. Repair Bays
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

d. Engine/Transmission Lab

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
8. Underground/In-Slab: GRC

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. All conduit to be installed on exterior masonry shall not run continuously within the wall cavity.

I. Support conduit within 12 inches of enclosures to which attached.

J. Raceways Embedded in Slabs:

1. Are not permitted, except as required for entry into recessed floor boxes.
2. Conduits run below slab on ground floor level shall be buried within the porous fill and stub-up at the required location. Transition from RNC to RGS with RGS elbow before rising above the floor. After RGS elbow, stub-up conduit shall be type indicated in Part 3.1 above.
3. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to GRC before rising above floor.

K. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

R. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements and also refer to Architectural elevations. Install boxes with height measured to center of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
3. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
4. Underground Warning Tape

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line, below grade.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078400 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

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. Metraflex Company (The).
c. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

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. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install 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.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's

wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-

laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

2.4 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,.

C. Warning Tape:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils.
3. Foil Core Thickness: 0.35 mil.
4. Weight: 28 lb/1000 sq. ft..
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
1. Warning labels and signs shall include, but are not limited to, the following:
    a. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

b. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
c. Arc Flash Hazard Warning: Refer to Section 260574 for requirements.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.

5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways and Ductbanks, more Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Cables within Buildings: Provide engraved laminated phenolic nameplates. Nameplates shall be securely attached to equipment using self-tapping stainless steel screws. Letters shall be 1/2" high except where resultant nameplate size exceeds equipment size. Nameplate lettering may be adjusted accordingly with approval of engineer. Nameplate material colors shall be:

1. Blue surface with white core for 120/208V equipment.
2. Black surface with white core for 277/480V equipment.
3. Bright red surface with white core for all equipment related to fire alarm system.
4. Dark red (burgundy) surface with while core for all equipment related to security.
5. Brown surface with white core for all equipment related to data systems.
6. White surface with black core for all equipment related to paging systems.

C. Pull and Junction Boxes: All pull and junction boxes shall have their covers and exterior visible surfaces painted/labeled with colors to match the surface color scheme outlined in above section "Accessible Raceways and Cables within Buildings".

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

    a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:

        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.
        4) Grounded (Neutral): White.
        5) Ground: Green.

    c. Colors for 480/277-V Circuits:

        1) Phase A: Brown.

2) Phase B: Orange.
3) Phase C: Yellow.
4) Grounded (Neutral): Gray.
5) Ground: Green.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

F. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes or self-adhesive, self-laminating polyester labels with the conductor designation.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Adhesive film label with clear protective overlay. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchboards.
    e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    f. Emergency system boxes and enclosures.
    g. Enclosed switches.
    h. Enclosed circuit breakers.
    i. Enclosed controllers.

j. Variable-speed controllers.
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Power-generating units.
p. Monitoring and control equipment.
q. UPS equipment.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EDSA Micro Corporation.
2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
9. Motor horsepower and NEMA MG 1 code letter designation.
10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Customer owned medium voltage primary supply termination point.
2. Incoming switchgear/main panelboard.
3. Control panels.
4. Standby generators and automatic transfer switches.
5. Branch circuit panelboards.
6. Disconnect switches.
7. Elevator controller

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 FIELD MARKING

A. Provide at all equipment listed in 3.2(F) with the date the fault-calculation was performed.

1. Provide field marking at elevator controller with available short-circuit current at its line terminals.

B. Marking shall be of sufficient durability to withstand the environment involved.

3.5 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary

submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. The following parts from the Protective Device Coordination Study Report:

1) One-line diagram.
2) Protective device coordination study.
3) Time-current coordination curves.

b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing

laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

    a. Phase and Ground Relays:

        1) Device tag.
        2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3) Recommendations on improved relaying systems, if applicable.

    b. Circuit Breakers:

        1) Adjustable pickups and time delays (long time, short time, ground).
        2) Adjustable time-current characteristic.
        3) Adjustable instantaneous pickup.
        4) Recommendations on improved trip systems, if applicable.

    c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

    a. Power utility's overcurrent protective device.
    b. Medium-voltage equipment overcurrent relays.
    c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

f. Cables and conductors damage curves.
g. Ground-fault protective devices.
h. Motor-starting characteristics and motor damage points.
i. Generator short-circuit decrement curve and generator damage point.
j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.
7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).

16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.
17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.4 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

    1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EDSA Micro Corporation.
2. Power Analytics, Corporation.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

3.4 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 01 91 13 – Commissioning General Requirements

C. Section 23 08 00 – Commissioning of HVAC Systems

D. Section 25 08 00 – Commissioning of Integrated Automation Control Systems

E. Section 27 08 00 – Commissioning of Communication Systems

F. Section 28 08 00 – Commissioning of Electronic Safety and Security Systems

G. Commissioning Plan

1.2 DESCRIPTION OF WORK

A. The purpose of this section is to specify the Division 26 responsibilities and participation in the commissioning process. All contractors responsible for Division 26 installation or other activities shall have commissioning responsibilities described herein.

B. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Electrical Systems, which are a part of this project.

C. Commissioning shall be a team effort to ensure that all electrical equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, equipment start-up, controls calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team is defined in Specification 01 91 13 Section 1.3 – Definitions. The electrical trades represented on the Commissioning Team shall include but not be limited to; electrical, lighting, fire alarm, telecommunications, security, and third party electrical testing agencies. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

E. Electrical Contractor(s) are responsible for electrical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 26 specification sections. Electrical Contractor(s) are responsible for coordination, observation,

and verification of commissioning as defined in this section and Section 01 91 13. Neither Section 01 91 13 - Commissioning General Requirements nor Section 26 08 00 – Commissioning of Electrical Systems shall relieve the Electrical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 26 08 00 – Commissioning of Electrical Systems shall not relieve the Electrical Contractor(s) from any obligations set forth within Section 01 91 13 – Commissioning General Requirements.

1.3 DEFINITIONS

A. Electrical Contractor(s): The term Electrical Contractor(s) utilized herein refers to any and all subcontracting companies or venders whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Subcontracting parties outside of the scope of the systems being commissioned or outside of the scope of Division 26 are not included.

B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies whom are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.

1.4 SCOPE OF WORK

A. The Electrical Contractor(s) shall be required to Commission all equipment, components and accessories of each of the commissioned systems as outlined within Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning. In order to accomplish a complete commissioning process, the Electrical Contractor(s) shall be required to fulfill all requirements set forth within Specification 26 08 00 Section 1.5 – Roles and Responsibilities. Additionally, the Electrical Contractor(s) shall be required to fulfill all requirements set forth within Specification 01 91 13.

B. Through the Commissioning Process, the Electrical Contractor(s) shall accomplish thorough documentation, organized scheduling and coordination, detailed installation verification, and detailed system functional verification. For this, the Electrical Contractor(s) must cooperate and coordinate with the Commissioning Agent.

1.5 ROLES AND RESPONSIBILITIES

A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company or vender whom is responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26

of the specifications. See Specification 01 91 13 Section 1.3 – Definitions for the definition of the Commissioning Team.

B. Contracting companies providing members shall include but not be limited to; electrical contractor, lighting contractor, telecommunications contractor, security system contractor, fire alarm contractor, and third party electrical test agencies whose responsibilities are defined herein.

C. In addition to all roles and responsibilities defined herein, all Electrial Contractor(s) shall be required to fulfill all requirements described within Specification 01 91 13 Section 1.4 – Roles and Responsibilities.

D. Electrical Contractor(s)

1. General Requirements:

a. Include all cost to complete commissioning requirements for electrical systems in the contract price. Contractor costs shall be reflected within the Schedule of Values as specified within Specification 01 91 13 Section 2.2 – Schedule of Values.

b. Ensure cooperation and participation of specialty Contractors and Sub-Contractors.

c. Ensure participation of major Equipment Manufacturers in appropriate start-up, testing and training activities.

d. Attend Commissioning Meetings for construction phase coordination as scheduled by the Commissioning Agent. Additionally, attend the Commissioning Kick-Off Meeting as scheduled by the Commissioning Agent.

2. Commissioning Schedule

a. Prepare a Preliminary Schedule for electrical systems and equipment, including component installation, start-up and checkout, and system start-up. Integrate commissioning activities into this Preliminary Schedule including Pre-Functional Checklists and Functional Performance Tests. Coordination of the commissioning activities and their integration into the schedule shall be conducted within the Commissioning Meetings.

b. Update the Preliminary Schedule and submit a Final Schedule which shall reflect all items within the Preliminary Schedule and shall also include but not be limited to: inspections, O&M manual submission, training sessions, feeder testing, ground system testing, equipment and component NETA testing, Coordination Study completion and implementation, equipment energizing, and task completion. All Contractor(s) shall integrate schedule activities into one complete Final Schedule which shall be reflected within the Construction Manager's/General Contractor's overall project schedule. The Final Schedule shall be continuously updated throughout the Construction Phase.

