

Project Manual

Wayne State University Science Hall Third Floor Renovation for Food and Nutrition Science

Owner

Wayne State University
Facilities Planning and Management
5454 Cass Avenue
Detroit, Michigan 48202

LAS Project # 10424-00
WSU Project # 005-242336

January 20, 2015

Bid Documents

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SECTION 01 1000 - SUMMARY

PART 1 GENERAL

1.01 REMOVALS

- A. Owner will remove the following items before start of work:
 - 1. Biosafety Cabinets.
 - 2. Lab equipment.
 - 3. Furnishing.

1.02 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.03 CONTRACTOR USE OF SITE

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site to allow:
 - 1. Owner occupancy.
- C. Provide access to and from site as required by law and by Owner.
- D. 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.
- E. Do not obstruct roadways, sidewalks, or other public ways without permit.
- F. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours when the building is unoccupied and when approved by the Owner.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without notice to and approval from the Owner. Secure the approval of authorities having jurisdiction when required.
 - 3. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2300 - ALTERNATES

PART 1 GENERAL

1.01 SCHEDULE OF ALTERNATIVES

- A. Bid Alternate No. 1 - TA Office and Seminar Room Renovation:
 - 1. Demolish existing wall between 3049 and 3049.1 and renovate room for the TA office.
 - 2. Renovate Seminar Rooms 3033 and 3037 as shown.
- B. Bid Alternate No. 2 - Equipment Lab Renovation.
 - 1. Renovate Equipment Lab 3023 as shown.
- C. Bid Alternate No. 3 - Nutrition Department Offices Renovation.
 - 1. Extensive renovation of offices and break room for the Nutrition Department.
- D. Bid Alternate No. 4: Epoxy in lieu of RCT at Labs and Tissue Culture rooms.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Construction progress schedule.
- D. Progress photographs.
- E. Procedural requirements for submittals for review, information, and project closeout.

1.02 SUBMITTALS

- A. Construction progress schedule.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Contractor shall schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's Superintendent.
- C. Agenda:
 - 1. Preliminary Contract Matters
 - a. Bonds, insurance certificates, and other preliminary contract compliance submittals
 - b. Notice to proceed
 - c. Schedule of values
 - d. Construction progress schedule
 - e. Submittal schedule
 - f. List of subcontractors
 - g. List of products
 - h. Posted construction documents (including addenda)
 - i. Mobilization
 - j. Use of premises by Owner
 - 2. Project Correspondence (mail/e-mail/web)
 - a. Meeting notes
 - b. Architect's Field Reports
 - c. Requests for Information
 - d. Submittals (product data, shop drawings, test reports, etc.)
 - e. Product substitutions
 - f. Procedures for processing of ASI, PR, CCD, CO
 - g. Substantiation of proposed cost of contract modifications and substitution requests
 - h. Applications for Payment
 - 3. Site
 - a. Temporary Utilities
 - b. Temporary facilities and services
 - c. Staging/storage

- d. Contractor parking
 - e. Owner Requirements (Badging, Housekeeping)
 - f. Testing Procedures
 - g. Severe Weather Rules
 - h. Security and housekeeping
 - i. Waste removal and disposal
- 4. Post Construction
 - a. Owner's requirements and occupancy prior to completion
 - b. Project close out procedures
 - c. Start-up, training, and O&M manuals
 - d. Inspection and acceptance of equipment put into service during construction period
 - e. Maintaining record documents
 - f. Releases (surety, waivers, etc.)
 - g. Reducing retainage
 - h. Inspection for Substantial Completion, Date of Substantial Completion, Final Completion, Final Payment
 - i. 12-Month Warranty Review
 - j. Post-Contract Evaluation
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

- A. Progress meetings will be held at weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Change Order Log.
 - a. Effect of proposed changes on progress schedule and coordination.
 - 3. Condemnation Log.
 - 4. Quality Issues.
 - a. Field observations, problems, and decisions.
 - 5. Review of Work progress.
 - 6. RFI Log.
 - 7. Review of submittals schedule and status of submittals.
 - 8. Review construction progress schedule.
 - a. Planned progress during succeeding work period.
 - b. Review of off-site fabrication and delivery schedules.
 - c. Time Extension Requests (if any).
 - d. Corrective measures to regain projected schedules.
 - 9. Payment or Claim Issues.
 - 10. Subcontractor Issues.
 - 11. Contractor Application for Payment.
 - 12. Identification of problems which impede planned progress.
 - 13. Other issues Affecting the Work.

- a. Owner-Provided items (FFE); especially submittal or coordination data.
 - 14. Scheduled pre-installation meetings.
 - 15. Scheduled mock-ups.
 - 16. Scheduled tests.
 - 17. Any other items for discussion.
 - 18. Is the Contractor being delayed because of any action or non-action by the Architect or Owner.
 - 19. Next Meeting Date.
 - 20. Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 15 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
- D. Submit updated schedule with each Application for Payment. Updated at each progress meeting.

3.04 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.

3.05 SUBMITTALS FOR REVIEW

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- D. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
 - 5. LEED submittals and reports.
 - 6. Other types indicated in respective specification sections.
- E. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents. Architect's review is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or

performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

- F. Contractor is responsible for determining and verifying materials, field measurements and field construction criteria related thereto, and checking and coordinating the information contained within the submittal with the requirements of the Work and of the Contract Documents.
- G. Samples will be reviewed only for aesthetic, color, or finish selection.
- H. Submittals that are required to be submitted at the same time for review and approval for aesthetic coordination are full Specification Section product listings noted below:
 - 1. 09 6500 Resilient Flooring
 - 2. 09 6800 Carpet Tile
 - 3. 09 9100 Paints and Coatings

3.06 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated in respective specification sections.
- B. Submit for Architect's knowledge as contract administrator or for Owner.
- C. Action taken by the Architect ("approval" or other action) indicates only that the item has been received in the form required by the contract documents and that the Architect will transmit the item to the Owner for the Owner's records, but does not indicate that the Architect has verified the accuracy or adequacy of the contents of the submittal.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.
- C. Action taken by the Architect ("approval" or other action) indicates only that the item has been received in the form required by the contract documents and that the Architect will transmit the item to the Owner for the Owner's records, but does not indicate that the Architect has verified the accuracy or adequacy of the contents of the submittal.

3.08 TIMING AND PACKAGING OF SUBMITTALS

- A. Submit complete, coordinated data. Partial submittals are not acceptable unless specifically exempted. For complex assemblies, submit data for all elements of the assembly as a single, coordinated package.

- B. Initial Product Information: Submit the initial product information listed below for each Section of the Specifications as a single package, prior to placing final purchase order.
 - 1. Product data.
 - 2. Samples.
 - 3. Installer and manufacturer qualifications.
 - 4. Manufacturer's instructions.
 - 5. Certificates, test reports, and inspection reports of standard plant runs that demonstrate compliance of proposed products with specified quality.
 - 6. Similar submittals demonstrating quality of proposed products.
- C. Shop Drawings and Design Data:
 - 1. Submit Shop Drawings and Design Data for each Section of the Specifications as a single package.
 - a. Exception: When approved by the Architect especially large quantities of drawings on large projects may be divided into individual submissions, such as package 1, 2, 3, etc.
 - 2. Submit the following prior to placing final order for fabrication:
 - a. Detailed drawings prepared specifically for the project, for example drawings of concrete reinforcing, structural steel, curtain wall.
 - b. Calculations or other designs prepared specifically for the project.
- D. In-Progress Reports: Multiple submittals permitted. Submit the following in a timely manner as the work progresses.
 - 1. Certificates, test reports, and inspection reports of actual plant runs for this project (where required) or of tests and inspections made at the project site (earthwork, concrete, steel, etc.).
 - 2. Similar submittals recording actual quality installed on-site.
- E. Closeout Submittals: Submit the following for each Section of the Specifications as a single package:
 - 1. Final certificates, test reports, and inspection reports of completed work.
 - 2. Project record documents.
 - 3. Operation and maintenance data.
 - 4. Warranties and bonds.
 - 5. Similar submittals attesting to completed work.

3.09 NUMBER OF COPIES OF SUBMITTALS

- A. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect. If not specified in individual specification sections, submit two.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.
- B. Documents for Project Closeout:
 - 1. Warranties, Bonds, and Executed Forms: Submit executed original to the Architect who will transmit original to the Owner.
 - 2. Testing, Balancing, Start-Up, and Operations and Maintenance Manuals: Submit number of copies as specified in respective specification sections. If quantity is not so indicated, submit two copies.

3.10 SUBMITTAL PROCEDURES

- A. Transmit each submittal with approved form.

- B. Transmit PDF submittals via a secure electronic exchange service specifically designed for collaborative sharing and tracking of architectural project information between all members of the project team, including Owner, Architect and Contractor, and including their consultants and subcontractors. Arrange for and pay for service for this project
- C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- E. 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.
- F. Deliver submittals to Architect at business address.
- G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- H. Provide space for Contractor and Architect review stamps.
- I. When revised for resubmission, identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- K. Submittals not requested will not be processed.

END OF SECTION

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. References and standards.
- B. Mock-ups.
- C. Control of installation.
- D. Tolerances.
- E. Testing and inspection services.
- F. Manufacturer's field services.

1.02 REFERENCES

- A. ASTM C 1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2001.
- B. ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2005b.
- C. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Unit Masonry; 2006.
- D. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2004a.
- E. ASTM E 329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2005b.
- F. ASTM E 543 - Standard Practice for Agencies Performing Nondestructive Testing; 2004.

1.03 SUBMITTALS

- 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.
- B. Test Reports: After each test/inspection, promptly submit report directly to Architect and to Contractor. Include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.
 - 6. Location in the Project.
 - 7. Type of test/inspection.
 - 8. Date of test/inspection.
 - 9. Results of test/inspection.
 - 10. Conformance with Contract Documents.
 - 11. When requested by Architect, provide interpretation of results.

- C. Manufacturer's Field Reports: Submit reports for Architect's information and benefit as contract administrator.
 - 1. Submit reports within 7 days of observation to Architect.

1.04 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. Conform to reference standard of date of issue specified in individual specification sections or, if none, the date current on the date of issue of the Contract Documents.
- C. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 TESTING AND INSPECTION AGENCIES

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection unless otherwise specifically indicated.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E 329, ASTM E 548, ASTM E 543, ASTM C 1021, ASTM C 1077, ASTM C 1093, and ASTM D 3740 as applicable to the nature of the testing.
 - 2. Maintain a full time registered engineer on staff to review services.
 - 3. 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. Testing may be performed under provisions identified in the respective product specification sections and as otherwise directed by the Architect..
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Approved mock-ups (in conjunction with the other requirements of the Contract Documents) shall be a standard of quality for judging the Work.
- D. If mock-up is specified to be removed, remove and dispose of the mock-up only after mock-up has been approved by Architect and when directed to do so.

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 required.
- B. Testing Agency Duties:
 - 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-conformance of Work or products.
 - 6. Perform additional tests and inspections required by Architect.
 - 7. 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 which 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. Provide reasonable notice to Architect and laboratory of expected time for operations requiring testing/inspection services to permit Architect and testing laboratory to schedule their activities.
- 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

3.05 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections or when requested by the Architect, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, and testing, adjusting, and balancing of equipment, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary sanitary facilities.
- C. Temporary closures.
- D. Temporary vehicular access and parking.
- E. Project waste removal.
- F. Project signs and identification.
- G. Temporary field offices.

1.02 TEMPORARY UTILITIES

- A. Provide all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes. Existing facilities may be used.

1.03 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas 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 .
- C. Protect the vehicles of others, stored materials, site, and structures from damage.

1.04 FENCING

- A. Construction: Commercial grade chain link fence.

1.05 INTERIOR ENCLOSURES

- A. Provide temporary partitions as indicated 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 reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces.

1.06 SECURITY

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

1.07 VEHICULAR ACCESS AND PARKING

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.08 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.

- C. 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.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on Drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without Owner permission except those required by law.

1.10 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Locate offices a minimum distance of 30 feet from existing and new structures.
- C. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Prohibition of asbestos-containing materials.
- C. Re-use of existing products.
- D. Storage and protection.
- E. Product option requirements.
- F. Substitution requirements and procedures.
- G. Procedures for Owner-Furnished-Contractor-Installed products.
- H. Spare parts and maintenance materials.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the 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 the Contract Documents.
- B. Do not use products that contain 1 percent or more by weight of asbestos (asbestiform varieties of chrysotile (serpentine), crocidolite (riebeckite), amosite (cummingtonite-grunerite), anthophyllite, tremolite, or actinolite)) .

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description, and comply with the remaining requirements of the project.
- B. Products Specified by Naming One or More Brand Name Products (or Manufacturers): Use one of the brand name products specified (or product of the manufacturers specified), and comply with the remaining requirements of the project.

2.04 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra products of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. For time restrictions on substitution requests see the Invitation to Bidders and the General Conditions.
- B. Approval of substitutions after the award of contract may occur only by Contract Modification.

- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request complying with the requirements specified herein.
- D. Substitution Submittal Procedure:
 - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Accompany requests during the bidding period with a completed Pre-Bid Substitution Request as specified in Section 01 6201.
 - 3. Accompany requests after the receipt of bids with a completed Post-Bid Substitution Request as specified in Section 01 6202.
 - 4. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 5. Accompany requests after the receipt of bids with complete documentation of cost (whether cost will increase, decrease, or remain the same) for both the specified item and the proposed item. Provide full information required for evaluation:
 - a. Quantities of materials and the cost thereof, including shipping to the site.
 - b. Manhours of labor and hourly cost including payroll taxes, insurance, and benefits for each skill or labor classification.
 - c. Quantities and costs of equipment, tools, and other material not incorporated into the work.
 - d. Overhead and profit.
 - e. Credit for deletions from Contract, similarly documented.
 - f. Justification for any change in Contract Time.
 - g. Other information requested by the Architect.
 - 6. The Architect will notify Contractor in writing of decision to accept or reject request.
- E. A request for substitution 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.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.