3. Submittal Requirements:

a. Comply with all Submittal requirements as outlined within Specification 01 91 13 Section 2.3 – Submittals.

b. Comply with all requirements as outlined within Specification 01 91 13 Section 2.5 – Start-Up and Test Reports

c. Provide the following documentation to the Commissioning Agent for the purpose of construction updates:

1) General construction progress and status reports

2) Updated Architect, Owner, System Design Professional, and Contractor deficiency logs

3) Minutes from all construction and coordination meetings not otherwise conducted by the Commissioning Agent

4) Pre Start-Up and Start-Up procedures

5) Value Engineering Proposals and a list of all accepted VE items

6) Coordination Studies, Manufacture Inspection Reports, Authority Having Jurisdiction Inspection Reports, etc.

7) Construction document changes resulting from electrical Requests for Information

4. Pre-Functional Requirements:

a. Detailed installation verification shall be performed on all installed equipment and systems to ensure that the installations conform to the contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Pre-Functional Checklists. The creation, distribution, completion and maintenance of Pre-Functional Checklists are detailed in Specification 01 91 13 Section 2.4 – Pre-Functional Checklists.

b. Complete Pre-Functional Checklists on all electrical equipment and system components installed or provided by the Electrical Contractors(s).

c. Notify the Commissioning Agent a minimum of two weeks (14 days) in advance, so that witnessing Equipment and System Start-Up can begin.

d. Provide written notification to the Commissioning Agent for each system listed in Specification 01 91 13 Section 1.5 – Systems to be Included in Commissioning, that the system installation is complete in its entirety and that the system is fully operational, online, and ready for Functional Performance Testing.

5. Equipment and System Start-Up

a. Perform all initial check-out and start-up procedures as outlined within the specifications and as per the Equipment Manufacturer's recommendations. Provide full documentation of all start-up and check-out procedures and results. Documentations is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist.

b. Perform all feeder tests, ground system tests, infrared scanning and any other system component test required by the specifications requiring a 3rd party test agency. Provide full documentation of all tests procedures and results. Documentation is to be submitted to the Commissioning Agent in conjunction with the associated Pre-Functional Checklist. Some tests and inspections may be required to be witnessed and documented by the Commissioning Agent. For these tests and inspections, follow the procedures outlined in this Specification, Section 1.5-D-6 – Functional Performance Test Requirements.

c. Perform all Testing requirements for electrical components. Submit copies of the Testing Report to all interested and reviewing parties as required by the specifications and to the Commissioning Agent. Also, submit a copy of the preliminary Testing documentation including the Testing Plan, Forms and Report format to the Commissioning Agent for review and approval.

6. Functional Performance Test Requirements:

a. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents, local and applicable codes, and standard practice. This shall be accomplished through the completion of Functional Performance Tests. The creation, distribution and completion of Functional Performance Tests are detailed in Specification 01 91 13 Section 2.6 – Functional Performance Tests.

b. Provide all appropriate equipment and materials as necessary to execute and complete all Functional Performance Tests. Comply with all requirements as outlined within Specification 01 91 13 Section 2.8 – Test Equipment.

c. Provide appropriate technicians for participation during system verification and functional performance testing. Technicians shall demonstrate equipment as-installed condition and system performance to Commissioning Agent including all modes of system operation (e.g. normal, abnormal, emergency, etc.)

d. Verify all functional performance tests prior to requesting test witness by the Commissioning Agent. Demonstrate all Functional Performance test tasks in the presence of the Commissioning Agent and assist the Commissioning Agent in all verification and functional performance tests. Equipment and component conditioning tests, such as resistance tests, overpotential test, turns-ratio tests, etc.) are not required to be performed prior to requesting test witness by the Commissioning Agent.

e. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Agent for verification or diagnostic purposes. Typically, TAB

Verification shall occur in conjunction with Functional Performance Testing. Electrical TAB requirements will include but not be limited to measuring and recording all electrical motor data; voltage, current, frequency, rotations per minute, power consumption, etc.

f. Cancellation or delays of any electrical tests or Functional Performance Testing upon the day of that particular scheduled test, due to lack of preparation or status of installation shall be considered a failed test due to the additional time required by the Commissioning Agent to witness electrical testing. These additional tests shall be treated in accordance with Specification 01 91 13 Section 3.6-A.

7. Training Requirements:

a. Comprehensive training of O&M personnel shall be performed by the Electrical Contractor(s) and Equipment Manufacturer(s) prior to turnover of the systems to the Owner. Training shall include but not be limited to classroom instruction and hands-on instruction of the installed equipment and systems.

b. The Training Schedule is to be coordinated and completed by the Electrical Contractor(s). The Training Schedule is to be updated and maintained as construction progresses. The Training Schedule and all updates shall be coordinated with and approved of by the Owner.

c. Contractor(s) responsible for the installation or provision of any piece of equipment or system shall attend, at minimum, the initial training session for that equipment or system.

d. All Training Documentation shall be assembled and organized in a binder or set of binders. Coordinate with all other Contractor(s) to provide one complete bound Training Record. This requirement shall not be negated, unless other specific complete Project Training Record requirements, encompassing ALL project training documentation, is outlined elsewhere within the specifications.

8. Close-Out Requirements:

a. Remedy all deficiencies identified during commissioning. Provide all materials, equipment, labor, etc. to accomplish these remedies.

b. Provide a complete set of Record Documents (As-Built Drawings and Specifications) to the Architect and/or Design Professional as required by the project specifications.

c. Provide a complete set of O&M Manuals and Project Training Record to the Architect and/or Design Professional as required by the project specifications.

d. Provide a complete copy of Equipment and System Warranties to the Architect and/or Design Professional as required by the project specifications.

E. Equipment Manufacturer(s):

1. Comply with all requirements as outlined within Specification 26 08 00 Section 1.5 Sub-Section D – Electrical Contractor(s).

2. Assist in scheduling of training sessions. Provide training of Owner's Maintenance Personnel with adequacy required for full comprehension of equipment and maintenance procedures.

3. Review installation for manufacturer's specific requirements. Verify safeties, limits, relays and all other equipment specific settings are correct. Verify these settings optimize equipment performance and efficiencies.

4. Perform, approve and document all start-up services as outlined within the specifications for each piece of equipment, component and accessory. Perform all standard manufacturer services as outlined on manufacturer supplied forms. Additionally, perform all other requirements specifically called for within the project specifications, not otherwise performed in a manufacturer standard startup service. Provide additional documentation for these services on forms with manufacturer's letterhead.

5. Demonstrate performance of equipment as required within Functional Performance Tests.

F. Third Party Electrical Test Agencies

1. Comply with all requirements as outlined within Specification 26 08 00 Section 1.5 Sub-Section D – Electrical Contractor(s).

2. Certified Third Party Test Agency shall perform all electrical tests as required by the specifications and as outlined within the Functional Performance Test procedures.

3. Testing Agency shall provide all equipment, components and accessories required for testing.

4. Functional Performance Tests for all power equipment, components and accessories shall follow NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems. Electrical Contractor(s) shall notify the Commissioning Agent prior to any testing being performed by the Certified Third Party Test Agency with a minimum of two weeks (14 days) notice.

5. Testing Agency shall notify the Commissioning Team of all deficiencies and un-safe conditions existing within these systems. If predominant un-safe conditions exist it shall be the responsibility of the Third Party Testing Agency to terminate testing to be continued at a later date.

1.6 DOCUMENTATION

A. The Commissioning Agent shall oversee and maintain the development of commissioning documentation. The commissioning documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The commissioning documentation shall include, but not be limited to, the following:

1. Start-Up and Check-Out Documentation: Organized and arranged with its associated Pre-Functional Checklist.

2. System and Component tests (i.e. Feeder Test Reports, Ground System Reports, etc.): Organized and arranged with its associated Pre-Functional Checklist.

3. Pre-Functional Checklist: Organized and arranged as per provided by the Commissioning Agent. Typically these forms are organized by System and Sub-System and according to the order of standard specifications as outlined by American Institute of Architects (AIA.)

4. Functional Performance Tests: All tests performed by the installing contractors for internal checkout and for witness by the Commissioning Agent shall be kept by the Contractor(s), organized and arranged by System and Sub-System, and turned over to the Commissioning Agent for inclusion into the Final Commissioning Report.

5. Project Training Record: The Training Record shall be provided with a Table of Contents followed by the updated Training Schedule and finally followed by each Training Session Agenda and Record. The Training Session Agenda and Record shall be organized by System and Sub-System.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Agent for approval. The owner shall furnish necessary utilities for the commissioning process. Additional test equipment requirements are found in Specification 01 91 13 Section 2.8 – Test Equipment.

2.2 TEST EQUIPMENT - PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the commissioning process.

PART 3 - EXECUTION

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. A Final Commissioning Plan shall be developed by the Commissioning Agent. The Electrical Contractor(s) shall assist the Commissioning Agent in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation in a

timely manner. If contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent shall notify the Owner.

C. The Commissioning Process shall follow the schedule and procedures set forth within the Final Commissioning Plan.

D. The Electrical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, feeders, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

E. The Electrical Contractor(s) shall coordinate all Commissioning Activities into the project as required herein and as outlined within the Commissioning Plan. The Electrical Contractor(s) shall complete all required Commissioning and Construction Activities correctly and on schedule.

3.2 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Electrical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Electrical Contractor(s). Electrical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods, at no cost to the owner, until the required system performance is obtained.

C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Electrical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor and equipment supplier. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner and/or Architect shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

3.4 ADDITIONAL COMMISSIONING

A. The Electrical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

B. The Commissioning Agent will invoice the Owner for additional time required to witness any retesting due to failed PFC's or FPT's at a rate of $85/hour (including travel time), plus expenses, and the Owner will deduct this cost from the Construction Manager's Application for Payment. The Construction Manager will then back charge the party responsible for the test's failure. It is the Electrical Contractor's responsibility to properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness the test.

3.5 SEASONAL COMMISSIONING

A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

3.6 PRE-FUNCTIONAL CHECKLISTS AND FUNCTIONAL PERFORMANCE TESTS

A. The Commissioning Agent shall be responsible for preparing the Pre-Functional Checklist. The Electrical Contractor(s) shall be responsible for completing their applicable sections. Detailed descriptions of Pre-Functional Checklists are outlined in Section 01 91 13-2.4.

B. The Commissioning Agent shall be responsible for preparing the Functional Performance Tests. The Commissioning Agent and Contractor (s) shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Detailed descriptions of Functional Performance Tests are outlined in Section 01 91 13-2.6.

C. Following is a list of tasks and supporting information that shall be required:

1. Electrical contractor - provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

D. Documentation and Reporting Requirements

1. Any contractors with responsibilities related to the equipment to be installed, i.e. mechanical, electrical, TAB, controls, Construction Manager or General Contractor, shall be responsible for completing their related portion of the Pre-Functional Checklist and Functional Performance Test forms and shall sign off on its completion.

2. If deficiencies are identified during verification, the construction manager must be notified, and action taken to remedy the deficiency. The final tabulated checklist data sheets shall be reviewed by the Design Professional and the Commissioning Agent, to determine if verification is complete, and the operating system is functioning in accordance with the contract documents.

END OF SECTION 26 08 00

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Indoor occupancy sensors.
   2. Lighting contactors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals indicating the following:

   1. Submittal data indicating all selected options for each piece of lighting equipment and lighting controls.
   2. Operation and maintenance manuals for each piece of lighting equipment. Required routing maintenance actions, cleaning and recommended relamping shall be clearly identified.
   3. A schedule for inspecting and recalibrating all lighting controls.
   4. A narrative of how each system is intended to operate, including recommended set points.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hubbell Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Lutron Electronics Co., Inc.
5. Sensor Switch, Inc.
6. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those acredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: 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. Sensor has 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: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. 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., and detect a person of

average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.

3. Detection Coverage:
   a. **Standard Height Units**: In areas that have ceiling heights of 12 feet or lower, provide Watt Stopper unit DT-300 (or approved equal): Detect occupancy anywhere within a circular area up to 2000 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.
   b. **High Ceiling Units**: In areas that have ceiling/mounting height over 12 feet up to 40 foot mounting including but not limited to Gymnasium, Auditorium, Cafeteria (commons) and forum spaces, provide Watt Stopper unit HB3x0 with L4 lens, or approved equal. Detect occupancy anywhere within a circular area up to 3500 square feet. Detectors shall be networkable to allow coverage of larger or irregularly shaped areas.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hubbell Building Automation, Inc.
2. Leviton Manufacturing Co., Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those acredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.3 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. General Electric Company.
4. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, 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.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status
2. Control: On-off operation

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. 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 Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-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 Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing required by North Carolina Energy Conservation Code C408.3.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 261219 - PADMOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

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 pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

1.3 DEFINITIONS

A. BIL: Basic Impulse Insulation Level.

B. Bushing: An insulating structure including a central conductor, or providing a central passage for a conductor, with provision for mounting on a barrier, conducting or otherwise, for the purpose of insulating the conductor from the barrier and conducting current from one side of the barrier to the other.

C. Bushing Elbow: An insulated device used to connect insulated conductors to separable insulated connectors on dead-front, pad-mounted transformers and to provide a fully insulated connection. This is also called an "elbow connector."

D. Bushing Insert: That component of a separable insulated connector that is inserted into a bushing well to complete a dead-front, load break or nonload break, separable insulated connector (bushing).

E. Bushing Well: A component of a separable insulated connector, either permanently welded or clamped to an enclosure wall or barrier, having a cavity that receives a replaceable component (bushing insert) to complete the separable insulated connector (bushing).

F. Elbow Connector: See "bushing elbow" above.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pad-mounted, liquid-filled, medium-voltage transformers.

1. Include plans and elevations showing major components and features.

    a. Include a plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.

2. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include single-line diagram.
4. Include list of materials.
5. Include nameplate data.
6. Manufacturer's published time-current curves of the transformer high-voltage fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For transformers, signed by product manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

B. Comply with IEEE C2.

C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

A. Windings Material: Copper.

B. Winding Connections: The connection of windings and terminal markings shall comply with IEEE C57.12.70.

C. Efficiency: Comply with 10 CFR 431, Subpart K.

D. Insulation: Transformer kVA rating shall be as follows: The average winding temperature rise above a 30 deg C ambient temperature shall not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested according to IEEE C57.12.90, using combination of connections and taps that give the highest average winding temperature rise.

E. Tap Changer: External handle, for de-energized operation.

F. Tank: Sealed, with welded-on cover. Designed to withstand internal pressure of not less than 7 psi (50 kPa) without permanent distortion and 15 psig (104 kPa) without rupture. Comply with IEEE C57.12.36.

G. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to the public.

H. Mounting: An integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.

I. Insulating Liquids:

1. Less-Flammable Liquids:

a. Edible-Seed-Oil-Based Dielectric: Listed and labeled by UL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic, having passed the Organisation for Economic Co-operation and Development G.L.203 with zero mortality, and shall be certified by the U.S. Environmental Protection Agency as biodegradable, meeting Environmental Technology Verification requirements.
b. Biodegradable and Nontoxic Dielectric: Listed and labeled by an UL as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92.

J. Sound level shall comply with NEMA TR 1 requirements.

K. Corrosion Protection:

1. Transformer coating system shall be factory applied, complying with requirements of IEEE C57.12.28, in manufacturer's standard color green.
2. Fabricate front sill, hood, and tank base of single-compartment transformers from stainless steel according to ASTM A 167, Type 304 or 304L, not less than No. 13 U.S. gage, complying with requirements of IEEE C57.12.28, standard color green.
3. Base and Cabinets of Two Compartment Transformers: Fabricate from stainless steel according to ASTM A 167, Type 304 or 304L, not less than No. 13 U.S. gage. Coat transformer with manufacturer's standard green color coating complying with requirements of IEEE C57.12.28, in manufacturer's standard color green.

2.3 THREE-PHASE TRANSFORMERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Schneider Electric.
2. Eaton
3. General Electric Company.

B. Description:

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.
2. Comply with IEEE C57.12.26.

C. Compartment Construction:

1. Single-Compartment Construction: Clamshell style, with provision for padlocking, hinged cover, and single-point latching.
2. Double-Compartment Construction: Individual compartments for high- and low-voltage sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with a stop in the open position and provision for padlocking.

D. Primary Fusing: Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.

1. 150-kV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
2. Interrupting Rating: 50,000 rms A symmetrical at system voltage.
3. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse shall sense both high currents and high oil temperature to provide thermal protection to the transformer. Connect current-limiting fuses ahead of radial-feed load-break switch.
4. Provide bayonet fuse assembly with an oil retention valve and an external drip shield inside the housing to eliminate or minimize oil spills. Valve shall close when fuse holder is removed and an external drip shield is installed.
5. Provide a conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.

E. High-Voltage Section: Dead-front design.

1. To connect primary cable, use separable insulated connectors. Bushings shall be one-piece units, with ampere and BIL ratings the same as connectors.
2. Bushing inserts and feed-through inserts:

a. Conform to the requirements of IEEE 386.

b. Rated at 200 A, with voltage class matching connectors. Provide a parking stand near each bushing well. Parking stands shall be equipped with insulated standoff bushings for parking of energized load-break elbow connectors on parking stands.
c. Provide insulated protective caps for insulating and sealing out moisture from unused bushing inserts and insulated standoff bushings.