3.02 OWNER-SUPPLIED PRODUCTS

- A. 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.
- B. 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 STORAGE AND PROTECTION

- A. 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.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Prevent contact with material that may cause corrosion, discoloration, or staining.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- I. 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

SECTION 01 6201 - PRE-BID SUBSTITUTION REQUEST

TO: LORD, AECK & SARGENT, INC.,
213.S. Ashley Street, Suite 200, Ann Arbor, MI 48104

Substitution of the following is hereby requested in accordance with the Instructions to Bidders, the General Conditions of the contract, and Section 01 6000.

SPECIFIED PRODUCT:

SECTION NO.: PAGE NO.: PARA. NO.:

REASON FOR REQUESTING SUBSTITUTION; CHECK ONE OR MORE:

- ☐ Contractor cannot provide the specified product, assembly or method of construction within the Contract Time;
- ☐ The request directly relates to an "or-equal" clause or similar language in the Contract Documents;
- ☐ The request directly relates to a "product design standard" or "performance standard" clause in the Contract Documents;
- ☐ The requested substitution offers Owner a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities Owner must assume;
- ☐ The specified product or method of construction cannot receive necessary approval by an authority having jurisdiction, and Owner can approve the requested substitution;
- ☐ Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility;
- ☐ Contractor cannot coordinate the specified product, assembly or method of construction with other materials and where Contractor certifies they can coordinate the proposed substitution; or
- ☐ The specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.
- ☐ Other (explain):

PROPOSED PRODUCT INFORMATION:

Manufacturer:

Address:

Product trade name, model number, other characteristics:

Name of fabricator or supplier:

Address:

CHECK ONE:

- ☐ The proposed product complies with the contract documents in every respect except for the specified manufacturer name or brand name or model number.
- ☐ The proposed product material complies with the contract documents in every respect except for deviations which are as follows:

CHECK ONE:

- ☐ No changes are required in other work or products if the substitute product is approved.
- ☐ Changes will be required in other work or products if the substitute product is approved, as follows:

MAINTENANCE SERVICES AND REPLACEMENT MATERIAL AVAILABILITY (IF APPLICABLE):

CONTRACTOR'S CERTIFICATION

To the Owner, to the Architect, to other bidders and sub-bidders (of any tier), and to the contractor(s) and subcontractors and suppliers (of any tier) to whom contracts are eventually awarded in connection with the project, the undersigned warrants that the undersigned:

- has examined the bidding documents for the project,
- has investigated the proposed product and has found it to be equal or superior in all significant respects to the specified product,
- will provide the same warranty for the proposed product as for the specified product,
- will coordinate the installation and make other changes which may be required for the work to be complete in all respects, including, redesign, additional components, and additional capacity required by other work affected by the change, and
- waives all claims for additional costs and time extensions which subsequently may be come apparent and which are caused by the change.

ENCLOSURES:

Complete product data, as specified in the Contract Documents, is enclosed with this request.
Other enclosures:

THIS REQUEST IS SUBMITTED IN THE NAME OF:

Company name:

Address:

Telephone:

By:

Authorized Signature:

Date:

Typed Name:

Title:

END OF SECTION

SECTION 01 6202 - POST-BID SUBSTITUTION REQUEST

TO: LORD, AECK & SARGENT, INC.,
213.S. Ashley Street, Suite 200, Ann Arbor, MI 48104

Substitution of the following is hereby requested in accordance with the Instructions to Bidders, the General Conditions of the contract, and Section 01 6000.

SPECIFIED PRODUCT:

SECTION NO.: PAGE NO.: PARA. NO.:

REASON FOR REQUESTING SUBSTITUTION; CHECK ONE OR MORE:

- ☐ Contractor cannot provide the specified product, assembly or method of construction within the Contract Time;
- ☐ The request directly relates to an "or-equal" clause or similar language in the Contract Documents;
- ☐ The request directly relates to a "product design standard" or "performance standard" clause in the Contract Documents;
- ☐ The requested substitution offers Owner a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities Owner must assume;
- ☐ The specified product or method of construction cannot receive necessary approval by an authority having jurisdiction, and Owner can approve the requested substitution;
- ☐ Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility;
- ☐ Contractor cannot coordinate the specified product, assembly or method of construction with other materials and where Contractor certifies they can coordinate the proposed substitution; or
- ☐ The specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and where Contractor certifies that the proposed substitution provides the required warranty.
- ☐ Other (explain):

PROPOSED PRODUCT INFORMATION:

Manufacturer:

Address:

Product trade name, model number, other characteristics:

Name of fabricator or supplier:

Address:

CHECK ONE:

- ☐ The proposed product complies with the contract documents in every respect except for the specified manufacturer name or brand name or model number.
- ☐ The proposed product material complies with the contract documents in every respect except for deviations which are as follows:

CHECK ONE:

- ☐ No changes are required in other work or products if the substitute product is approved.
- ☐ Changes will be required in other work or products, if the substitute product is approved, as follows:

MAINTENANCE SERVICES AND REPLACEMENT MATERIAL AVAILABILITY (IF APPLICABLE):

CHECK ONE:

- ☐ No change in the Contract Sum is proposed.
- ☐ Modification of the Contract Sum by adding \$ _____ is hereby requested.
- ☐ Modification of the Contract Sum by subtracting \$ _____ is hereby requested.

CHECK ONE:

- ☐ No change in the Contract Time is proposed.
- ☐ Modification of the Contract Time by adding _____ calendar days is hereby requested.
- ☐ Modification of the Contract Time by subtracting _____ calendar days is hereby requested.

CONTRACTOR'S CERTIFICATION:

To the Owner, to the Architect, and to other contractors and their subcontractors (if any), the undersigned warrants that the undersigned:

- has examined the Contract Documents for the project,
- has investigated the proposed product and has found it to be equal or superior in all significant respects to the specified product,
- will provide the same warranty for the proposed product as for the specified product,
- will coordinate the installation and make other changes which may be required for the work to be complete in all respects, including, redesign, additional components, and additional capacity required by other work affected by the change, and
- waives all claims for additional costs and time extensions which subsequently may be come apparent and which are caused by the change.

- Will reimburse Owner for review or redesign services, when request is made after the award of contract.

ENCLOSURES:

The following complete information is enclosed for evaluation:

Quantities of materials and the cost thereof including shipping to the site.

Manhours of labor and hourly cost including payroll taxes, insurance, and benefits for each skill or labor classification.

Quantities and costs of equipment, tools, and other material not incorporated into the work.

Overhead and profit.

Credit for deletions from Contract, similarly documented.

Justification for any change in Contract Time.

Other information requested by the Architect.

For Time and Material work, submit itemized account and supporting data as the work progresses and after completion of change, within time limits indicated in the Conditions of the Contract.

Complete product data on the proposed substitution is enclosed with this request.

Other enclosures:

THIS REQUEST IS SUBMITTED IN THE NAME OF:

Company name:

Address:

Telephone:

BY:

Authorized Signature:

Date:

Typed Name:

Title:

END OF SECTION

SECTION 01 7000 - EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.

1.02 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
- C. Rodent and Pest Control: Provide methods, means, and facilities to prevent rodents and pests and insects from accessing or invading premises.
- D. 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.

1.03 COORDINATION

- A. 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.
- B. Notify affected utility companies and comply with their requirements.
- C. 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.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. 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 - NOT USED

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 PREINSTALLATION MEETINGS

- A. Notify Architect sufficiently in advance of meeting date to allow for coordination with Architect's schedule.
- B. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- C. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. 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.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are not record documents or precise surveys of actual conditions.
 - 1. Verify that construction and utility arrangements are as shown.

2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Separate areas in which alterations are being conducted from other areas that are still occupied; provide, erect, and maintain temporary dustproof partitions of construction.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. 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.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
 5. 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; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.
- G. Adapt existing work to fit new work.

- H. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
- I. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- J. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- K. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
 - 3. Patch as specified for patching new work.
- L. Clean existing systems and equipment.
- M. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- N. Do not begin new construction in alterations areas before demolition is complete.

3.06 CUTTING AND PATCHING

- A. Execute cutting and patching including excavation and fill to complete the work, to uncover work in order to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit products together to integrate with other work.
- B. Execute work by methods to avoid damage to other work, and which will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- C. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- D. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- E. Restore work with new products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- H. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- I. Make neat transitions. Patch work to match adjacent work in texture and appearance. Where new work abuts or aligns with existing, perform a smooth and even transition.
- J. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.07 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.

3.08 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. 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.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.09 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate to Owner's personnel the start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season near the onset of the other season.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.12 FINAL CLEANING

- A. 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, dust and mop hard flooring.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean permanent washable filters and replace disposable filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

END OF SECTION

SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of 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. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Changes made by Addenda and modifications.

- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Field changes of dimension and detail.
 - 2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. 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.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 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 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 24 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

3.04 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 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 the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 02 4100 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Provide, erect, and maintain temporary barriers and security devices.
 - 3. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 5. 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.
 - 6. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be 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.
- D. 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.

3.02 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; 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. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 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 other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction indicated on drawings in locations indicated on drawings.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- D. 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 that are to remain in operation; 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.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching 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

SECTION 04 2000 - UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete Block.
 - 2. Ceramic Glazed Structural Facing Tile.
 - 3. Mortar and Grout.
 - 4. Reinforcement and Anchorage.
 - 5. Precast Concrete Lintel
- B. Products Installed but not Furnished Under this Section, Including, but not Limited to:
 - 1. Items specified elsewhere and which are built into masonry.
 - 2. Frames for openings.
 - 3. Anchors for built-in items.
 - 4. Inserts and connectors.
 - 5. Utility items.

1.02 REFERENCES

- A. ACI 530.1 - Specification for Masonry Structures; 2005.
- B. ASTM A 153/A 153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
- C. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2007.
- D. ASTM A 951 - Standard Specification for Masonry Joint Reinforcement; 2006.
- E. ASTM C 129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2006.
- F. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar; 2004.
- G. ASTM C 150 - Standard Specification for Portland Cement; 2007.
- H. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006.
- I. ASTM C 404 - Standard Specification for Aggregates for Masonry Grout; 2007.
- J. ASTM C 476 - Standard Specification for Grout for Masonry; 2007.
- K. "Standard Practice for Bracing Masonry Walls Under Construction", Council for Masonry Bracing.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Masonry units.
 - 2. Cementitious materials.
 - 3. Joint reinforcement.
 - 4. Anchors.
 - 5. Accessories.
 - 6. Precast Concrete lintels.

1.04 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not allow materials to become damaged or contaminated by other materials.

- B. Provide on-site storage of masonry units required for not less than 4 weeks production.
 - 1. Store units raised above ground on pallets or similar flooring to prevent moisture pick-up.
 - 2. Store units under cover to prevent moisture pick-up from rain or snow.
 - 3. Do not tarp or wrap units so as to trap moisture or to permit condensation to form.
 - 4. Allow air to circulate freely around units.
 - 5. Use only masonry units that have been stored thus for not less than 3 weeks.
- C. Sand:
 - 1. Maintain sand at a constant moisture content.
 - 2. Cover pile when not in use.
 - 3. Arrange pile for free drainage.
 - 4. Do not use the bottom portion of the pile (wet or in contact with earth) in mortar.
 - 5. At Contractor's option use bagged, kiln-dried sand.
- D. Cement and Lime:
 - 1. Store materials raised above ground on pallets or similar flooring to prevent moisture pick-up.
 - 2. Store materials under cover to prevent moisture pick-up from rain or snow.
 - 3. Do not tarp or wrap materials so as to trap moisture or to permit condensation to form.
 - 4. Allow air to circulate freely around units.
 - 5. Do not use bags that have been broken or exposed to moisture.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MASONRY UNITS

- A. Where fire rated construction is indicated, provide units complying with UL requirements.
- B. Non-Load-Bearing Concrete Masonry Units: ASTM C 129
 - 1. Hollow block.
- C. Ceramic Glazed Structural Facing Tile:
 - 1. Existing undamaged units may be cleaned and reused.
 - 2. Where new units are needed to supplement existing reused units, match existing units in quality, size, and face color and texture.
- D. Provide specially shaped units where required by project conditions, including but not limited to:
 - 1. Corner block: Bullnose.
 - 2. Lintels.
 - 3. Bond beams.
- E. Nominal Face Size: 8 by 16 inches, unless otherwise indicated on the drawings.
 - 1. Nominal Thickness: As indicated on the drawings.

2.03 PRECAST CONCRETE LINTELS

- A. Manufacturers: York Building Products, Ernest Maier Inc, Cast-Crete, or approved alternates.
- B. Concrete lintels matching concrete masonry wall width. Reinforced top and bottom for span and capacity to carry weight of masonry located above lintel.
- C. Size: 4" width x 8" height.

2.04 MORTAR MATERIALS

- A. Deliver cementitious materials to the job site in bags containing factory proportioned quantities of cement and lime in each bag according to the approved design mix, unless an alternate method of batching is approved by the Architect. Manufacturer's label on each bag shall clearly indicate compliance with this specification. Labels bearing the words "masonry cement" shall in addition bear the words "portland-lime" or other clear indication of compliance with this specification.
- B. Portland Cement: ASTM C 150, Type I.
 - 1. Masonry Cement and Mortar Cement are not acceptable.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Mortar Aggregate: ASTM C 144.
- E. Grout Aggregate: ASTM C 404.
- F. Water: Clean and potable.