3. Bushing wells configured for loop-feed application.
4. Access to liquid-immersed fuses.
5. Dead-front surge arresters.
6. Tap-changer operator.
7. Load-Break Switch:

a. Radial-feed, liquid-immersed type with voltage class and BIL matching that of separable connectors, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12 kA rms symmetrical.
b. Loop-feed sectionalizing switches, using three two-position, liquid-immersed-type switches for closed transition loop-feed and sectionalizing operation. Voltage class and BIL shall match that of separable connectors, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 12 kA rms symmetrical. Switch operation shall be as follows:

1) Position I: Line A connected to line B and both lines connected to the transformer.
2) Position II: Transformer connected to line A only.
3) Position III: Transformer connected to line B only.
4) Position IV: Transformer disconnected and line A not connected to line B.
5) Position V: Transformer disconnected and line A connected to line B.

8. Ground pad.

F. Low-Voltage Section:

1. Bushings with spade terminals drilled for terminating the number of conductors indicated on the Drawings, and the lugs that comply with requirements of Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

G. Capacities and Characteristics:

1. Power Rating (kVA): 500.
2. Voltage Ratings: 12,470 V – 480/277 V.
3. Taps: Comply with IEEE C57.12.26 requirements.
4. Transformer BIL (kV): Comply with IEEE C57.12.26 requirements.
5. Minimum Tested Impedance (Percent at 85 deg C): 2.87.
6. Comply with FM Global Class No. 3990.
7. Comply with UL listing requirements for combination classification and listing for transformer and less-flammable insulating liquid.

H. Transformer Accessories:

1. Drain and filter connection.

2. Filling and top filter press connections.
3. Pressure-vacuum gauge.
4. Dial-type analog thermometer with alarm contacts.
5. Magnetic liquid level indicator with high and low alarm contacts.
6. Automatically resetting pressure-relief device. Device flow shall be as recommended by manufacturer. With alarm contacts and a manual bleeder.
7. Stainless-steel ground connection pads.
8. Machine-engraved nameplate, made of anodized aluminum or stainless steel.
9. Sudden pressure relay for remote alarm or trip when internal transformer pressure rises at field-set rate. Provide with seal-in delay.

2.4 SERVICE CONDITIONS

A. Transformers shall be suitable for operation under service conditions specified as usual service conditions in IEEE C57.12.00, except for the following:

1. Cooling air temperature exceeds limits.
2. Excessive load current harmonic factor.
3. Operation above rated voltage or below rated frequency.
4. Exposure to fumes, vapors, or dust.
5. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
6. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
7. Exposure to excessively high or low temperatures.
8. Unusual transportation or storage conditions.
9. Unusual grounding resistance conditions.

2.5 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s). Sign legend shall be "DANGER HIGH VOLTAGE" printed in two lines of nominal 2-inch-high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background.
2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of high-voltage compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

2.6 SOURCE QUALITY CONTROL

A. Provide manufacturer's certificate that the transformer design tests comply with IEEE C57.12.90.

1. Perform the following factory-certified routine tests on each transformer for this Project:

a. Resistance.
b. Turns ratio, polarity, and phase relation.
c. Transformer no-load losses and excitation current at 100 percent of ratings.
d. Transformer impedance voltage and load loss.
e. Operation of all devices.
f. Lightning impulse.
g. Low frequency.
h. Leak.
i. Transformer no-load losses and excitation current at 110 percent of ratings.
j. Insulation power factor.
k. Applied potential, except that this test is not required for single-phase transformers or for three-phase Y-Y-connected transformers.
l. Induced potential.
m. Resistance measurements of all windings on rated voltage connection and at tap extreme connections.
n. Ratios on rated voltage connection and at tap extreme connections.
o. Polarity and phase relation on rated voltage connection.
p. No-load loss at rated voltage on rated voltage connection.
q. Exciting current at rated voltage on rated voltage connection.
r. Impedance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine padmounted, liquid-filled, medium-voltage transformers upon delivery.

1. Upon delivery of transformers and prior to unloading, inspect equipment for any damage that may have occurred during shipment or storage.
2. Verify that tie rods and chains are undamaged and tight, and that all blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.
4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on high- or low-voltage bushing parts, and at transformer base.
5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge; it is required to read other than zero.
6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
7. Verify presence of polychlorinated biphenyl content labeling, affirming insulating liquid does not contain PCBs..
8. Unload transformers carefully, observing all packing label warnings and handling instructions.

9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:

1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use all lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with a crane.
8. Use spreaders or a lifting beam to obtain a vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:

1. Store transformers in accordance with manufacturer's recommendations.
2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
4. Store transformers with compartment doors closed.
5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting any discrepancies or adverse conditions. Verify that an effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.

D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.

E. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.

F. Examine concrete bases for suitable conditions for transformer installation.

G. Pre-Installation Checks:

1. Verify removal of any shipping bracing after placement.
2. Remove a sample of insulating liquid according to ASTM D 923. Insulating-liquid values shall comply with NETA ATS, Table 100.4. Sample shall be tested for the following:

a. Dielectric Breakdown Voltage: ASTM D 877 or ASTM D 1816.
b. Acid Neutralization Number: ASTM D 974.
c. Specific Gravity: ASTM D 1298.
d. Interfacial Tension: ASTM D 971.
e. Color: ASTM D 1500.
f. Visual Condition: ASTM D 1524.
g. Water in Insulating Liquids: Comply with ASTM D 1533.
h. Power Factor or Dissipation Factor: ASTM D 924.

H. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at transformer location.

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

3.2 INSTALLATION

A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Transformer shall be installed level and plumb and shall tilt less than 1.5 degrees while energized.

C. Comply with requirements for vibration isolation and seismic control devices specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and IEEE C2.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. For counterpoise, use tinned bare copper cable not smaller than No. 4/0 AWG, buried not less than 30 inches below grade interconnecting the grounding electrodes. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors, sized as shown. Keep lead lengths as short as practicable, with no kinks or sharp bends.

2. Fence and equipment connections shall not be smaller than No. 4 AWG. Ground fence at each gate post and corner post and at intervals not exceeding 10 ft.. Bond each gate section to fence post using 1/8 by 1 inch tinned flexible braided copper strap and clamps.
3. Make joints in grounding conductors and loops by exothermic weld or compression connector.
4. Terminate all grounding and bonding conductors on a common equipment grounding terminal on transformer enclosure.
5. Complete transformer tank grounding and lightning arrester connections prior to making any other electrical connections.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.

3.4 SIGNS AND LABELS

A. Comply with installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. General Field-Testing Requirements:

a. Comply with provisions of NFPA 70B Ch. "Testing and Test Methods."
b. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
c. After installing transformer but before primary is energized, verify that grounding system at the transformer is tested at specified value or less.
d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
e. Visual and Mechanical Inspection:

1) Verify equipment nameplate data complies with Contract Documents.
2) Inspect bolted electrical connections for high resistance using one of the following two methods:

a) Use a low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values

that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.

f. Remove and replace malfunctioning units and retest.
g. Prepare test and inspection reports. Record as-left set points of all adjustable devices.

2. Medium-Voltage Surge Arrester Field Tests:

a. Visual and Mechanical Inspection:

1) Inspect physical and mechanical condition.
2) Verify arresters are clean.
3) Verify that ground lead on each device is individually attached to a ground bus or ground electrode.

b. Electrical Test:

1) Perform an insulation-resistance test on each arrester, phase terminal-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.
2) Perform a watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.

3. Liquid-Filled Transformer Field Tests:

a. Visual and Mechanical Inspection:

1) Test dew point of tank gases if applicable.
2) Inspect anchorage, alignment, and grounding.
3) Verify bushings are clean.
4) Verify that alarm, control, and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
5) Verify that liquid level in tanks is within manufacturer's published tolerances.
6) Perform specific inspections and mechanical tests recommended by manufacturer.
7) Verify presence of transformer surge arresters and that their ratings are as specified.
8) Verify that as-left tap connections are as specified.

b. Electrical Tests:

1) Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the

absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; the value of the index shall not be less than 1.0.

2) Perform power-factor or dissipation-factor tests on all windings according to test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values shall be according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.3.
3) Measure core insulation resistance at 500-V dc if the core is insulated and the core ground strap is removable. Core insulation-resistance values shall not be less than 1 megohm at 500-V dc.
4) Perform a power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.
5) Perform turns-ratio tests at tap positions. Turns-ratio test results shall not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
6) Perform an excitation-current test on each phase. The typical excitation-current test data pattern for a three-legged core transformer is two similar current readings and one lower current reading. Investigate and correct if test shows a different pattern.
7) Measure resistance of each winding at each tap connection, and record temperature-corrected winding-resistance values in the Operations and Maintenance Manual.
8) Perform an applied-voltage test on high- and low-voltage windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9. This test is not required for single-phase transformers and for three-phase Y-Y-connected transformers.
9) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
10) Remove a sample of insulating liquid according to ASTM D 923, and perform dissolved-gas analysis according to IEEE C57.104 or ASTM D 3612.

3.6 FOLLOW-UP SERVICE

A. Voltage Monitoring and Adjusting: If requested by Owner, but not more than six months after Final Acceptance, perform the following voltage monitoring:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at the outgoing section of each transformer. Use voltmeters with calibration traceable to the National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from the nominal value by more than plus or minus 5 percent during test period, is unacceptable.
2. Corrective Action: If test results are unacceptable, perform the following corrective action, as appropriate:

   a. Adjust transformer taps.
   b. Prepare written request for voltage adjustment by electric utility.

3. Retests: Repeat monitoring, after corrective action is performed, until satisfactory results are obtained.
4. Report:

    a. Prepare a written report covering monitoring performed and corrective action taken.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 261219

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

1. Division 23 Section "Sequence of Operations for HVAC Controls" for BAS monitoring requirements, including equipment and parameters to be monitored.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," 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 that allows adjustments.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

D. Series rating of panelboards is not acceptable.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

1.10 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate surge protection ratings with requirements of 264113 "Lightning Protection for Structures"

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace surge suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

B. Enclosures: Flush and surface-mounted cabinets as indicated on the drawings.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Piano Type Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top or bottom to match incoming conduit location.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
4. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

I. All doors shall be keyed alike.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of distribution panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Square D.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only per drawings.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

F. Accessories:
1. Digital meter to measure voltage – phase to phase and phase to neutral, amperage – all three phases, KW, KVAR, KW demand, peak demand, power factor, and events recording, minimum of 4 events. Meter shall be connected to the BAS system for monitoring. Meter shall be capable of BACnet communication protocol. Refer to Division 23 controls details for more information.
2. Phase monitor relay. Relay shall be connected to the BAS system for monitor via BACnet communication protocol. Refer to Division 23 controls details for more information.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Electric Company.

2. Square D.
3. Eaton Electrical Sector; Eaton Corporation.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only per the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Square D.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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 circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and 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 squared x t 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 Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor
c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting:
1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to panelboards.
3. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. 90 inches to top of trim above finished floor unless otherwise indicated or as required to ensure that the operating handle of the top most switch or circuit breaker is not higher than 79" above the finished floor level.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. 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.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform service disconnect ground-fault test by a qualified person(s) using a test process of primary current injection in accordance with NEC 230.95.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study.

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:

1. Division 23 Section "Sequence of Operations for HVAC Controls" for BAS monitoring requirements, including equipment and parameters to be monitored.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

B. Panelboard Schedules: For installation in panelboards.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," 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 that allows adjustments.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.

D. Series rating of panelboards is not acceptable.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

1.10 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. All panelboards, switchboards, circuit breakers, dry type transformers and disconnect switches shall be of the same manufacturer.

B. Enclosures: Flush and surface-mounted cabinets as indicated on the drawings.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Piano Type Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:

   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top or bottom to match incoming conduit location.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
4. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

I. All doors shall be keyed alike.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of distribution panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Square D.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only per drawings.

E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

F. Accessories:
1. Digital meter to measure voltage – phase to phase and phase to neutral, amperage – all three phases, KW, KVAR, KW demand, peak demand, power factor, and events recording, minimum of 4 events. Meter shall be connected to the BAS system for monitoring. Refer to Division 23 controls details for more information.
2. Phase monitor relay. Relay shall be connected to the BAS system for monitor. Refer to Division 23 controls details for more information.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Electric Company.
2. Square D.
3. Eaton Electrical Sector; Eaton Corporation.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only per the drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton Electrical Sector; Eaton Corporation.
2. General Electric Company.
3. Square D.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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 circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and 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 squared x t 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 Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor
    c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    d. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Equipment Mounting:
1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to panelboards.
3. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. 90 inches to top of trim above finished floor unless otherwise indicated or as required to ensure that the operating handle of the top most switch or circuit breaker is not higher than 79" above the finished floor level.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. 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.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform service disconnect ground-fault test by a qualified person(s) using a test process of primary current injection in accordance with NEC 230.95.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study.

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.
5. Wall-switch and exterior occupancy sensors.

B. All receptacles, attachment plugs, and similar wiring devices shall be federal specification grade.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge Protective Device.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hubbell.
2. Leviton Manufacturing Co., Inc.
3. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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. Hubbell.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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. Hubbell.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

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. Hubbell.
    b. Leviton Manufacturing Co., Inc.
    c. Pass & Seymour/Legrand (Pass & Seymour).

2. Description:

    a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Single Pole:

1) Hubbell; HBL1221.
2) Leviton; 1221-2.
3) Pass & Seymour; CSB20AC1.

b. Two Pole:

1) Hubbell; HBL1222.
2) Leviton; 1222-2.
3) Pass & Seymour; CSB20AC2.

c. Three Way:

1) Hubbell; HBL1223.
2) Leviton; 1223-2.
3) Pass & Seymour; CSB20AC3.

d. Four Way:

1) Hubbell; HBL1224.
2) Leviton; 1224-2.
3) Pass & Seymour; CSB20AC4.

C. Key-Operated Switches, 120/277 V, 20 A:

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. Hubbell.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

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. Hubbell.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

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. Hubbell.
b. Leviton Manufacturing Co., Inc.
c. Pass & Seymour/Legrand (Pass & Seymour).

2.7 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. LED Dimmer Switches: Modular; compatible with dimmer drivers; trim potentiometer to adjust low-end dimming; dimmer-driver combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic Material for Unfinished Spaces: Galvanized steel.

2.9 FINISHES

A. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

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A. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display 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 unacceptable.
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. 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 ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes lightning protection for structures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

D. Coordinate the evaluation of and adjustment of electrical surge protection devices and their ratings with the lightning protection system.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I, aluminum unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Advanced Lightning Technology, LTD.
b. East Coast Lightning Equipment Inc.
c. ERICO International Corporation.

2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.
3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Aluminum.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

F. Heavy-Duty, Stack-Mounted, Lightning Protection Components: Stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet of building.

D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 264113

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Exit Signs
3. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Confirmation of compliance with Design Lighting Consortium (DLC) or ENERGY STAR product requirements.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of luminaire.

C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Final Acceptance.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Battery and Charger Data: One for each emergency lighting unit.
3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
4. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
6. Exit signs: Provide 10 additional exit signs (single face or double face, as needed) including 100' of conduit, boxes, wire, associated accessories and installation for each. Exit signs shall be installed as directed by the Architect, Owner, or Authority Having Jurisdiction (AHJ). Any unused additional exit signs shall be turned over to the Owner in their original boxes.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide products as scheduled on the drawings.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.

C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. Recessed Fixtures: Comply with NEMA LE 4.

F. Bulb shape complying with ANSI C79.1.

G. Lamp base complying with ANSI C81.61.

H. CRI of minimum 80. CCT of 4000 K.

I. Rated lamp life of 50,000 hours.

J. Lamps dimmable from 100 percent to 0 percent of maximum light output.

K. Internal driver:
1. Minimum efficiency: 85% at full load.
2. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.).
3. Input Voltage: 120 - 277V (±10%) at 60 Hz.
4. Integral short circuit, open circuit, overload protection and minimum 2-KV surge protection integral with the driver.
5. Power Factor: ≥ 0.95.
6. Total Harmonic Distortion: ≤ 20%.
7. Comply with FCC 47 CFR Part 15.

L. LED Modules:
1. Comply with IES LM-79 and LM-80 requirements.
2. Minimum CRI 80 and color temperature 4000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
3. Minimum Rated Life: 50,000 hours per IES L70.
4. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

M. Nominal Operating Voltage: 277 V ac.

N. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

O. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized powder-coat finish.

P. All interior LED lighting fixtures shall be compliant with current product requirements of Design Lighting Consortium (DLC) or ENERGY STAR program.

2.2 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Charger: Fully automatic, solid-state type with sealed transfer relay.
      b. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      c. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      d. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      e. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

C. Provide Five (5) extra exits signs for installation as directed by the Architect. Installation costs for these shall be included in the bid. Unused exit signs shall be turned over to the owner.

2.3 MATERIALS

A. Metal Parts:

   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components shall be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, [12 gage] <Insert size>.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

G. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 27 52 27 – TWO WAY COMMUNICATION INTERCOM SYSTEM

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: One complete Area of Rescue Assistance System (ARA) complete with components specified herein and cabling in conduits with devices, outlet boxes, enclosures, faceplates, telephone system cabling and connections, Master Station and Area Stations. Install equipment as indicated on the drawings. See Division 26 for conduits and see Section 27 10 00 for outlet boxes.