2.05 REINFORCING AND ANCHORS

- A. Reinforcing Steel:
 - 1. ASTM A 615, Grade 60, deformed, plain finish.
- B. For the materials below, provide products of one of the following:
 - 1. Blok-Lok.
 - 2. Wire-Bond.
 - 3. Heckmann.
 - 4. H & B.
- C. For the reinforcing and anchoring products below, provide the following material:
 - 1. Interior walls and partitions:
 - a. Hot dip galvanized ASTM A 153 Class B-2.
- D. Joint Reinforcement: ASTM A 951.
 - 1. Side wire size: W1.7 (No. 9).
 - 2. Cross wire size: W1.7 (No.9).
 - 3. Configurations:
 - a. Single Wythe CMU:
 - 1) Ladder type, 1 side rod per face shell; between 5/8 inch and 1 inch mortar coverage at each face.
 - 2) Blok-Lok BL-10.
 - 3) Wire-Bond Series 200 Ladder Mesh.
 - 4) Heckmann "1100 Series".
 - 5) H & B "#220 Ladder-Mesh"
- E. Anchoring CMU to Structural Frame:
 - 1. Anchoring CMU to Cast-In-Place Concrete:
 - a. Top of Wall Anchors:
 - 1) Blok-Lok.
 - 2) Wire-Bond #4300 (cast-in-place concrete), #4301 #4310 (steel).
 - 3) H
 - 4) H & B

2.06 MIXING

- A. Mortar for Concrete Unit Masonry: ASTM C 270, proportion specification; Type N unless otherwise indicated on the structural drawings.
- B. Grout: ASTM C 476.
 - 1. Compressive strength, ASTM C 1019: As indicated on the structural drawings, or if not indicated, provide grout complying with the proportions of Table 1, ASTM C 476.
 - 2. Slump, ASTM C 143: 8 to 11 inches.
 - 3. 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.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Verify that items to be built-in such as pipes, conduit, boxes, and other items are properly positioned and do not interfere with masonry or reinforcing.
 - 2. Verify that non-masonry structural elements such as foundations for masonry, columns, beams, floor slab edges are properly positioned and do not interfere with masonry or required cavity.
 - 3. Verify that field measurements of project conditions allow for proper coursing both vertically and horizontally, unless otherwise required by the contract documents. Notify the Architect of non-coursing conditions.
- B. Ensure that as-built field tolerances of other trades will permit the proper construction of masonry.
- C. Where conditions are not compliant, notify the Architect before beginning masonry construction.
- D. Provide corrected conditions before beginning masonry construction.

3.02 PREPARATION

- A. Temporarily brace masonry until permanent bracing is provided.
- B. Brace masonry in accordance with "Standard Practice for Bracing Masonry Walls Under Construction," Council for Masonry Bracing.

3.03 PLACING UNITS

- A. Hollow Units:
 - 1. Construct with fully mortared face shells.
 - 2. Construct fully mortared web joints:
 - a. At the first course of bearing.
 - b. All courses of columns, piers, and pilasters.
 - c. Perimeter of grouted construction.
- B. Ensure that units are in final position and adjusted to line, level, and plane before 60 seconds have expired since mortar contact with unit. Do not disturb units after this time. If further adjustment is required, remove unit and mortar and install fresh unit and mortar. Removed units may be reused if cleaned promptly and allowed to dry 24 hours before reuse.
- C. Strike-off extruded mortar from the face and rear of the unit using a lifting and cutting motion of the trowel. Avoid dropping mortar in the cavity. Do not smear of mortar on the face of units.
- D. Precast concrete lintels: Minimum bearing of 8" each end.

3.04 COURSING AND JOINTING

- A. Place units in running bond, unless otherwise indicated.
- B. Joint thickness: 3/8 inch. Construct joints of uniform thickness.
 - 1. Exception: Where stretching or compressing joints is necessary to accommodate dimensional tolerances or other conditions, consult with the Architect to determine acceptable tolerances.
- C. Control Joints in Concrete Masonry:
 - 1. Construct control joints using sash block and control joint filler topped with joint sealant specified in Division 7.
- D. Joint Shape:
 - 1. Concave, unless otherwise indicated.
- E. Openings: Construct masonry openings for windows, doors, and penetrations to allow for proper sealant joint width between masonry and other material.
 - 1. Joint width adjacent to openings: 3/8 inch unless otherwise indicated on the drawings.
- F. At top of non-bearing walls and partitions do not install mortar joint:
 - 1. At fire-rated construction install firestopping specified in Division 7.
 - 2. At non-fire-rated construction install compressible joint filler to receive joint sealant specified in Division 7.
- G. Where walls and partitions abut columns or other construction:
 - 1. At fire-rated construction install firestopping specified in Division 7.
 - 2. At non-fire-rated construction rake back mortar to receive joint sealant specified in Division 7.
- H. Where differing exterior masonry materials meet (brick, CMU, cast stone, precast concrete, cast-in-place concrete, etc.), rake back mortar to receive joint sealant specified in Division 7.

3.05 SPECIAL SHAPES

- A. Cut units neatly where required. Do not use broken or chipped units.
- B. Use special shapes where required.
- C. Do not place units such that core holes or raw edges are exposed to view or to weather.

3.06 HORIZONTAL JOINT REINFORCEMENT IN CMU

- A. Reinforce all CMU walls and partitions.
- B. Lay joint reinforcement directly on masonry units and cover with mortar. Provide mortar cover specified in Part 2.
- C. Lap joint reinforcement at least 6 inches.
- D. At corners and intersecting walls, install joint reinforcement with prefabricated corners and tees.
- E. Vertical Spacing:
 - 1. 16 inches on center, unless otherwise indicated.
 - 2. Prefabricated units at corners and intersecting walls, 8 inches on center. Extend legs at least 30 inches in each direction.
 - 3. First 2 courses above and below openings. Extend at least 16 inches beyond each side of opening.
 - 4. First 2 courses below the tops of walls.
- F. Do not continue horizontal joint reinforcement through control joints.

3.07 ANCHORING CMU TO STRUCTURAL FRAME

- A. Anchor CMU to structure as indicated on structural drawings.
- B. Fasten top of wall to underside of structure at 24 inches on center. Position anchors to align with groove in sash block in top course.

3.08 OTHER MATERIALS

- A. Build-in items specified elsewhere including, but not limited to:
 - 1. Lintels.
 - 2. Door frames. Fill hollow metal frames with grout.
 - 3. Window frames.
 - 4. Frames for openings.
 - 5. Anchors for built-in items.
 - 6. Inserts and connectors.
 - 7. Utility items.
- B. Simultaneously construct chases and contiguous walls or partitions.
- C. Do not embed wood (whether or not preservative treated) or other organic materials.
- D. Do not embed aluminum that has not been coated with an approved anti-corrosion coating.

3.09 TOLERANCES

- A. Code Tolerances: As specified in ACI 530.1.
- B. Appearance of completed work: Appearance shall match adjacent existing work that this is an extension of in joint width, alignment, masonry product and visual result.

3.10 IN PROGRESS CLEANING

- A. Arrange means, methods, and techniques of construction masonry and the work of other trades to avoid and prevent the soiling or staining of in-progress and completed masonry.
- B. On-site Storage:
 - 1. Protect masonry units from soil and mud.
 - 2. Store units on pallets or equivalent to raise units above ground or place on well drained hard pavement. Do not place units directly on the ground.
 - 3. Cover units with tarps to keep out precipitation. Ventilate tarps at the base to allow air circulation and to avoid condensation.
- C. Laying Masonry:
 - 1. After units are laid, cut off excess mortar, capturing it with the trowel so as not to allow excess to drop down the face of the wall.
- D. After Completion:
 - 1. Do not allow other trades to stain or soil completed masonry. Provide protection to avoid staining or soiling.
 - 2. Keep mud protection at the base of masonry until permanent landscaping is completed and viable, effective groundcover is well established.
- E. Tooling:
 - 1. Tool joints when they are thumbprint hard.
 - 2. Tool joints at about the same "age" from lift to lift of masonry, from section to section of masonry, from day to day, and from crew to crew.
 - 3. Tool joints with a consistent technique.

4. Then cut off mortar tailings with a trowel and, using a medium soft hair bricklayer's brush, brush mortar burrs and dust from the face of units.
 5. At the start of work each morning, remove any remaining excess mortar from the face of units with a wire brush.
- F. Non-Compliance with any of the above provisions is defective workmanship and grounds for rejection.

END OF SECTION

SECTION 06 4100 - CUSTOM CABINETRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic Laminate Countertops - Base Bid.
- B. BID ALTERNATE #3: Plastic Laminate Cabinets.
- C. BID ALTERNATE #3: Plastic Laminate Countertops.
- D. BID ALTERNATE #3: Break Room Cabinet Hardware.

1.02 REFERENCES

- A. AHA A135.4 - Basic Hardboard; American Hardboard Association; 2004.
- B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2002.
- C. AWI/AWMAC (QSI) - Architectural Woodwork Standards; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2009, Edition 1.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2003 (ANSI/BHMA A156.9).
- E. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- F. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress; National Hardwood Lumber Association; 2007.

1.03 SUBMITTALS

- A. Product Data: Provide data for laminates.
- B. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- C. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- D. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Member in good standing of the Architectural Woodwork Institute (AWI). Manufacturer listings are available at www.awinet.org/find/index.cfm.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Protect units from moisture damage.

1.06 PROJECT CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 CABINET CONSTRUCTION

- A. Perform cabinet construction in accordance with AWI Section 400 as follows:

1. Plastic Laminate Cabinets: Custom quality.

2.03 WOOD MATERIALS

- A. Hardwood Lumber: NHLA; Graded in accordance with AWI, average moisture content of 5-10 percent; species as follows:
 1. Exposed Surfaces: White (sap) Maple.
 2. Semi-Exposed Surfaces: White (sap) Maple.

2.04 PANEL MATERIALS

- A. Formaldehyde Free Medium Density Fiberboard (MDF): ANSI A208.2; composed of wood fibers pressure bonded with moisture resistant adhesive with no added formaldehyde, to suit application; sanded faces; thickness as required.
 1. Product: Medex, manufactured by Sierra Pine Composite Solutions.
- B. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth two sides (S2S). Use for drawer bottoms, dust panels, and other components indicated on drawings.

2.05 LAMINATE MATERIALS

- A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:
 1. Exposed Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
 2. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as scheduled, finish as scheduled.
 3. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
- B. Manufacturers:
 1. Formica Corporation: www.formica.com.
 2. Nevamar: www.nevamar.com.
 3. Pionite: www.pionite.com.
 4. WilsonArt International: www.wilsonart.com.
- C. Colors:
 1. BASE BID; Plastic Laminate 1; **PL1**: Countertops for Technician desks.
 - a. Formica, Basalt Slate 3690-58
 - b. Nevamar, Black Lodestone LD6001T
 - c. Pionite, Graphite Talc AG361 Suede
 - d. WilsonArt, Rustic Slate 4888-38
 2. BID ALTERNATE #3; Plastic Laminate 2; **PL2**: Break Room Vertical Surfaces
 - a. Formica, Figured Annigre 7284-58
 - b. Nevamar, Carmel Sagawood WM8350T
 - c. Pionite, Cinnamon Noce WW601 Suede
 - d. WilsonArt, Tuscan Walnut 7921-38
 3. BID ALTERNATE #3; Plastic Laminate 3; **PL3**: Break Room Horizontal Surfaces and Back and Side Splashes
 - a. Formica, Tuscan Marble 7736-58
 - b. Nevamar, Visible Vava VA2001T
 - c. Pionite, Santiago MT260 Suede
 - d. WilsonArt, Salentina Grigio 1865K-55

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Fasteners: Size and type to suit application.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel, or chrome-plated finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel.
- E. Grommets: Painted metal, black color, flip lid.
 - 1. Basis of Design: Max2/A by Mockett.
 - 2. Size: 3-15/16" x 3-15/16".

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Brackets:
 - 1. Manufacturers: Hafele
 - a. BASIS OF DESIGN: Hafele
 - 1) 287.74.307; Heavy Duty Folded Steel Work Surface Brackets, 15"x18"
 - (a) Load capacity 1,000 lbs per pair
 - b. Other Acceptable Manufacturers:
 - 1) Knape & Vogt Manufacturing Company
 - 2) Fastcap
 - 2. Finish: Black
 - 3. Spacing: 16" on center, unless noted otherwise.
- C. ALTERNATE #3; Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.
- D. ALTERNATE #3; Drawer and Door Pulls: "U" shaped wire pull, stainless steel with satin finish, 4 inch centers.
- E. ALTERNATE #3; Catches: Magnetic.
- F. ALTERNATE #3; Drawer Slides:
 - 1. Manufacturers:
 - a. Basis of Design: Accuride International, Inc.
 - b. Hafele America Co.
 - c. Knape & Vogt Manufacturing Company.
 - 2. Light/Medium Duty Drawer Slides For Drawers 24 inches Wide or Less: Accuride 7434 with overtravel.
 - a. Overtravel: 1 inch.
 - b. Type: All ball bearing, full extension, rail-mounted, hold-in detent, smooth progressive movement.
 - c. Capacity: 100 pounds per pair for 18-inch slide length.
 - d. Finish: Clear zinc.
- G. ALTERNATE #3; Hinges: 5 knuckle type; stainless or chromium plated steel with satin polished finish. European style not acceptable.

2.08 FABRICATION - CABINETS

- A. Cabinet Style: Flush overlay.

- B. Cabinet Doors and Drawer Fronts: Flush style.
- C. Drawer Construction Technique: Dovetail joints.
- D. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- E. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- F. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- G. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

2.09 FABRICATION - COUNTERTOPS

- A. Edge Detail: Waterfall edge.
- B. Plastic Laminate:
 - 1. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes.
 - 2. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 3. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
 - 4. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 5. Cap exposed plastic laminate finish edges with material of same finish and pattern.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION - CABINETS

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use concealed joint fasteners to align and secure adjoining cabinet units.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- D. Secure cabinets to floor using appropriate angles and anchorages.
- E. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 INSTALLATION - COUNTERTOPS

- A. Install components plumb, level true and straight in accordance with approved shop drawings, project installation details and manufacturer's printed instructions. Shim as necessary using concealed shims.
- B. Provide inconspicuous joints in finished work.
- C. Attach top securely to base unit or support brackets.
- D. Provide side splashes where countertops abut vertical walls.

- E. Provide back splashes where countertops abut vertical walls.
- F. Seal between wall and back and side splashes with mildew resistant sealant specified in Section 07 9000.
- G. Coordinate plumbing installation with Division 22.

3.04 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.05 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 5010 - CUTTING AND PATCHING OF BITUMINOUS ROOF COVERING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Modification of existing roof coverings.
 - 2. Patching of penetrations in roof coverings after removal of existing items.
 - 3. Patching of new penetration in roof coverings.

1.02 REFERENCES

- A. ASTM D 450 - Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing; 2007.
- B. FM P7825 - Approval Guide; Factory Mutual System; current edition.
- C. The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; current edition.
- D. Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors National Association, Inc.; current edition.