1. Conduit and boxes.
2. Cabling.
3. Faceplates and enclosures.
4. Master Station with Auto-Dialer (may be separate adjacent enclosures).
5. Area Stations.

B. Related Sections: Division 26 - Electrical.

1.3 GENERAL OPERATION AND DESCRIPTION:

A. General

1. The system shall be vandal resistant, manufactured of 16 gauge (0.062) 304 stainless steel and comply with the Americans with Disabilities Act sections 4.3.11.4 and 4.3.11.5.
2. The Master Station and Area Stations shall be custom engraved (not silk screened or stamped).
3. The Area Station shall have a large domed, stainless steel engraved 3" diameter momentary pushbutton with the words "Push for Help" backfill painted in bright red. The momentary button shall be "heavy duty" and the surface engraving shall be deep enough to withstand extreme conditions. It shall be activated with a minimum of effort and engineered so that it may be depressed from any angle for ease of use provided. No other hardware shall protrude from the station as high as the pushbutton.
4. The system's Area Stations shall also be weather resistant.
5. The system shall be modular and expandable to include future Area Stations.
6. The wire shall be 7 conductor 3 pair + one conductor 20 AWG with an overall shield.

1.4 QUALITY ASSURANCE

A. Source Quality Control: Materials and equipment shall be new, unused and U.L. listed.

1. Furnish Manufacturer's manuals of the completed system including individual specification sheets, schematics, inter-panel and intra-panel wiring diagrams. In addition, all information necessary for the proper operation of the system must be included.

2. As built drawings that include any changes to wiring, wiring designations, junction box labeling and any other pertinent information shall be supplied upon completion of project.

1.5 REFERENCES

A. The complete installation, including additions and modifications, shall be in accordance with:

1. The 2017 National Electrical Code Article 800.
2. Minimum standards of Electronic Industries Association (ETA).

1.6 SUBMITTALS

A. Submit shop drawings, analysis and product data.

1. Shop Drawings: The contractor shall provide a one-line riser diagram indicating route and conduit size, power wiring and connections of system to the Owner's equipment, as purchased.
2. Product Data: Submit application, technical and installation data.

B. Submit Operation and Maintenance Manuals.

1. O&M manuals shall include a list of each stations location with space number.

1.7 WARRANTY, SERVICES

A. The ARA System wiring installer shall warrant the system for a minimum of one (1) year from date of Final Acceptance against defective parts and/or workmanship, excluding normal burnout of lamps, and shall provide parts and labor to fulfill this warranty at no cost to Owner.

B. Qualified service and parts shall be available to call on within a 150 mile basis.

1.8 BASIS OF DESIGN

A. Rath AORA (Owner Preferred Alternate No. 13)

PART 2 - PRODUCTS

2.1 BASIC SYSTEM OPERATION

A. When the system is in normal operating mode, the Master Station shall display an illuminated "green" LED system ready light indicating the system is functioning and operating correctly. When operated, the system shall provide two-way audio and visual communications between the Master Station location and each Area Station initiating a request for help. Communication at each Area Station shall be hands-free after initial contact from the Area Station.

B. When a "call for help" is placed by an Area Station, the system shall initiate audio and visual alarms at both the Master Station and each of the affected Area Stations. The audible alarm shall be at least 90 decibels and the visual display shall be indicated by a SuperBrite® LED light and surface engraved or attached engraved location name (ID) directory of the calling Area Station.

C. Communication is established by simply answering via the Master Station. When communication is completed and the Master Station communication link has been broken, the LED display will continue to show the Area Station location (ID) until the system has been reset at the Master Station.

D. When a "call for help" is placed by an Area Station, several indications must be provided at the Area Station to assure the caller that the call is being processed. After pressing the 3" "Push For Help" call button the caller will be provided with both an audio and visual confirmation. A "Help Requested" LED shall illuminate and an alarm will sound at both the Area Station and the Master Station. When the security attendant at the Master Station has answered the call, the "Help Coming" LED will illuminate and the security attendant's voice can be heard through the speaker at the Area Station. Full two-way voice "hands-free" communication shall be provided at the Area Stations. The caller simply talks in the direction of the Area Station speaker, which acts as a microphone and enables the caller's voice to be reproduced at the Master Station. Upon completion of the call, an LED on the Area Station indicating "Help Coming" shall remain illuminated, providing visual indication that the "HELP REQUESTED" LED is acknowledged from the Master Station. The LED will not extinguish until building personnel have reported to the Area of Rescue Assistance and the system has been reset. Resetting the system shall be accomplished by turning a momentary key switch at the Master Station.

E. Upon signal from Master Station (if call to Master Station is not answered within a programmed time period), Auto Voice Phone Dialer shall dial programmed phone numbers and transmit recorded message, repeated 3 times.

2.2 MASTER STATION

A. The Master Station shall be constructed of 16 gauge 304 stainless steel. The station faceplate shall be 11"W x 11"H, be capable of surface or flush mounting and utilize tamper proof mounting hardware. It shall include the following:

1. Panel capacity for the indicated number of Area Stations.
2. Two 7/16" diameter flat metal buttons ("Talk", "Listen") per Area Station to initiate and respond to a request for assistance from each specific Area Station in the system.
3. When in standby mode, a "green" LED shall be illuminated to indicate the system is operational. Depressing the "Talk" button shall illuminate a "Help Coming" LED at the respective Area Station, silence the piezoelectric alarm, and open up two-way voice communication between the Master Station and Area Station(s).
4. Two SuperBrite® colored LEDs per Area Station to visually indicate "Help Requested" (red LED) or a line fault (amber LED) for each specific Area Station in the system, and to indicate that a fault has occurred at a particular Area Station(s), wiring between Area Station(s) and Master Station, or other system components shall be provided.
5. A piezoelectric alarm shall generate a 90 dbA signal sounding through the Master Station to aurally indicate "Help Requested" from an Area Station.
6. An audio confirmation signal shall be generated from the Master to the Area Station to acknowledge the request for assistance.
7. Acknowledgment of the "Help Requested" call from the Area Station to the Master Station shall also be indicated at the Area Station by the illumination of a red LED ("Help Coming") on the Area Station.

8. The system shall be able to provide an optional set of N/O dry contacts (if specified) for connection to a secondary Master Station, paging system, fire alarm system, or other optional devices such as AVPD telephone dialer or PBX telephone system. All communication between Master Stations or DTMF telephones shall be non-blocking.
9. The system shall have the capability to add Master Stations and sub-annunciator panels as specified.
10. It shall be possible to redirect "Help Requested" calls to a secondary Master Station, PBX system, or other outside telephone if there is no answer at the primary Master Station.
11. Provide battery backup capable of sustaining equipment for 90 minutes under normal operating conditions, and 24 hours in standby mode.

2.3 AUTO VOICE PHONE DIALER

A. Provide Auto Voice Phone Dialer (AVPD), Housing Devices model ADA-2001 or approved equal.
B. AVPD shall Store up to 4numbers in EPROM for dialing voice phones, numeric and/or voice pagers. Numbers may be up to 50 digits long with multiple PAUSE segments. A PAUSE is 2 seconds long & contains 1 digit.
C. Provide with LCD numeric display, 16-character 2-line display of program, test, and status.
D. AVPD shall have EPROM memory to store voice messages, phone numbers, and dialer status information even after total power failure (including removal of battery).
E. AVPD shall be 24V powered from the Master Station, with 9V battery to provide 24 hours standby operation upon loss of normal power.
F. Semi-flush enclosure, 6"x4"x1.5".

2.4 AREA STATIONS

A. Manufacturer

    a. Rath AORA 1-116 Call Box (Owner Preferred Alternate No. 13)

B. The Area Station assembly shall be constructed of 16 gauge 304 stainless steel. The station faceplate shall be 9"W x 9"H, be capable of surface or flush mounting and utilize tamper proof mounting hardware. The faceplate shall have the following features:

    1. A large 3" diameter domed stainless steel momentary pushbutton surface engraved and backfill painted in bright red the words "PUSH FOR HELP". It shall be activated with a minimum of effort and engineered so that it may be depressed from any angle for ease of use provided. No other hardware shall protrude from the station as high as the pushbutton.
    2. Two "SuperBrite®" red colored LEDs shall visually indicate and confirm request status to the caller with the words "HELP REQUESTED" and "HELP COMING" surface engraved and backfill painted as labels next to each LED.
    3. A 3" mylar 45 ohm speaker shall be provided.
    4. A piezoelectric alarm shall generate a 90 dbA signal sounding through the Area Station to aurally indicate "HELP REQUESTED" from an Area Station.
    5. An extra set of dry contacts shall be provided (if specified) for connection to optional equipment, such as, strobe light, video camera, DTMF dialer, etc.
    6. An optional momentary type keyed reset switch shall also be provided, if required. The reset switch will provide the means to reset the "HELP COMING" LED at the Area Station and al

so reset the corresponding area's red LED on the Master Station in order to ensure response by building personnel to the caller at the Area Station.

7. Braille Instructional Signs shall be provided for each Area Station. Signs shall be tactile lettering & rastor braille with tamper proof mounting hardware. Text shall conform with the Americans with Disabilities Act Sec. 4.30.4 for text size and style, be in Braille and English, and read: "FOR ASSISTANCE PUSH HELP BUTTON"

2.5 CABLING

A. All cable shall be as recommended by the manufacturer or an approved equivalent. All Area Station wiring shall be home run with individually jacketed cable.

B. Area Station wiring shall be 7 Conductor (3) 20AWG overall shielded twisted pairs + 1 conductor.

C. Master Station wiring shall be 7 Conductor (3) 20AWG overall shielded twisted pairs + 1 conductor.

D. Three (3) 20AWG conductors for each Area Station are also required.

E. All cables run in underground conduits shall be suitable for wet locations and appropriately grounded as per EIA and NEC recommendations. See wiring diagrams for details.

PART 3 – EXECUTION

3.1 INSPECTION

A. System field wiring diagrams shall be provided to the Contractor by the system Manufacturer prior to installation.

B. Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and name, address, and telephone number of parts source.

C. Upon completion of the installation of the equipment, the Contractor shall provide to the Engineer a signed statement that the system has been wired, tested, and functions properly according to the specifications.

D. Nothing herein contained shall be construed to relieve the Contractor from furnishing a complete and acceptable electrical wiring system in all its categories. The Engineer will reject any materials or labor which are or may become detrimental to the accomplishment of the intentions of these specifications.

3.2 INSTALLATION

A. Complete system shall be installed in strict accordance with manufacturer's recommendations.

B. All wiring shall be installed in raceways where routed through ceiling areas.

C. Master Station and Area Station mounting shall be in accordance with the ADA recommendations and specifications.

D. Provide dedicated telephone line in conduit from master station auto-dialer to nearest IDF and connection to telephone system. If call to Master Station is not answered within a programmed time, the system Master Station shall automatically transfer the call to an offsite phone number or numbers designated by the Owner.

3.3 FIELD QUALITY CONTROL

A. General: Upon completion of the installation, the ARA System Trade's technician shall perform all necessary electrical tests and adjustments and who shall then submit a Letter of Certification to the Owner/Architect/Engineer that the system functions properly.

B. The technician shall perform all electrical and mechanical tests, measurements and adjustments required below. A checkout report shall be prepared by the installation technicians and submitted in triplicate. The report shall include, but not be limited to:

1. A complete list of all wiring components.
2. Indication that all equipment is properly installed and functions and conforms with these specifications.
3. Technician's name, certificate number and date.

C. After completion of all tests, measurements and adjustments listed above, the ARA System Trade shall submit the following information to the Architect/Engineer.

1. "As built" conduit layout diagrams including wire color code and/or tag number.
2. Complete "As built" wiring diagrams.
3. Complete operating and programming instructions, including engineering data sheets on each component and complete part numbers of the each component.

D. Final tests and inspection shall be held in the present of Architect's representatives and to their satisfaction. The ARA System Trade shall supply personnel and required auxiliary equipment for this test without additional cost.

3.4 TRAINING

A. The Contractor shall furnish training with the system. These sessions shall be broken into segments that will facilitate the training of individuals in operating the Master Station as well as Area Stations. Operating manuals and users guides shall be provided at the time of the training.

END OF SECTION 27 52 27

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Communications equipment coordination and installation.
2. Sleeves for pathways and cables.
3. Sleeve seals.
4. Grout.
5. Wireless Access Point Wall Mounted Right Angle Bracket
6. Common communications installation requirements.

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For sleeve seals.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of communications equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in 078400 "Firestopping".

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

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

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway 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: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway 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.

2.3 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.
1. Wireless Access Point Wall Mounted Right Angle Bracket

2.4 WIRELESS ACCESS POINT WALL MOUNTED RIGHT ANGLE BRACKET

A. Basis of Design: 1011-00-WH as manufactured by Oberon, a division of Chatsworth Products, Inc., or equal.

B. Design: Wedge shaped right-angle mounting bracket with cover for securing Wi-Fi APs on walls. Designed to mount the AP in the preferred horizontal orientation. Constructed of 20-gauge white powder-coated steel.

C. Hinged cover to conceal cabling.

D. Mounting features to directly attach Cisco, Meraki, and Aruba APs.

E. Shipped loose, adjustable T-bar bracket for attaching to variety of manufacturer's APs.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS 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 communications 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.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, wireways, or cable trays 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 (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway 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 pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual pathways 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 (25-mm) 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 (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 270536 - CABLE TRAYS FOR COMMUNICATIONS 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. Single-Rail cable trays
2. Ladder cable trays.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for support of all cable trays

2. Section 260533 "Raceways and Boxes for Electrical Systems" for raceways between communications outlet locations and cable tray as well as between cable tray and MDF/IDF closet.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:.

1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.

2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 WIRE BASKET CABLE TRAY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. MonoSystems, Inc.
3. MP Husky USA Cable Tray & Cable Bus.

B. Description:

1. Configuration: 2" x 4" standard wire mesh pattern with intersecting wires welded together and continuous top wire safety edge.

2. Construction: High strength steel
3. Straight Section Lengths: 12 feet except where shorter lengths are required to facilitate tray assembly.
4. Width: 12 inches unless otherwise indicated on Drawings.
5. Support Point: Splice fittings shall be hanger support point.
6. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
7. Loading Depth: 4 inches.
8. Maximum Loads: 50 lb/ft..
9. Maintaining cable tray rungs within six degrees of horizontal is for aesthetic reasons. The tray looks uneven when tilted more than this. Support variations are available to allow varying levels of unbalanced loads while not exceeding the maximum tilt.
10. Splicing Assemblies: Bolted type using serrated flange locknuts.
11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
12. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.

2.4 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1008/A 1008M, Grade 33, Type 2.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.

    a. Standard: Comply with ASTM A 653/A 653M, G90.
    b. Hardware: Chromium-zinc plated, ASTM F 1136.

2.5 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.6 WARNING SIGNS

A. Lettering: 1-1/2-inch- high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Provide ladder cable tray in all data rooms and wire basket cable trays throughout all other spaces cable tray is shown on drawings.

C. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

D. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

E. Remove burrs and sharp edges from cable trays.

F. Fasten cable tray supports to building structure.

G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems."

H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

J. Support bus assembly to prevent twisting from eccentric loading.

K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

O. Make changes in direction and elevation using manufacturer's recommended fittings.

P. Make cable tray connections using manufacturer's recommended fittings.

Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078400 "Firestopping."

R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

S. Install cable trays with enough workspace to permit access for installing cables.

T. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

U. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

W. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches.

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 CONDUIT RACEWAYS

A. Provide conduit raceways above ceiling where cable tray is not installed for installation of communication cabling.

B. Conduit raceways shall originate at the communications outlet and terminate at a cable tray. J-hooks will not be permitted.

C. Provide conduit sleeves as required for transition between cable tray sections where cable tray fittings cannot be used to join cable tray sections.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.

6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.7 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 260536

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. Backboards
3. UTP cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

B. Related Sections:

1. Division 26 Section "Raceways and Boxes for Electrical Systems" for raceway and box specifications.

1.2 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

F. EMI: Electromagnetic interference.

G. IDC: Insulation displacement connector.

H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

I. LAN: Local area network.

J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

L. RCDD: Registered Communications Distribution Designer.

M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

O. UTP: Unshielded twisted pair.

1.3 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA-568-C.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics, including the following:

a. Cross-connects.
b. Patch panels.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.
b. Clearances for access above and to side of cable trays.
c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Cabling Installer must have personnel certified by BICSI on staff.
a. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
b. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
2. Cabling installer must be a current PartnerPRO network member.
a. Installers, supervisors and designers must have a current valid certification

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA-569-C.

E. Grounding: Comply with ANSI/TIA-607-B.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
   2. Test each pair of UTP cable for open and short circuits.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA-569-C.

B. Cable Support: NRTL labeled for support of Category 6 & 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, and D-rings.
   3. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

   1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

B. Provide 4'x8'x3/4" plywood backboards around perimeter of all MDF and IDF closets.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, following:

1. Commscope SYSTIMAX (Owner Preferred Alternate No. 12)

B. Description: 100-ohm, 4-pair UTP, binder groups covered with a color coded thermoplastic jacket.
1. Category 6 and 6A cabling
   a. Wireless access points shall be category 6A and all other shall be Category 6
2. Comply with ICEA S-90-661 for mechanical properties.
3. Comply with TIA-568-C.1 for performance specifications.
4. Comply with TIA-568-C.2, Category 6 and 6A.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM or CMG.
   b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
   c. Communications, Riser Rated: Type CMR, complying with UL 1666.
   d. Communications, Limited Purpose: Type CMX.
   e. Multipurpose: Type MP or MPG.
   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
   g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

6. Cable and outlet colors shall be as follows:
   a. Voice – White
   b. Data – Blue
   c. Wireless Access Points – Purple
   d. AV – Green

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

1. Commscope SYSTIMAX (Owner Preferred Alternate No. 12)

B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

1. All connecting hardware shall be compatible with the Commscope SYSTIMAX solution (Owner Preferred Alternate No. 12).

C. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated, plus spares and blank positions adequate to suit specified expansion criteria.