1.03 SUBMITTALS

- A. Product Data: Submit technical product information, installation instructions, and recommendations for each type of roofing material. Furnish additional information as necessary to demonstrate products comply with project criteria.
 - 1. Bituminous products (membrane plies, flashing plies, bitumen, mastics, and adhesives):
 - a. Cut sheets demonstrating compliance with specified requirements.
 - b. Manufacturer's patching and installation instructions.

1.04 PRODUCT HANDLING

- A. Deliver materials to project site in manufacturer's unopened, sealed containers or packages, with manufacturer's labels intact.
- B. Store materials in weather-protected environment, clear of ground and moisture, in strict accordance with manufacturer's and NRCA recommendations.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 ASSEMBLIES AND DETAILS

- A. For cutting and patching back, employ only materials, assemblies, and details that would qualify for premium quality 20-year NDL warranty for new work.
- B. Where a manufacturer's warranty is not currently in force, this specification does not require that a manufacturer's warranty be provided.

2.03 SHEET MATERIALS

- A. Base Flashings: Modified Bituminous Ply Sheets.
 - 1. Bottom ply for flashing and stripping: Smooth surface. Thickness: At least 100 mils.
 - 2. Top flashing ply: Mineral granule surface. Thickness: At least 100 mils exclusive of surfacing.

2.04 INSULATION

- A. Roof Insulation: Match existing insulation type, number of layers, and thickness.

B. Crickets, Saddles, and Tapered Edge Strips: Tapered insulation.

C. Cants:

1. Tapered insulation.

2.05 ACCESSORY MATERIALS

A. Roofing Bitumen:

1. Coal-tar roof coverings: ASTM D 450, Type I, roofing pitch.

B. Primer: As recommended by membrane manufacturer.

C. Cold-applied mastics and adhesives: As recommended by membrane manufacturer; asbestos-free.

D. Fasteners:

1. Material: Galvanized steel, fluoropolymer-coated steel, or nonferrous metal.
2. Size, length, and type recommended by manufacturer as suitable for material to be fastened, substrate, and that will comply with wind uplift requirements.
3. Fasteners used to attach materials to metal roof deck shall be Factory Mutual System approved for deck and insulation type used.
4. Roofing nails: Standard or threaded type; provide metal or plastic washers (caps) minimum diameter 1 inch for nails with head diameter less than 1 inch. Provide fasteners suitable for fastening into wood and fasteners suitable for fastening into masonry.

E. Termination Bar: Aluminum or Type 304 stainless steel.

F. Nailers and Blocking: Fabricate from treated wood as specified in Division 6 section on rough carpentry.

G. Roof Drain Flashing: Not less than 3-pound nor more than 4-pound lead sheet.

H. Edge caulk: "NP-1"; Sonneborn.

I. Other materials: As recommended by membrane manufacturer.

J. Aggregate surfacing: Match existing aggregate.

PART 3 EXECUTION

3.01 GENERAL

A. Perform all cutting, patching, and repairs in accordance with the NRCA manual and the material manufacturer's details and instructions for a premium quality installation.

B. No roofing operations shall occur without the presence of the installer's supervisor on site, whether:

1. Demolition.
2. Installation of insulation and roof covering.
3. Installation of base flashings.
4. Installation of wood nailers and blocking specified elsewhere.
5. Installation of sheet metal flashings specified elsewhere.

3.02 EXAMINATION

A. Examine areas where roofing is to be installed. Correct substrate surfaces which are unacceptable to the installer, and are not in agreement with manufacturer's installation instructions, before starting roofing application.

3.03 SUBSTRATE PREPARATION

A. General: Remove trash, debris, grease, oil, water, and contaminants from surface.

- B. Removal Of Existing Roofing: Remove existing roofing, insulation, blocking, etc., as indicated and as necessary to accommodate project requirements.
- C. Penetrations: Ensure that roof curbs, equipment supports, columns, posts, piping, etc., which will penetrate roof are installed in correct locations, and permanently secured.
- D. Spud-back gravel or other surfacing on existing roofing around areas to be patched or to receive flashing and stripping.
 - 1. Remove dirt, dust, debris, and contaminants from surface.
 - 2. Apply primer in accordance with manufacturer's instructions.
- E. Install blocking, nailers, cants, reglets, and similar attachment devices as indicated or required.

3.04 VAPOR BARRIER AND INSULATION

- A. Vapor Barrier: Preserve, repair, and restore vapor barrier where encountered prior to installing insulation.
- B. Insulation:
 - 1. Install insulation of total thickness to match existing insulation and to fill voids around penetrations and where patching occurs.
 - 2. Butt insulation units tightly together and trim to fit penetrations and interruptions so that gaps between units and between insulation and adjacent construction do not exceed 1/4 inch.
 - 3. Provide preformed units at drains to ensure positive drainage.
 - 4. Provide crickets on high side of roof curbs and other obstructions.
 - 5. Provide crickets, saddles, and tapered areas where necessary to conform to deck, penetrations, and existing irregularities and to avoid localized areas of ponding.
- C. Installation of Roofing Sheets:
 - 1. Follow manufacturer's recommendations for installation to ensure proper installation of sheet without irregularities such as fishmouths or wrinkles.
 - 2. Place and press sheets during installation to ensure proper adhesion to substrate and adjacent roofing sheet.
 - 3. Comply with manufacturer's recommendations to ensure that joints are solidly adhered and weather-tight.

3.05 BASE FLASHING AND STRIPPING

- A. General: Follow manufacturer's standard installation specifications for 2-ply flashings, and as follows:
 - 1. Acceptable installation methods:
 - a. Cold-applied mastic-adhesive.
- B. Patching of Existing Roof Membrane:
 - 1. Install 4-ply built up roof repair, cold process or hot mopped in accordance with manufacturer's details and instructions. Extend repair sheet onto existing roofing membrane.
- C. Flashing:
 - 1. Install bottom ply of smooth surface modified bituminous sheet. Extend at least 4 inches beyond cant onto roof membrane.
 - 2. Install top ply of modified bituminous roofing sheet. Extend top ply beyond cant onto roof membrane, at least 4 inches onto existing roofing membrane.
 - 3. Extend both plies full height of curbs and other vertical surfaces, unless otherwise required.

4. Install termination bar and fasten at 8 inches on center, approximately 1 inch from top edge. Seal bar and flashing edge with mastic.
 5. Shape flashings to conform to substrate without bridging at any point. Ensure that bottom ply is well-bonded to substrate. Ensure that top ply is continuously fused to bottom ply. Ensure that laps are continuously fused.
- D. Stripping: Do not strip metal items heavier than 24 gage sheet steel, 16-oz copper or 0.040-inch aluminum. Do not strip metal items greater than 10 feet in length.
1. Prime metal surface to receive stripping.
 2. Extend modified bituminous stripping a minimum of 4 inches onto field of roof membrane. At penetrations with flange less than 24 by 24 inches, use a single piece of stripping 39 inches square, cut to fit over penetration.
 3. Install top ply of roofing membrane over stripping ply.
 4. Caulk exposed edge of membrane.
- E. Roof Drains:
1. Coat clamping ring base with application of roofing cement.
 2. Set 30-inch-square lead flashing sheet in a bed of roofing cement on bottom ply of roof membrane. Prime top surface of lead flashing.
 3. Apply 39-inch-square smooth-surfaced modified bitumen sheet flashing as specified above over lead flashing.
 4. Set clamping ring.
- F. Install other accessories in accordance with manufacturer's instructions and applicable SMACNA and NRCA Construction Details.

3.06 CLEANING

- A. Remove bituminous markings from finished surfaces. In areas where finished surfaces are soiled by asphalt or any other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

END OF SECTION

SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protection of fire-resistance-rated construction and smoke barriers as required by the building code, and using materials subject to the limitations of this specification.
- B. The location and extent of fire-resistance-rated construction and smoke barriers are indicated on the Drawings.
 - 1. Protect every penetration into or through such construction.
 - 2. Protect every joint in such construction or between elements of such construction and adjacent construction.
- C. Work Not Included: Repairing penetrations made in error and repairing penetrations which are too large to be sealed by the methods indicated; these are to be repaired using the original material of the construction.

1.02 REFERENCES

- A. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; 2008b.
- B. ASTM E 1966 - Standard Test Method for Fire-Resistive Joint Systems; 2009.
- C. ASTM E 2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- D. ASTM E2307 - Standard Test Method or Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2010.
- E. ASTM E 2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a.
- F. UL 1479 - Standard for Fire-Tests of Through-Penetration Firestops; Underwriters Laboratories, Inc.; 2003.
- G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; 2004.

1.03 DEFINITIONS

- A. Fire Wall, Fire Barrier, Smoke Barrier, Fire Partition: As defined by the building code.

1.04 SUBMITTALS

- A. Schedule: Submit a single, integrated, and complete list of joints and penetrations to be sealed including penetrations caused by mechanical, electrical, plumbing, and other work. Do not submit separate schedules prepared by the various subcontractors. Identify the following:
 - 1. Type of penetration (floor, wall, other).
 - 2. Fire rating of penetrated assembly.
 - 3. Material of penetrated assembly (e.g., cast-in-place concrete wall, CMU wall, composite floor deck, etc.).
 - 4. Size and material of the penetrating object (e.g. 4"-8" C.I.P, EMT up to 2" dia., etc.).
 - 5. Testing laboratory design number.
 - 6. Manufacturer's design number.
- B. Product Data: Provide data on product characteristics, performance ratings, limitations, and tested assembly details including preparation and installation instructions.
- C. Preinstallation Inspection Report.
- D. Final Inspection Report.

1.05 QUALITY ASSURANCE

- A. Manufacturer's technical representative shall be available for initial job start-up and trouble-shooting as needed, and to assist with inspections.
- B. Coordination Meeting: Prior to the start of work which involves cutting penetrations, conduct a meeting with installers of such work to identify fire barriers and required configurations of penetrations and to discuss the proper procedures and time schedule for cutting, patching, and sealing penetrations in such assemblies, with emphasis on avoiding unnecessary cutting and patching.

1.06 REGULATORY REQUIREMENTS

- A. Protect fire rated construction and smoke barriers as required by the building code, and using materials subject to the limitations of this specification. Construction to be protected includes:
 - 1. Penetrations into or through fire walls, fire barriers, smoke barriers, and fire partitions.
 - 2. Penetrations into or through fire-resistance-rated floors, floor/ceiling assemblies, and the ceiling membrane of roof/ceiling assemblies.
 - 3. Penetrations in smoke barriers.
 - 4. Joints in or between fire-resistance-rated walls, floors, floor/ceiling assemblies, roofs, and roof/ceiling assemblies.
 - 5. Joints between fire-resistance-rated floor or floor/ceiling assemblies and exterior curtain wall assemblies (where a curtain wall is formed by wall materials that bypass the floor slab edge such as aluminum framing and glass, steel studs and other cladding, or other wall materials).
 - 6. Joints in smoke barriers.
 - 7. Joints at the intersection of horizontal smoke barriers and exterior curtain wall assemblies.
 - 8. Penetrations into or through non-fire-resistance-rated floors, floor/ceiling assemblies, and the ceiling membrane floor/ceiling assemblies.

1.07 MOCK-UP

- A. Install one mock-up of each major type of firestop assembly using proposed materials and illustrating workmanship to be expected in the completed work.
- B. Obtain approval of the manufacturer's technical representative before proceeding with firestopping work.
- C. Disassembly or removal may be required during inspection.

1.08 PROJECT CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original unopened containers bearing the name of the manufacturer, product name, type, and testing agency's identification mark.
- B. Store products in accordance with manufacturer's instructions.

1.10 SEQUENCING AND SCHEDULING

- A. Perform firestopping work after completion of work which penetrates fire barriers, but prior to covering up or eliminating access to the penetration. Coordinate with installers of such other work.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS

- A. Fire Testing of Assemblies: Provide materials and designs that have been tested by approved agencies, as follows:
1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) 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.
- B. Provide products complying with requirements of the contract documents and made by a single manufacturer to the greatest extent practicable, unless otherwise indicated and approved by the Architect.

2.03 MATERIALS

- A. Firestopping Materials: Provide assemblies whose fire-resistance ratings have been determined by testing in the configurations required and which have fire-resistance ratings at least as high as that of the fire-rated assembly in which they are to be installed.
1. If a tested assembly is not available for a particular penetration or joint configuration, modify the penetration or joint configuration to suit available assemblies; do not modify assembly configuration except as specifically stated in the test report or as approved by the authority having jurisdiction.
 2. Provide products that:
 - a. Allow normal expansion and contraction movement of the assembly without failure of the seal.
 - b. Emit no hazardous, combustible, or irritating by-products during installation or curing period.
 - c. Do not require special tools for installation.
 3. Provide products that allow for differential movement unless otherwise approved.
 4. For products used in horizontal assemblies, provide products that are impervious to water when fully cured.
 5. For materials used in expansion joints, provide sealant with at least 40% movement capability in compression or extension. For other joints provide at least 25% movement capability in compression or extension.
 6. Select assemblies and products so as to minimize the number of different assemblies and different products used.
- B. Penetration Assembly Labels: Permanent, red marking with black lettering.
1. For marking firestopping assemblies, use self-adhesive tape or wired-on labels.
 2. Legend:
 - a. Fire-Rated Assembly - Do not disturb - See maintenance instructions".
 - b. Product manufacturer's name.
 - c. U.L. Des. No. _____
 - d. F rating: _____
 - e. T rating: _____
 - f. Installer's name.
- C. Partition Labels:

1. Permanent, red lettering with legend "FIRE AND SMOKE BARRIER - PROTECT ALL OPENINGS".
2. Use letters at least 3 inches (77 mm) high.

2.04 ASSEMBLIES

- A. Protect fire rated construction and smoke barriers as required by the building code, and using materials subject to the limitations of this specification.
 1. Exceptions: Certain materials, locations, and assemblies are exempt where permitted by the building code and approved by the authorities having jurisdiction.
- B. Penetrations into or through fire walls, fire barriers, smoke barriers, and fire partitions: Provide through-penetration firestop systems tested per ASTM E 814 or UL 1479, minimum positive pressure differential of 0.01 inch of water, F rating not less than that of the wall.
- C. Penetrations into or through fire-resistance-rated floors, floor/ceiling assemblies, and the ceiling membrane of roof/ceiling assemblies: Provide through-penetration firestop systems tested per ASTM E 814 or UL 1479, minimum positive pressure differential of 0.01 inch of water, F rating and T rating not less than that of the floor nor less than 1 hour whichever is greater.
- D. Penetrations in smoke barriers: Provide through-penetration firestop systems tested per UL 1479 for air leakage. The L rating measured at 0.30 inch of water in ambient and elevated temperature tests: Not greater than 5.0 CFM/SF of penetration opening for each penetration or a total leakage of 50 CFM for any 100 SF of wall area or floor area.
- E. Joints in or between fire-resistance-rated walls, floors, floor/ceiling assemblies, roofs, and roof/ceiling assemblies: Provide fire-resistant joint systems tested per ASTM E 1966 or UL 2079.
- F. Joints between fire-resistance-rated floor or floor/ceiling assemblies and exterior curtain wall assemblies (where a curtain wall is formed by wall materials that bypass the floor slab edge such as aluminum framing and glass, steel studs and other cladding, or of other wall materials): Provide an approved system tested per ASTM E 2307, F rating not less than that of the floor.
- G. Joints in smoke barriers: Provide fire-resistant joint systems tested per UL 2079 for air leakage. The L rating measured at 0.30 inch of water in ambient and elevated temperature tests: Not greater than 5 CFM/LF.
- H. Joints at the intersection of horizontal smoke barriers and exterior curtain wall assemblies.

2.05 ACCESSORIES

- A. Primers, Sleeves, Forms, and Accessories: Type required for tested assembly design.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Preinstallation Inspection:
 1. Inspect for penetrations of any type; mark or otherwise identify all penetrations indicating action required: "Repair" or "Firestop".
 2. Conduct inspection prior to covering up or enclosing walls or ceilings.
 3. Conduct inspection jointly with authorized representative of authority having jurisdiction, unless the authority waives the inspection.
 4. Submit a report detailing findings of inspection to the Architect.

- B. If the configuration of a particular penetration does not conform to the configuration necessary for the required firestopping assembly, modify the construction to suit the firestopping assembly design.

3.02 PREPARATION

- A. Prepare penetrations in accordance with material manufacturer's instructions.
- B. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- C. Remove incompatible materials which may affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings. Provide all accessory materials required.
- B. Produce a smooth, uniform, neat appearing finish.
- C. Remove combustible forming materials, unless they are a required component of the tested assembly.
- D. Do not cover installed firestopping until inspected by authority having jurisdiction, unless such inspection is waived by the authority.

3.04 PERMANENT IDENTIFICATION

- A. Affix penetration assembly labels to each fire-stop penetration assembly.
- B. Install partition labels on fire rated partitions above lay-in ceilings at intervals not exceeding 12 feet.

3.05 FIELD QUALITY CONTROL

- A. Special inspections are required by the building code or by the authority having jurisdiction. Inspections shall be conducted in accordance with ASTM E 2174 and ASTM E 2393 by an approved inspection agency acceptable to the authority having jurisdiction.
 - 1. The Owner will pay for the cost of one such inspection. The cost of additional inspections, if required, will be deducted from the Contract Price in accordance with the General Conditions.
- B. Special Inspections: Coordinate and schedule special inspections by the approved inspection agency.
- C. Inspect completed installations for completeness and correct installation.
 - 1. Arrange for the firestopping material manufacturer's representative to conduct an inspection of completed work.
 - 2. If installed work is to be covered in completed work, inspect and obtain approval prior to covering.
- D. Submit report of inspection to the Architect.
- E. Notify the Architect of completed firestopping work prior to covering with subsequent work.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces of excess firestopping materials promptly. Use methods and materials approved by the manufacturers of the penetration seals and of surfaces to be cleaned.
- B. Protect adjacent surfaces from damage by material installation.
- C. Protect installed work during curing period.

- D. Protect installed work from damage from construction operations using substantial barriers, if necessary.
- E. Repair damaged firestopping and adjacent materials in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 9000 - JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section Includes:
 - 1. Sealants and joint backing.
- B. Work of this section includes:
 - 1. Sealing of joints indicated in the schedule at the end of this section and in other locations required by the Contract Document.
 - 2. Seal joints on the interior of the building to prevent the passage of water or air from space to space or between adjacent building materials and assemblies.
 - 3. Joints of a nature similar to that of joints indicated shall be sealed with same sealer, whether or not specifically indicated on the drawings and schedules to be sealed.

1.02 REFERENCES

- A. ASTM C 834 - Standard Specification for Latex Sealants; 2005.
- B. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants; 2005.
- C. ASTM C 1193 - Standard Guide for Use of Joint Sealants; 2005a.

1.03 DEFINITIONS

- A. M Type Substrates: Cast-in-place concrete, concrete masonry units, clay brick, masonry mortar, natural stone.
- B. G Type Substrates: Glass and transparent plastic glazing sheets.
- C. A Type Substrates: Metals, porcelain, glazed tile, and smooth plastics.
- D. O Type Substrates: Wood, unglazed tile; substrates not included under other categories.
- E. Use T: Surfaces bearing pedestrian or vehicular traffic.
- F. Use NT: Non-traffic-bearing surfaces.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide manufacturer's data on each joint sealer indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability, and installation instructions.
 - 2. Provide manufacturer's technical guide containing recommendations for primers for each exterior sealant/substrate combination.
- B. Samples: Submit two cured samples for each product exposed to view, illustrating full range of sealant colors available for selection.
- C. Installer's Preconstruction Inspection Report: List all conditions detrimental to performance of joint sealer work.
- D. Warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original containers or bundles with labels showing manufacturer, product name or designation, color, shelf life, and installation instructions.

1.06 PROJECT SITE CONDITIONS

- A. Environmental Limitations: Do not install sealers if any of the following conditions exist:

1. Air or substrate temperature exceeds the range recommended by sealer manufacturer or is below 40 degrees F (4.4 degrees C) or is above 100 degrees F (38 degrees C).
 2. Substrate is wet, damp, or covered with snow, ice, or frost.
 3. Substrate is dusty, oily, or otherwise contaminated.
- B. Dimensional Limitations: Do not install sealers if joint dimensions are less than or greater than that recommended by sealer manufacturer; notify the Architect and get joint sealer manufacturer's recommendations for alternative procedures.
- C. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 WARRANTY

- A. Submit a written warranty signed by the Contractor guaranteeing to correct failures in joint sealer work within a five year period after Date of Substantial Completion, without reducing or otherwise limiting any other rights to correction which the Owner may have under the contract documents. Failure is defined as failure to remain weathertight due to faulty materials or workmanship. Correction is limited to replacement of sealers.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 SEALANTS

- A. Mildew-Resistant Silicone Sealant: One-part, ASTM C 920, Type S, Grade NS, Class 25, Use NT, formulated with fungicide, for interior use on nonporous substrates.
1. Products:
 - a. Dow Corning Corporation; Dow Corning 786: www.dowcorning.com. (33 g/l)
- B. Latex Sealants:
1. Acrylic-Latex Emulsion Sealant: One-part, nonsag, mildew-resistant, paintable; complying with ASTM C 834.
 - a. Products:
 - 1) Bostik; Chem-Calk 600; www.bostik.com. (39 g/l)
 - 2) Pecora Corporation; AC-20 + Silicone: www.pecora.com. (31 g/l)
 - 3) Sonneborn/BASF Building Products; Sonolac: www.buildingsystems.basf.com. (41 g/l)

2.03 ACCESSORIES

- A. Primer for Silicone Sealants: Nonstaining type, as recommended by joint sealant manufacturer for specific substrates encountered on the project and as verified by testing.
- B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; not damaging to substrates, and compatible with joint forming materials.
- C. Backer Rods: Flexible, nonabsorbent, compressible polyurethane foam, either open cell or nongassing closed cell, unless otherwise restricted by sealant manufacturer; preformed to appropriate size and shape.
- D. Bond-Breaker Tape: Self-adhesive, polyethylene or other plastic tape, unless otherwise restricted by sealant manufacturer; suitable for preventing sealant adhesion.
- E. Masking Tape: Nonabsorbent, nonstaining.
- F. Tooling Agents: Approved by sealant manufacturer; nonstaining to sealant and substrate.

2.04 SEALANT COLORS

- A. The Architect will select sealant colors from manufacturer's full range of available colors for each respective sealant and adjacent substrate.
- B. Obtain approval of mock-up color before ordering job quantities of sealant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints for characteristics that may affect sealer performance, including configuration and dimensions.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Cleaning: Just before starting sealer installation, clean out joints as follows:
 - 1. Remove loose materials and foreign matter which might impair adhesion of sealant including, but not limited to, dust, dirt, coatings, paint, oil, and grease.
 - 2. Dry out damp and wet substrates thoroughly.
 - 3. Clean A-type and G-type substrates by chemical or other methods that will not damage the substrate.
 - 4. Remove loose particles by brushing and by blowing with oil-free compressed air.
 - 5. Concrete: Remove laitance and form-release coatings.
 - 6. Use methods which will not leave residues that will impair adhesion.
- B. Prime joint substrates where required by this specification, manufacturer's recommendations, or adhesion tests.
- C. Masking Tape: Use masking tape to keep primers and sealers off of adjacent surfaces which would be damaged by contact or by cleanup. Remove tape at the end of each day.
- D. Protect elements surrounding the work of this section from damage or disfigurement.
- E. Install fillers where needed to provide proper joint depth or support for sealant backers.
- F. Do not begin joint sealer work until unsatisfactory conditions have been corrected.

3.03 INSTALLATION

- A. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- B. Comply with sealer manufacturer's installation instructions and recommendations, except where more restrictive requirements are specified.
- C. Gunnable and Pourable Sealants: Comply with recommendations of ASTM C 1193.
- D. Backers:
 - 1. Install backers at depth required to result in shape and depth of installed sealant which allows the most joint movement without failure.
 - a. Make backers continuous, without gaps, tears, or punctures.
 - b. Do not stretch or twist backers.
 - 2. Use bond-breaker tape wherever it is necessary to keep sealant from adhering to back or third side of joint.
 - 3. If backers become wet or damp before installation of sealant, dry out thoroughly before proceeding.
- E. Shape and Depth: Use methods recommended by manufacturer; completely fill the joint; make full contact with bond surfaces; tool nonsag sealants to smooth surface eliminating air pockets.

1. Use concave joint shape shown in Figure 8 in ASTM C 1193, where not otherwise indicated.
2. Depth of sealant at center of joint, unless otherwise required by the Contract Documents or recommended by manufacturer:
 - a. For joints up to 1/4 inch (6.4 mm) wide: Depth equal to width.
 - b. For joints 1/4 inch to 1/2 inch (13 mm) wide: Depth equal to 1/4 inch.
 - c. For joints over 1/2 inch (13 mm) wide: Depth equal to 1/2 the width but not deeper than 1/2 inch.
3. Contact depth: Twice the depth of sealant at center of joint, unless otherwise required.

3.04 CLEANING

- A. Clean adjacent soiled surfaces adjacent to joints as work progresses and before sealants set using methods and materials approved by manufacturers of sealers and of surfaces to be cleaned.

3.05 PROTECTION OF FINISHED WORK

- A. Protect sealants from contamination and damage until cured.
- B. Remove and replace damaged sealers.

3.06 SCHEDULE

- A. General:
 1. Seal joints on the interior of the building to prevent the passage of water or air from space to space or between adjacent building materials and assemblies.
 2. Joints of a nature similar to that of joints indicated shall be sealed with same sealer, whether specifically indicated on the drawings and schedules to be sealed or not.
- B. Typical Interior Joints:
 1. Including, but not limited to:
 - a. Between walls or partitions and adjacent casework, laboratory furniture, fixed shelving, fixed equipment, lighting fixtures, laboratory piped utility fittings.
 - b. Between concrete or masonry or other material and the perimeters of frames of doors, windows, access panels, etc. (Note: Sealing of gypsum panel/metal stud construction is specified in Section 09 2116.)
 - c. Between hollow metal jambs and resilient flooring.
 - d. Around penetrations such as electrical boxes, plumbing, cabinets, ducts, and other openings in concrete or masonry walls or partitions. Comply with recommendations and details in USG Corporation's "Gypsum Construction Handbook".
 - e. Interior joints for which no other sealer is indicated.
 2. Use the following sealant:
 - a. Acrylic-emulsion latex sealant.
 3. Between concrete or masonry walls or partitions and adjacent columns, pilasters, walls, partitions, floors, ceilings, or other construction: One-part, nonsag urethane sealant.
- C. Joints in Interior Wet Areas:
 1. Including, but not limited to:
 - a. Between walls or other surfaces and adjacent plumbing fixtures, fittings, and casework.
 2. Use the following sealants:
 - a. Mildew-resistant silicone sealant.

END OF SECTION

SECTION 08 1100 - STEEL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work Included in this Section:
 - 1. Steel Doors:
 - a. Non-fire-resistance rated interior steel doors.
 - b. Fire-resistance rated interior steel doors.
 - 2. Steel Frames:
 - a. Non-fire-resistance rated interior steel frames.
 - b. Fire-resistance rated interior steel frames.
 - c. Steel frames in masonry openings.
 - d. Steel frames in gypsum board partitions.
 - e. Steel frames for glazed lights, interior transoms, and panels.

1.02 REFERENCES

- A. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- B. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2004).
- C. DHI A115 Series - Specifications for Steel Doors and Frame Preparation for Hardware; Door and Hardware Institute; current edition (ANSI/DHI A115 Series).
- D. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- E. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; 2007.
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2008.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

1.03 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 identifying location of different finishes, if any.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01600 - Product Requirements.

2.02 GENERAL

- A. Requirements for All Units:
 - 1. Door Top Closures: Flush with top of faces and edges.

2. Door Edge Profile: Beveled on both edges.
3. Door Texture: Smooth faces.
- B. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
- C. Finish: Factory primed, for field finishing.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all 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 STEEL DOORS

- A. Interior Doors, Non-Fire-Rated:
 1. Grade: ANSI A250.8 Level 2, 18 ga., physical performance Level B, Model 1, full flush.
 2. Core: Cardboard honeycomb.
 3. Thickness: 1-3/4 inches.
 4. Texture: Smooth faces.
- B. Interior Doors, Fire-Rated:
 1. Grade: ANSI A250.8 Level 2, 18 ga., physical performance Level B, Model 1, full flush.
 2. Fire Rating: As indicated on Door and Frame Schedule, with temperature rise ratings as required by code, tested in accordance with NFPA 252.
 - a. Provide units listed and labeled by UL or WH.
 - b. Attach fire rating label to each fire rated unit.
 3. Core: Mineral fiberboard.
 4. Texture: Smooth faces.