2. Provide 25% spare capacity on all patch panels or termination fields.

D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

E. Patch Cords: By same manufacturer and same cabling type as outlet/cable it serves.
1. Outlet side of cable: 50% 10ft, 50% 5ft
2. IDF side of cable: 1ft
3. Wireless access points: 5ft

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.1.

1. All connecting hardware shall be compatible with the Commscope SYSTIMAX solution (Owner Preferred Alternate No. 12).

B. Workstation Outlets: as indicated on the drawings.
1. Faceplate: White, complying with requirements in Division 26 Section "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

2.6 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-TIA-607-B.

2.7 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-C.

B. Comply with TIA-569-C for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (76 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. MUTOA shall not be used as a cross-connect point.
4. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
5. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA-568-C.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-C for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

3.5 Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.6 FIRESTOPPING

A. Comply with requirements in 078400 "Firestopping."

B. Comply with TIA-569-C, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-TIA-607-B.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 6 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. ~~6 AWG~~ 3/0 AWG equipment grounding conductor.

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in 099100 "Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Consult owner's IT personnel for exact numbering sequence prior to labeling.
2. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
3. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA-606-B.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. UTP Performance Tests:

   a. Test for each outlet and MUTOA. Perform the following tests according to TIA-568-C.1 and TIA-568-C.2:

      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.

5. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA-568-C.1 and TIA-568-C.3.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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. Electronic safety and security equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in 078400 "Firestopping".

PART 2 - PRODUCTS

2.1 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 (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Carbon Steel. Include two for each sealing element.

5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 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 ELECTRONIC SAFETY AND SECURITY 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 electronic safety and security 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.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays 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 (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) 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

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

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 (25-mm) 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 (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 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.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. 62.5/125-micrometer, multimode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Low-voltage control cabling.
7. Control-circuit conductors.
8. Fire alarm wire and cable.
9. Identification products.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

H. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

I. RCDD: Registered Communications Distribution Designer.

J. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

K. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

L. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

B. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable trays.
3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical-fiber flashlight or optical loss test set.
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CommScope SYSTIMAX.

B. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled as defined in NFPA 70, by a third-party agency that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) and marked for the following types:

a. Communications, General Purpose: Type CM or CMG.
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MP or MPG.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CommScope SYSTIMAX.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. SYSTIMAX Solutions; a CommScope, Inc. brand.

B. Description: Multimode, 62.5/125-micrometer, 24-fiber,tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-A for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

   a. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CommScope SYSTIMAX.

B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.

4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or CMG.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.

4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.10 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.11 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Comtran Corp.
2. Draka USA.
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corporation.
5. West Penn Wire/CDT; a division of Cable Design Technologies.
6. .

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.12 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.
5. .

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (75 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and

back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.5 CONNECTIONS

A. Comply with requirements in 283111 "Digital, Addressable Fire Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 FIRESTOPPING

A. Comply with requirements in 078400 "Firestopping."

B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

5. Coaxial Cable Tests: Comply with requirements in Division 27 Section "Master Antenna Television System."

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    c. Locate detectors according to manufacturer's written recommendations.

12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by the architect prior to submission to authorities having jurisdiction.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level IV minimum.
    c. Licensed or certified by authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.6 Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Maintenance manuals shall be installed at the system control unit or at another approved location at the protected premises for storage of all record documentation.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Strobe Units: Quantity equal to 4 percent of amount installed, but no fewer than one unit.
2. Smoke Detectors, Fire Detectors: Quantity equal to 6 percent of amount of each type installed, but no fewer than one unit of each type.
3. Detector Bases: Quantity equal to 6 percent of amount of each type installed, but no fewer than one unit of each type.
4. Keys and Tools: One extra set for access to locked or tamperproofed components.
5. Audible and Visual Notification Appliances: Quantity equal to 4 percent of amount installed, but no fewer than one unit.
6. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
7. Manual Fire Alarm Boxes: Quantity equal to 2 percent of amount installed, but no fewer than one unit.
8. Addressable Control Relays: Quantity equal to 4 percent of amount installed, but no fewer than one unit.
9. Monitor Modules: Quantity equal to 4 percent of amount installed, but no fewer than one unit.
10. Isolation Modules/Isolation Bases: Quantity equal to 4 percent of amount installed, but no fewer than one unit.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be supervised by personnel certified by NICET as fire-alarm Level IV technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.10 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing Edwards Fire Alarm equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by third party agencies that shall be amongst those accredited by the NCBCC (North Carolina Building Code Council), and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
5. Recall elevators to primary or alternate recall floors.
6. Activate elevator power shunt trip.
7. Record events in the system memory.

8. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.
5. Open or short circuit fault conditions causing the telephone communications circuit to become fully or partially inoperative.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:
1. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
2. Record the event on system printer.
3. Transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.

2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers:

1. Notifier. (Owner Preferred Alternate No. 14)

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.

c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
d. The FACP shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
4. All notification devices shall be able to be bypassed with a single membrane switch.
5. All mechanical equipment shall be able to be bypassed with a single membrane switch.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 Insert number characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

E. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations:

a. Initiation Device Circuits: Class A
b. Notification Appliance Circuits: Class B
c. Signal Line Circuits: Class 6

2. Pathway Survivability: Level 0.
3. Signaling-line circuit cards shall be capable of 100 or more devices.
4. Install no more than 20 addressable devices on each signaling-line circuit.
5. Serial Interfaces:

a. One dedicated RS 485 port for remote station operation using point ID DACT.

b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

a. Elevator lobby detectors except the lobby detector on the designated floor.
b. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch. Batteries must be sized for minimum of 60-hours plus 5/15 minutes of full alarm load.

1. Batteries: Sealed lead calcium.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. Manufacturers:

1. Notifier. (Owner Preferred Alternate No. 14)

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. 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.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. Manufacturers:

1. System Sensor. (Owner Preferred Alternate No 14)

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
7. Provide Remote Alarm Indicating Light in accessible location below the duct smoke detector

2.6 MULTICRITERIA DETECTORS

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Heat sensor shall be as described in "Heat Detectors" Article.
3. Each sensor shall be separately listed according to requirements for its detector type.

2.7 HEAT DETECTORS

A. Manufacturers:

1. Notifier. (Owner Preferred Alternate No 14)

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

E. Continuous Linear Heat-Detector System:

1. Detector Cable: Rated detection temperature 155 deg F. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.8 NOTIFICATION APPLIANCES

A. Manufacturers:

1. System Sensor (Owner Preferred Alternate No. 14)
2. Wheelock
3. Gentex

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated on fire alarm schematic riser diagram, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

E. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

F. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

G. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

1. Manufacturer: Notifier FMM-1 (Owner Preferred Alternate No 14)

C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically transmit that information to main campus fire alarm panel via existing cellular DACT.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide network communications required to connect to existing Starlink cellular dialer. Reinstall existing Starlink cellular dialer.

2.13 DEVICE GUARDS

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 device manufacturer.
2. Finish: Paint of color to match the protected device.

2.14 DOCUMENT CABINET

A. Description: Surface mounted fire alarm document cabinet with the following features
1. 16 gauge steel with solid piano hinge and key lock
2. Dimensions of approximately 12"x13"x2-1/4".
3. Labeled "FIRE ALARM DOCUMENTS"

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex Ain NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

J. 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. Install all devices at the same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to elevator recall system and components.
2. Supervisory connections at valve supervisory switches.
3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
4. Supervisory connections at elevator shunt-trip breaker.
5. Data communication circuits for connection to building management system.

B. Connect RJ45 data jack & cable (IN and OUT) to the existing Starlink DACT; coordinate with communications system installer and UNCW Fire Alarm shop.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 REMOTE MONITORING SERVICE

A. UNC Wilmington's remote monitoring service is Security Central. Coordinate monitoring service requirements.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.8 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by owner 's representative and authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections. Notify State Construction Office minimum 7-days prior to proposed testing date. Provide SCO with complete testing documentation in advance of the SCO witnessed testing.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Final Acceptance, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Final Acceptance, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Final Acceptance, service agreement shall include software support for two years.

C. Upgrade Service: At Final Acceptance, update software to latest version. Install and program software upgrades that become available within two years from date of Final Acceptance. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111