2.04 STEEL FRAMES

- A. General:
 1. Comply with the requirements of grade specified for corresponding door, except:
 - a. ANSI A250.8 Level 1 Doors: 16 gage frames.
 2. Finish: Same as for door.
 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- B. Interior Door Frames, Non-Fire-Rated:
 1. Masonry openings: Fully welded.
 2. Gypsum board partitions: Fully welded.
- C. Interior Door Frames, Fire-Rated:
 1. Masonry openings: Fully welded.
 2. Gypsum board partitions: Fully welded.
 3. Fire Rating: Same as door, labeled.
- D. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 ACCESSORY MATERIALS

- A. Glazing:

1. As specified in Section 08 8000.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- D. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- E. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.06 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard.
- B. In addition, 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. Coordinate installation of hardware.
- F. Coordinate installation of glazing.

3.04 ERECTION TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Solid core veneer-faced doors with a transparent finish.
 - 2. Factory finishing.
 - 3. Prefitting by manufacturer.
 - 4. Premachining by manufacturer.

1.02 REFERENCES

- A. Architectural Woodwork Standards; Architectural Woodwork Institute (AWI); 2009, Edition 1.
- B. WDMA (HOW)-- How to Store, Handle, Finish, Install, and Maintain Wood Doors; Wood Flush Doors; National Wood Window and Door Association; 2004.
- C. WDMA I.S. 1A -- Architectural Wood Flush Doors; National Wood Window and Door Association; 2004.

1.03 SUBMITTALS

- A. Product Data: Submit detailed technical information for each distinct product specified in this section. Include complete data for factory finished doors.
- B. Shop Drawings: Prepare and submit shop drawings showing relevant information, including:
 - 1. Construction details for each distinct product type.
 - 2. Dimensions and location of blocking for hardware.
 - 3. Factory finishing details.
- C. Samples: Submit samples for the following:
 - 1. Veneer verification samples: Minimum 8-1/2 by 11 inches.
 - 2. Factory finishes:
 - a. Verification samples: Minimum 8-inch-square sample for each color, effect, and type of factory finish.
- D. Certificates:
 - 1. Submit certification that manufacturer's construction standards and tested fire door assembly requirements comply with contract requirements indicated for doors, hardware, hardware templating, size of lights, and other design characteristics.
 - a. Clearly note any exceptions to certification, citing door number and hardware set. Exceptions shall be subject to the approval of the Architect.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Member of AWI Quality Certification Program (QCP).

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as required to prevent damage or deterioration. Conform to manufacturer's recommendations, requirements of referenced standard, and recommendations of WDMA I.S.1A, Appendix, "How to Store, Handle, Finish, Install, and Maintain Wood Doors."
- B. Clearly label each door with opening number where door will be installed. Use removable, temporary labels or mark on door surface which will be concealed from view after installation.
 - 1. Coordinate door identification with shop drawing designations.

- C. Environmental Requirements: Do not deliver, store, or install products of this section before building's design temperature and humidity levels have been achieved and will be maintained at those levels.

1.06 WARRANTIES

- A. Manufacturer's Warranty (Interior Doors):
 - 1. Submit a written warranty signed by the manufacturer guaranteeing to correct failures in products which occur within the warranty period indicated below, without reducing or otherwise limiting any other rights to correction which the Owner may have under the contract documents. Failures are defined to include:
 - a. Faulty workmanship.
 - b. Delamination.
 - c. Stile, rail, or core show-through (telegraphing) visible to the naked eye to any degree when viewed from a horizontal distance of 3 to 4 feet.
 - d. Warp (including bow, cup, and twist) in excess of 1/4 inch when measured in accordance with WDMA I.S. 1A.
 - 2. Correction includes repair or replacement at the option of the Architect. Correct failures which occur within the following warranty periods after Substantial Completion:
 - a. Solid core interior doors: Life of original installation.
- B. If, for any reason, the Contractor's work results in nullification of manufacturer's warranty, the Contractor shall correct failures and pay for such correction.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 WOOD DOORS - GENERAL REQUIREMENTS

- A. Flush Doors: Conform to the following, hereinafter referred to as referenced standard(s):
 - 1. "Architectural Woodwork Quality Standards" including Section 1300, "Architectural Flush Doors".
 - a. Where the AWI standard indicates requirements that conflict with WDMA standards, comply with AWI.

2.03 CONSTRUCTION

- A. Faces:
 - 1. Veneer species, cut, and grade for transparent finish (NWWDA, AWI, HPVA standards):
 - a. White (sap) Maple, Plain Sliced, Grade A.
- B. Construction: PC-5 (5-ply).
- C. Core, Non-Fire-Rated Doors: Particleboard, bonded to stiles and rails, sanded.
- D. Glue: Type I at exterior doors and at interior doors subject to wetness or humidity such as at toilets, kitchens, showers, etc. Type I or II at other interior doors.

2.04 FABRICATION

- A. General:
 - 1. Fabricate to provide consistent clearances as indicated.
 - 2. Hinge and lock edges:
 - a. Provide 1/8-inch standard bevel at edges, unless standard bevel would not precisely match hardware bevel; provide proper bevel for hardware.
 - 3. Make neat mortises and cutouts for door hardware indicated.

4. Prefitting: Fabricate and trim doors to size at factory to coordinate with frame shop drawings and floor finishes as indicated in the finish schedule.
 - a. Provide non-standard clearances and tolerances indicated in Part 3.
5. Premachining: Make all mortises and cutouts required for hardware at the factory to conform to approved hardware schedule, hardware templates, and door frame shop drawings.

2.05 FACTORY FINISHING

- A. Comply with AWI Section 5, "Factory Finishing".
- B. Transparent Finish:
 1. manufacturers standard satin finish

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect door frames and doors before beginning door installation.
 1. Verify that frames are properly installed and aligned and are capable of providing trouble free support for doors throughout range of door swing.
- B. Correct unsatisfactory conditions before installing products of this section. Commencement of installation indicates acceptance of conditions.

3.02 INSTALLATION

- A. Hardware Installation: Elsewhere in Division 8.
- B. Install doors in accordance with manufacturer's recommended procedures and requirements of referenced standard.
- C. Prefit Doors: Minimize field fitting to those procedures which are necessary to complete work unfinished during factory prefitting and to provide trouble free operation.
 1. Accurately align and fit doors for trouble free operation throughout range of door swing.
- D. Prefitting Clearances:
 1. Door edge and head: 1/8 inch.
 2. Door edge and jamb: 1/8 inch.
 3. Door bottom edge and top surface of threshold: 1/4 inch.
 4. Door bottom edge and floor covering surface or finish (where threshold is not indicated): 1/8 inch.
 5. Meeting edges at pairs of doors: 1/8 inch total.
- E. Installation Clearances: Install doors so as to maintain prefitting clearances specified.
- F. Factory-Finished Doors: Before installing doors, restore finish at door edges cut during field fitting.

3.03 ADJUSTING

- A. Adjust doors for proper operation; coordinate with hardware adjustment; replace doors that cannot be properly adjusted.
- B. Where door finishes are damaged during installation, restore in a manner that results in the door showing no evidence of the restoration. If refinished door cannot be made to match other doors, remove refinished door and replace with new conforming work at the Contractor's expense.
- C. Protect installed work.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

1.02 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- B. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 SUBMITTALS

- A. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- B. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS

2.01 ACCESS DOOR AND PANEL APPLICATIONS

- A. Walls, Unless Otherwise Indicated:
 - 1. Size: 12 x 12 inches, unless otherwise indicated.
 - 2. Tool-operated spring or cam lock; no handle.
 - 3. In Gypsum Board: Drywall bead frame with door surface flush with wall surface.
 - 4. In Masonry: Surface mounted frame with door surface flush with frame surface.
- B. Fire Rated Walls: See drawings for wall fire ratings.
 - 1. Size: 12 x 12 inches, unless otherwise indicated.
 - 2. Uninsulated, single thickness door panel.
 - 3. Tool-operated spring or cam lock; no handle.
- C. Ceilings, Unless Otherwise Indicated: Same type as for walls.
 - 1. Material: Steel.
 - 2. Size in Lay-in Grid Ceilings: To match grid module.
 - 3. Size in Other Ceilings: 12 x 12 inches, unless otherwise indicated.
 - 4. Standard duty, hinged door.
 - 5. Tool-operated spring or cam lock; no handle.

2.02 WALL AND CEILING UNITS

- A. Basis of Design:
 - 1. Acudor Products Inc: www.acudor.com.
 - a. Units in Non-Rated Walls, Unless Otherwise Indicated: ACUDOR UF-5000.
 - b. Units in Fire-Rated Walls Rated 2 Hours and Less: ACUDOR FB-5060.
 - 2. Other acceptable manufacturers:
 - a. Cendrex, Inc: www.cendrex.com.
 - b. Karp Associates, Inc: www.karpinc.com.
 - c. Milcor by Commercial Products Group of Hart & Cooley, Inc: www.milcorinc.com.
 - d. The Bilco Company. www.bilco.com.
- B. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
 - 1. Style: Flush to frame with reinforced edges, flange to be 1 inch wide.

2. Door Style: Single thickness with rolled or turned in edges.
3. Frames: 16 gage, 0.0598 inch, minimum.
4. Units in Fire Rated Assemblies: Fire rating as required by applicable code for the fire rated assembly in which they are to be installed.
 - a. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
5. Steel Finish: Primed.
6. Primed Finish: Polyester powder coat; manufacturer's standard color.
7. Hardware:
 - a. Hardware for Fire Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION

SECTION 08 4000 - ALUMINUM FRAMING SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Storefront.
- B. Glass infill.
- C. Perimeter sealant.

1.02 REFERENCES

- A. AA DAF-45 - Designation System for Aluminum Finishes; The Aluminum Association, Inc.; 2003.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2004.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2006.
- E. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2007.
- F. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
- G. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2002.
- H. ASTM E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000.

1.03 SUBMITTALS

- A. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glazing and infill, and internal drainage details.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- C. Samples: Submit two samples 12 x 12 inches in size illustrating finished aluminum surface, glazing, infill panels, glazing materials.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

1.05 MOCK-UP

- A. Provide mock-up including all components occurring on project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- B. Locate on-site where directed. Mock-up may not remain as part of the Work.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS

- A. Kawneer Company, Inc: www.kawneer.com.
- B. Vistawall Architectural Products: www.vistawall.com.

2.03 STOREFRONT SYSTEM

- A. Kawneer Company, Inc.:
- B. Vistawall Architectural Products:
- C. Performance Requirements:
 - 1. Design and size components to withstand the following load requirements without damage or permanent set:
 - a. Design Wind Load (positive or negative): 20 lbf/sq ft.
 - b. Member Deflection: Limit member deflection to L/175 in any direction or 3/4 inch, whichever is less, with full recovery of glazing materials.
 - c. Measure performance by testing in accordance with ASTM E 330, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
 - 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Movement between aluminum framing and perimeter framing.
 - b. Inter-story drift.
 - 3. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E 283.
 - 4. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 6.24 lbf/sq ft.
 - 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. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.
 - 7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

2.04 COMPONENTS

- A. Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
- B. Aluminum Framing Members: Tubular aluminum sections, drainage holes, and internal weep drainage system.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- B. Fasteners: Stainless steel.
- C. Glazing: As specified in Section 08 8000.
- D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- E. Glazing Accessories: As specified in Section 08 8000.
- F. Perimeter Seal Materials:
 - 1. Air Seal:
 - a. Dow Corning Corporation; Dow Corning 578 Silicone Weather Barrier Sealant: www.dowcorning.com (61 g/l)
 - 2. Edge Seal:
 - a. Dow Corning Corporation; Dow Corning 578 Silicone Weather Barrier Sealant: www.dowcorning.com (61 g/l)
 - 3. Weather Seal: High movement silicone sealant specified in Section 07 9000.

2.06 FINISHES

- A. Comply with AA DAF-45 for aluminum finishes required.
- B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.07 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce framing members for imposed loads.
- G. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

- C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

3.03 PERIMETER SEALING

- A. Storefront: Provide a continuous seal around the entire perimeter of each assembly at each of the following locations:
 - 1. Weather Seal: Place backer rod and seal between aluminum framing and adjacent cladding using high movement silicone sealant specified in Section 07 9000.
 - 2. Weather-Resistant Barrier: Place backer rod and seal between aluminum framing and adjacent weather-resistant barrier with a bead of Edge Seal.
 - 3. Air Seal and Back Dam: Seal the interior of each assembly to the weather-resistant membrane.
 - a. Place backer rod, and seal the aluminum framing to the weather-resistant membrane with a bead of Air Seal.

3.04 ERECTION TOLERANCES

- A. Storefront Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Aluminum Framing and Adjacent Construction: 1/2 inch +/- 1/8 inch, unless indicated otherwise on the drawings.

3.05 CLEANING AND PROTECTION

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
- D. Protect finished work from damage.

END OF SECTION

SECTION 087100
HARDWARE

PART 1 - GENERAL

- 1.1 Refer to "General and Special Conditions", and "Instructions to Bidders", Division 1 of Specifications. Requirements of these Sections and the project drawings shall govern work in this section.
- 1.2 Work Included:
- A. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
 - B. Related Sections:
 - 1. Division 8 – Standard Steel Doors
 - 2. Division 8 – Standard Steel Frames
 - 3. Division 8 – Special Doors
 - 4. Division 8 – Aluminum Entrances and Storefronts
 - 5. Division 8 – Window Hardware
 - 6. Division 16 – Smoke Detection Systems
 - 7. Division 16 – Security Access Systems
 - 8. Division 16 – Electrical rough-in, conduit junction boxes, wiring, primary power and final hook-up of all finish hardware components requiring electrical connections.
 - C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
 - 1. Windows
 - 2. Cabinets of all kinds, including open wall shelving and locks.
 - 3. Signs, except as noted.
 - 4. Toilet accessories of all kinds including grab bars.
 - 5. Installation
 - 6. Rough hardware
 - 7. Folding partitions, except cylinders where detailed.
 - 8. Access doors and panels
 - 9. Overhead doors
- 1.3 Quality Assurance
- A. Requirements of Regulatory Agencies:
 - 1. Furnish finish hardware to comply with the requirements of laws, codes, ordinances, and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the Specifications.
 - 2. Furnish finish hardware to comply with the requirements of the regulations for public building accommodations for physically handicapped persons of the governmental authority having jurisdiction and to comply with Americans with Disabilities Act.
 - 3. Provide hardware for fire-rated openings in compliance with NFPA 80 and state and local building code requirements. Provide only hardware that has been tested and listed

by UL for types and sizes of doors required and complies with requirements of door and door frame labels.

4. Where emergency exit devices are required on fire-rated doors that carry supplementary marking on the doors UL labels indicating "Fire Door to be equipped with Fire Exit Hardware" provide UL label on exit devices indicating "Fire Exit Hardware".

B. Hardware Supplier:

1. Shall be an established firm dealing in contract builders' hardware. He must have adequate inventory, qualified personnel on staff and be located within 100 miles of the project. Only domestic manufacturers are acceptable and the distributor must be a factory-authorized dealer for all materials required. The supplier shall be or have in employment an Architectural Hardware Consultant. (AHC)

C. Electrified Door Hardware Supplier:

1. Shall be an experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.
2. Shall prepare data for electrified door hardware, including shop drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this project.
3. Shall have experience in providing consulting services for electrified door hardware installations.

D. Pre-construction Meeting:

1. Prior to development of the Hardware Schedule, a Finish Hardware Meeting will be held at the Architect's office. The Contractor/Construction Manager and the Hardware Supplier's personnel, directly responsible for preparing the Hardware Schedule, shall meet with the Architect and the Architect's Hardware Consultant. The purpose of the meeting is to review the contract documents' hardware schedule requirements and will include, but not be limited to the following:
 - a. Review specification requirements for hardware schedule, formats, hardware locations, opening descriptions, and other information specified.
 - b. Review products specified versus products proposed.
 - c. Hardware Supplier shall distribute, at the meeting, samples of schedules from other projects of similar nature prepared by the same person as will prepare schedule for this project.

E. Pre-installation Meeting:

1. Before hardware installation, General Contractor/Construction Manager shall request a hardware installation seminar be conducted on the installation of hardware; specifically that of locksets, closers, exit devices, overhead stops and coordinators. Manufacturer's representatives of the above products, in conjunction with the hardware supplier for the project, shall present the seminar. Seminar to be held at job site and attended by installers of hardware for aluminum, hollow metal and wood doors. Seminar to address proper coordination and installation of hardware, per finish hardware schedule for this specific project, by using installation manuals, hardware schedule, templates, physical product samples and installation video's.
2. When any electrical or pneumatic hardware is specified this meeting shall also include the following trades/installers: Electrical, Security, Alarm systems and Architect.

3. Convene one week prior to commencing work of this Section
4. Coordinate with Division 1.
5. The Hardware Supplier shall include the cost of this seminar in his proposal.

F. Manufacturer:

1. Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
2. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.

1.4 Submittals:

A. Hardware Schedule

1. Submit proper number of Hardware Schedules to allow the Architect to retain two copies for his use, plus the number of copies required by the Contractor for his distribution and use. In any event, do not submit more than six copies.
2. Include the following:
 - a. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

CATEGORY	SPECIFIED	SCHEDULED
Hinges	Manufacturer A	Manufacturer B
Lock sets	Manufacturer X	Manufacturer X
Kick Plates	Open	Manufacturer Z

3. Hardware Locations: Refer to Article 3.1 B.2 Locations.
4. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
5. Hardware Description: Quantity, category, product number, fasteners, and finish.
6. Headings that refer to the specified Hardware Set Numbers.
7. Scheduling Sequence shown in Hardware Sets.
8. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
9. Riser drawings, wiring drawings and system operation description.
10. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
11. Typed Copy.
12. Double-Spacing.
13. 8-1/2 x 11 inch sheets
14. U.S. Standard Finish symbols or BHMA Finish symbols.
15. Generally, follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule. Modified as above.

B. Product Data:

1. Submit, in booklet form using supplier's schedule covers as binders. Product data of items of hardware listed in supplier's schedule.
2. Submit product data concurrently with hardware schedule.

C. Inspection Report:

1. Submit inspection report specified in 3.1.C.2. for locksets, exit devices, ADA special closers, door closers and all electrical hardware.

D. Samples:

1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

E. Key Schedule:

1. Submit detailed schedule indicating clearly how the Owner's final keying instructions have been followed.
2. Submit as an integral part of finish hardware schedule or as a separate keying schedule.

F. Elevation and Wiring Drawings:

1. Submit elevation drawing showing relationship of all electrical hardware components to door and frame. Indicate number and gage of wires required.
2. Submit wiring drawing showing point to point wire hook up for all components.
3. Submit system operations descriptions for each type of opening; describe each possible condition.
4. Submit system operation description as part of the original hardware schedule submittal. Failure to include will result in the schedule being returned not reviewed and not approved.

- G. Submit to General Contractor/Construction Manager, two copies each of parts and service manuals and two each of any special installation or adjustment tools. Include for locksets, exit devices, door closers and any electrical products.

1.5 Product Delivery, Storage, and Handling

- A. Label each item of hardware with the appropriate door number and Hardware Schedule heading number, and deliver to the installer so designated by the contractor.

1.6 Warranties

- A. Mortise locksets shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.
- B. Closers shall carry manufacturer's 10-year warranty against manufacturing defects and workmanship.
- C. Exit devices shall carry manufacturer's 3-year warranty against manufacturing defects and workmanship.

- D. Continuous gear hinges shall carry manufacturer's guarantee to be free from defects in material and workmanship.
- E. ADA Special Closers shall carry manufacturer's 2-year warranty against manufacturing defects and workmanship.
- F. Balance of items shall carry a manufacturer's 1-year warranty against manufacturing defects and workmanship.
- G. 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 Owner. Replace work found to be defective as defined in the Contract Documents.

1.7 Maintenance

- A. Attic Stock: Provide additional locksets, complete with levers, escutcheons and other specified trim, but not including cylinders, as follows:
 - 1. For each individual lock function type, provide additional locksets of the same function in the following quantities:
 - a. For less than 20 locksets: No attic stock.
 - b. For 20 locksets or more, but less than 100 locksets: 2 additional units.
 - c. For 100 locksets or more: 4 additional units.
 - d. For each 50 additional locksets over 100 units: 1 additional unit.
 - 2. When 20 or more locksets of all function types are scheduled, but less than 20 are of a single function, provide 2 additional locksets of functions selected by the Architect from the range of function types included in the Project.
 - 3. Deliver attic stock units to Owner's Key Office in manufacturer's original packaging. Clearly mark each box with Project title, including building and description, and University of Michigan Project Number.

PART 2 - PRODUCT

- 2.1 Furnish each category with the products of only one manufacturer unless specified otherwise; this requirement is mandatory whether various manufacturers are listed or not.
- 2.2 Provide the products of manufacturer designated or if more than one manufacturer is listed, the comparable product of one of the other manufacturers listed. Where only one manufacturer or product is listed, "no substitution" is implied.
 - A. Hinges:
 - 1. Furnish hinges of class and size as indicated in sets.
 - 2. Numbers used in sets are lvs.
 - 3. Equal products of any B.H.M.A. member will also be acceptable.
 - B. Locksets and Latchsets – Grade 1 Mortise Type with Tubular Lever Trim:
 - 1. Locks are to have a standard 2 ³/₄" backset.
 - 2. Function numbers are Schlage (SCH) L9000 series with 03N lever trim.
 - a. Corbin-Russwin ML2000 LSM lever trim.

3. Provide strikes with extended lips where required to protect trim from being marred by latch bolt. Provide strike lips that do not project more than 1/8" beyond door frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

C. Closers:

1. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
2. LCN 4000 Series as listed in sets. (No substitutions)

D. Low-Energy Door Operators:

1. Refer to door and frame details and furnish accessories such as drop plates, panel adapters, spacers and supports as required to correctly install door closers. State degree of door swing in the hardware schedule.
2. LCN 4640 Series as listed in sets.
 - a. Equal product from Dorma will also be acceptable.

E. Overhead Holders and Stops:

1. Type, function and fasteners must be same as Glynn-Johnson specified. Size per manufacturer's selector chart. Plastic end caps, hold open mechanisms and shock blocks are not allowed. End caps must be finished same as balance of unit.
2. Manufacture products using base material of Brass/Bronze for US3, US4, & US10B finished products and 300 Stainless Steel for US32 & US32D finished products.
3. Type, function, and fasteners must be the same as Glynn-Johnson specified. Size per manufacturer's selector chart.
 - a. Equal product from any B.H.M.A. member will also be acceptable.

F. Kick Plates:

1. Furnish .050 inches thick 10" high x door width less 2" at single doors and less 1" at pairs. Where glass or louvers prevent this height, supply with height equal to height of bottom rail less 2".
2. Any BHMA manufacturing product meeting above is acceptable.

G. Bumpers:

1. Wrought, forged, or cast, approximately 2-1/2 inch diameter, convex or concave rubber center, concealed fasteners.
 - a. IR-Ives WS407CCV
 - b. BHMA L02101.

H. Wall Stops:

1. Length to exceed projection of all other hardware
 - a. IR-Ives WS33
 - b. BHMA L12011 or L12021

I. Perimeter Smoke Seals:

1. Apply to head and jamb stops.
2. Numbers specified are National Guard. Products from other manufacturers are acceptable if equal in material, shape, thickness, and contain equal gasket material.
 - a. Pemko
 - b. Hager

- c. Reese
- d. Zero

J. Astragal Smoke Seals:

- 1. Apply to edge of active door leaf.
- 2. Numbers specified are National Guard. Products from other manufacturers are acceptable if equal in material, shape, thickness, and contain equal gasket material.
 - a. Pemko
 - b. Hager
 - c. Reese
 - d. Zero

K. Miscellaneous:

- 1. Furnish items not categorized in the above descriptions but specified by manufacturer's names in Hardware Sets.

L. Fasteners:

- 1. Furnish fasteners of the proper type, size, quantity and finish. Use machine screws and expansion shields for attaching hardware to concrete or masonry, and wall grip inserts at hollow wall construction. Supply sex bolts for closers at lead-lined or UL listed wood doors only. Supply sex bolts when UL listing of wood doors requires them. Furnish machine screws for attachment to reinforced hollow metal doors and frames and reinforced aluminum doors and frames. Furnish full thread wood screws for attachment to solid wood doors and frames. "TEK" type screws are not acceptable.

2.3 Finishes:

- A. Provide finishes as indicated in sets.

2.4 Templates and Hardware Location:

- A. Furnish hardware made to template. Supply required templates and hardware locations to the door and frame manufacturers.
- B. Furnish metal template to frame/door supplier for continuous hinge.
- C. Refer to Article 3.1 B.2, Locations, and coordinate with templates.

2.5 Cylinders Key Control and Keying:

- A. Provide a cylinder housing that will accept a 7-pin (SFIC) small format interchangeable core for all hardware components capable of being locked.
- B. Best small format interchangeable final cores and keys will be furnished by the WSU key shop.

PART 3 - EXECUTION

3.1 Installation

A. General:

1. Install hardware according to manufacturers installations and to manufacturers template dimensions. Attach all items of finish hardware to doors, frames, walls, etc. with fasteners furnished and required by the manufacture of the item.
2. Reinforced hollow metal doors and frames and reinforced aluminum door and frames: drilled and tapped machine screws.
3. Solid wood doors and frames: full thread wood screws. Drill pilot holes before inserting screws.
4. Install weather-strip gasket prior to parallel arm closer bracket, rim exit device or any stop mounted hardware. Gasket to provide a continuous seal around perimeter of door opening. Allow for gasket when installing finish hardware. Door closers will require special templating. Exit devices will require adjustment in backset.

B. Locations:

1. Dimensions are from finish floor to center line of items.
2. Include this list in Hardware Schedule.

CATEGORY

DIMENSION

Hinges	Door Manufacturer's Standard
Flush Bolt Levers	72" and 12"
Levers	Door Manufacturer's Standard
Wall Stops	At Head

C. Final Adjustment:

1. Provide the services of a representative to inspect material furnished and its installation and adjustment, to make final hardware adjustment, and to instruct the Owner's personnel in adjustment, care and maintenance of hardware.
2. Locksets, closers and exit devices shall be inspected by the factory representative and adjusted after installation and after the HVAC system is in operation and the final air balance has been completed, to insure correct installation and proper adjustment in operation. The manufacturer's representative shall prepare a written report stating compliance, and also recording locations and kinds of noncompliance. The original report shall be forwarded to the Architect with copies to the Contractor, hardware distributor, hardware installer and building owner.

3.2 Hardware Sets:

HW SET: 01

3	EA	HINGE	5BB1 4.5 X 4.5 (ACTIVE)	652	IVE
3	EA	SPRING HINGE	3SP1 4.5 X 4.5 (INACTIVE)	652	IVE
1	EA	CONSTANT LATCHING BOLT	FB51T (TOP ONLY)	630	IVE
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	SURFACE CLOSER	4111 EDA X ST-1384	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS33 (ACTIVE)	626	IVE
1	EA	WALL STOP	WS407CCV (INACTIVE)	630	IVE
1	SET	SMOKE GASKET	2525B	BRN	NGP
1	EA	ASTRAGAL	5070CL	CLR	NGP

HW SET: 02

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	SURFACE CLOSER	4111 EDA X ST-1384	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	SET	SMOKE GASKET	2525B	BRN	NGP

HW SET: 03

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	WALL STOP	WS33	626	IVE

HW SET: 04

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 24VDC	630	VON
1	EA	AUTO-EQUALIZER	4642	695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	SET	SMOKE GASKET	2525B	BRN	NGP
2	EA	WALL SWITCH	8310-853T	630	LCN
1	EA	KEY SWITCH	653-04-L2	626	SCE

OPERATION: THE KEY SWITCH WILL BE USED TO DISABLE THE OUTSIDE ACTIVATION SWITCH TO PERMIT THE DOOR TO BE LOCKED AFTER HOURS. WHEN THE DOOR IS UNLOCKED, THE ACTIVATION SWITCHES LOCATED ON EACH SIDE OF THE DOOR WILL RELEASE THE ELECTRIC STRIKE BEFORE ACTIVATING THE OPERATOR. THE POWER SUPPLY FOR THE ELECTRIC STRIKE IS LOCATED WITHIN THE OPERATOR. THE SYSTEM WILL BE CONNECTED TO THE FIRE ALARM PANEL TO PERMIT THE DOOR TO CLOSE AND LATCH UPON ACTIVATION.

HW SET: 05

3	EA	HINGE	5BB1 4.5 X 4.5 (ACTIVE)	652	IVE
3	EA	SPRING HINGE	3SP1 4.5 X 4.5 (INACTIVE)	652	IVE
1	EA	CONSTANT LATCHING BOLT	FB51T (TOP ONLY)	630	IVE
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH X ST-1496	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV (INACTIVE)	630	IVE
1	SET	SMOKE GASKET	2525B	BRN	NGP
1	EA	ASTRAGAL	5070CL	CLR	NGP

HW SET: 06

6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CONSTANT LATCHING BOLT	FB51T (TOP ONLY)	630	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	OVERHEAD STOP	100S	630	GLY
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV (INACTIVE)	630	IVE

HW SET: 07

6	EA	HINGE	5BB1 4.5 X 4.5 (ACTIVE)	652	IVE
1	EA	CONSTANT LATCHING BOLT	FB51T (TOP ONLY)	630	IVE
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH X ST-1496	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	SET	SMOKE GASKET	2525B	BRN	NGP

1	EA	ASTRAGAL	5070CL	CLR	NGP
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HW SET: 08

6	EA	HINGE	5BB1 4.5 X 4.5 (ACTIVE)	652	IVE
1	EA	CONSTANT LATCHING BOLT	FB51T (TOP ONLY)	630	IVE
1	EA	STOREROOM LOCK	L9080BDC 03N	626	SCH
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	ASTRAGAL	5070CL	CLR	NGP

HW SET: 09

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050BDC 03N L583-363	626	SCH
1	EA	OVERHEAD STOP	100S	630	GLY

HW SET: 10

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 03N	626	SCH
1	EA	WALL STOP	WS33	626	IVE

END OF SECTION 087100

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clear Tempered Glass.

1.02 REFERENCES

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2004.
- B. ASTM C 1036 - Standard Specification for Flat Glass; 2006.
- C. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2004.
- D. GANA (GM) - GANA Glazing Manual; Glass Association of North America; 2004.
- E. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; 1990.

1.03 SUBMITTALS

- A. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 FLAT GLASS MATERIALS

- A. Safety Glass (08 8000.SG): Clear; fully tempered with horizontal tempering.
 - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select) and ASTM C 1048.
 - 2. Comply with ANSI Z97.1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 INSTALLATION

- A. Install glazing in accordance with GANA Glazing Manual and system manufacturer's instructions.

3.03 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION

SECTION 09 0610 - PARTITION SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Partitions faced with gypsum panels, and including facings of:
 - 1. Gypsum wallboard.
- B. Partitions of concrete unit masonry (CMU) with or without gypsum panel facings.

1.02 DEFINITIONS

- A. Partitions: Every partition dividing two spaces is a noise, air, and dust control partition.

PART 2 PRODUCTS

2.01 GYPSUM PANEL FACINGS

- A. Provide types of gypsum panels in locations listed below.
- B. General use, and where not otherwise indicated:
 - 1. Provide gypsum wallboard.

2.02 PRODUCTS

- A. Provide products specified elsewhere in Division 4 and Division 9.

PART 3 EXECUTION

3.01 GENERAL

- A. Construct partitions in accordance with requirements specified elsewhere in Division 4 and Division 9.
- B. Seal smoke, noise, air, and dust partitions in accordance with requirements specified in Gypsum Board Assemblies section and Joint Sealers section.

3.02 PARTITION LEGEND

- A. On the drawings, partition types are indicated using tags composed generally as follows (see individual descriptions in partition schedule below for specific requirements).
- B. First Position: Fire rating.
 - 1. Zero, 1, 2, 3, or 4 hours.
- C. Second Position: Construction Material. Extend all partitions and materials from floor to overhead solid structure unless otherwise indicated.
 - 1. A Metal studs and gypsum panels from floor to 6" above ceiling.
 - 2. D Divider, partial height.
 - 3. M Masonry (CMU typical.)
 - 4. SA Metal studs to structure, gypsum panels from floor to 6" above ceiling.
 - 5. S Metal studs and gypsum panels.
 - 6. U Steel studs and gypsum board from floor to underside of ceiling.
- D. Third Position: Indicates construction features as described under individual descriptions in partition schedule below.
- E. Fourth Position:
 - 1. G Gypsum panels (wallboard, tile backer, veneer base, etc.); type of panel as specified above under "gypsum panel facings".
- F. Final Position, outside of box on drawings:
 - 1. Dimension of stud or masonry measured to outside face. Dimensions of stud are actual. Dimensions of masonry are actual unless indicated otherwise.

2. Where no stud dimension is indicated adjacent to box, provide 3-5/8-inch studs.

3.03 PARTITION SCHEDULE

0 F 1 G:

No fire rating.

Metal furring channels, 1 layer gypsum panels.

0 S 1 G:

No fire rating.

Metal studs to structure.

Gypsum panels 1 side only.

0 S 40 G:

No fire rating.

Construct metal stud, gypsum panel partition per UL Des. U465.

No batts.

0 S 49 G:

No fire rating.

Construct metal stud, gypsum panel partition per UL Des. U465.

a. Metal studs to go to structure.

b. Gypsum panels to go to structure.

Install mineral fiber batts in stud cavities. No resilient channels.

1 M 40:

1 hr. fire rating; construct concrete masonry unit partition.

END OF SECTION

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior metal stud wall framing.
- B. Acoustic insulation.
- C. Gypsum wallboard.
- D. Interior gypsum ceilings/soffits.
- E. Joint treatment and accessories.

1.02 REFERENCES

- A. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile; 1999 (R2005).
- B. ASTM C 475/C 475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- C. ASTM C 645 - Standard Specification for Nonstructural Steel Framing Members; 2007.
- D. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2006.
- E. ASTM C 754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2007.
- F. ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board; 2007.
- G. ASTM C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- H. ASTM C 1396/C 1396M - Standard Specification for Gypsum Board; 2009.
- I. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2007.
- J. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for systems required. Include installation instructions and data sufficient to show compliance with requirements.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Design Data:
 - 1. Submit data substantiating gage and spacing of metal framing members to comply with specified loading requirements.
 - 2. Submit data substantiating bracing requirements.
 - 3. Submittal of manufacturer's standard published load tables, marked to show products selected to comply with design requirements and project conditions, will be acceptable. Where manufacturer's standard published load tables are not adequate to demonstrate compliance with design requirements and project conditions, submit design data bearing the seal of a professional engineer licensed to practice in the state in which the project is located.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original and unopened packages, containers, or bundles, with brand names and manufacturer's labels intact and legible.
- B. Store materials in dry location, fully protected from weather and direct exposure to sunlight.
- C. Stack gypsum board products flat and level, properly supported to prevent sagging or damage to ends and edges.
- D. Store corner bead and other metal and plastic accessories to prevent bending, sagging, distortion, or other mechanical damage.

1.05 PROJECT CONDITIONS

- A. Do not store or install products until building is fully enclosed and temperature and humidity controlled.
- B. Temperature: Maintain temperature in areas of installation between 50 and 80 degrees F for at least 48 hours before installation begins and continuously thereafter.
- C. Ventilation: Provide controlled ventilation and dehumidification.
- D. Do not allow excessive variations in humidity or temperature.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C 645; galvanized sheet steel of size and properties necessary to comply with ASTM C 754, for the spacing indicated.
 - 1. Studs: C-shaped .
 - a. Nominal depths: As indicated in Section 09 0610 or as otherwise indicated on the drawings.
 - 2. Runners: U-shaped, sized to match studs.
 - a. Nominal depths: As indicated in Section 09 0610 or as otherwise indicated on the drawings.
 - 3. Ceiling Channels: C-shaped, cold-rolled.
 - 4. Furring:
 - a. Hat-shaped, minimum depth of 7/8 inch, except as otherwise indicated.
 - 5. Thickness: Provide thickness as required for span, loading, deflection, and other required criteria.
 - a. Minimum thickness, all locations, unless otherwise indicated: 0.0188 inch design thickness / 0.0179 inch minimum base metal thickness.
 - b. So-called "EQ" or "equivalent gage" with thickness less than specified above is not acceptable.
 - 6. Finish: G40 hot-dip galvanized per ASTM A653.
 - a. So-called "G40e" equivalent coating is not acceptable.
 - 7. Stud spacing: 16 inches, maximum.
 - 8. Furring spacing: 16 inches on center, maximum.
 - 9. Maximum deflection of wall framing of L/240 at 5 psf.
- B. Establish bracing size and spacing for the following partitions. (See Section 09 0610 - Partition Schedule):
 - 1. Type A.

2. Type SA.
 3. Type U.
 4. Type F and Z when furring is installed over spaced supports.
- C. Ceiling Hangers: Type and size as specified in ASTM C 754 for spacing required.
- D. Partition Head To Structure Connections:
1. Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.

2.03 GYPSUM BOARD MATERIALS

- A. Gypsum Wallboard: ASTM C1396; sizes to minimize joints in place; ends square cut.
1. Thickness: 5/8 inch, all locations. 1/2 inch not acceptable.
 2. Edges: Tapered; beveled or rounded.
 3. Type X: Fire resistant, UL or WH rated.

2.04 ACOUSTICAL MATERIALS

- A. Sound Attenuation Batts: ASTM C 665, Type I; unfaced semirigid mineral wool batt (made from rock or slag); thickness as follows:
1. Use 1-1/2-inch batts in 1-5/8-inch studs.
 2. Use 2-inch batts in 2-1/2-inch studs.
 3. Use 3-inch batts in 3-5/8-inch and wider studs.
 4. Where batts are required in furred spaces, use batt thickness equal to furring depth.
- B. Sound Attenuation Batts: Glass fiber, unfaced blanket/batt: Type I (ASTM C 665), passing ASTM E 136 combustion test requirements.
1. Use 2-1/2-inch or 2-3/4-inch batts in 1-5/8-inch studs.
 2. Use 2-1/2-inch or 2-3/4-inch batts in 2-1/2-inch studs.
 3. Use 3-1/2-inch or 4-inch batts in 3-5/8-inch studs.
 4. Use 4-inch batts in 4-inch studs.
 5. Use 6-inch batts or double batts whose thickness totals 6 or more inches in 6-inch studs.
 6. Use 16-inch-wide batts where studs are spaced at 16 inches O.C. 15-1/2 or 15-3/4 inch wide batts are not permitted.
- C. Acoustical Sealants:
1. Concealed Locations: ASTM C919; non-drying, non-hardening, non-skinning type.
 2. Exposed Locations: ASTM C 919; non-oxidizing, skinning type.

2.05 ACCESSORIES

- A. Except as otherwise specifically indicated, provide trim and accessories by manufacturer of gypsum board materials, made of galvanized steel or zinc alloy and configured for concealment in joint compound.
1. Include corner beads, edge trim, and other trim units necessary for project conditions. Provide accessories as required in order to achieve details indicated, whether or not specific accessories are shown on the drawings.
 2. Exposed trim: At locations indicated, provide manufacturer's standard metal units designed to be left exposed or semiexposed.
- B. Corner Beads: Galvanized steel.
- C. Edge Trim: Bead types as detailed.
- D. Control Joints: At locations indicated, provide manufacturer's standard one-piece control joints of zinc alloy.

- E. Joint Materials: ASTM C 475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Joint Compound:
 - a. General Interior Use: Ready-mixed vinyl-based joint compound. All-purpose taping and topping compound: type specifically formulated for embedding tape and accessories, for prefilling, and for finishing drywall.
 - 2. Joint Tape:
 - a. Gypsum wallboard: Provide manufacturer's standard paper type tape.
- F. Screws: ASTM C 1002; self-piercing tapping type, lengths as recommended by gypsum board manufacturer for project conditions.
- G. Furring Fasteners/Connectors: Manufacturer's recommended system for specific application indicated, complying with ASTM C 754.
- H. Hanger Wire: ASTM A 641, soft, Class 1 galvanized.
 - 1. Ceiling hangers: Minimum 8 gage wire.
 - 2. Furring channel ties: Minimum 18 gage wire.
- I. Blocking: Provide metal blocking for mounting of wall cabinets, shelves, toilet accessories, etc.
 - 1. Provide 6 inch, 16 gage, steel runner notched to bypass steel studs and secured with two 3/8 inch pan head screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions and substrates are appropriate for work of this section to commence.
- B. Coordinate installation of anchorage devices for suspended ceilings/soffits, verifying that spacing and rated strength are correct for anticipated load conditions.

3.02 FRAMING INSTALLATION

- A. Comply with ASTM C 754 and manufacturer's instructions.
- B. Fire-rated assemblies: Comply with requirements of tested assemblies.
- C. Studs:
 - 1. Extend partitions to structure unless otherwise indicated.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
 - 4. Slab Deflection: At fire-rated partitions, construct slip-joint head in accordance with UL-witnessed reports and manufacturer's recommendations.
- D. Partition heights:
 - 1. Where not indicated otherwise, extend partitions from floor to underside of solid structure above.
 - 2. Where indicated, extend partitions to underside of suspended ceiling or to just above suspended ceiling, as indicated.
 - a. Brace partial height partitions in accordance with design requirements specified in Part 1 of this Section.

3. Blocking and bracing: Install blocking and bracing as recommended by manufacturer for adequate support of wall-mounted items installed as work of other sections.
- E. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double 20 gage, side-by-side studs at jambs on both sides of opening.
 1. At openings in fire rated partitions, comply with requirements of governing authorities for framing.
- F. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 1. Orientation on solid walls: Vertical.
- G. Blocking: Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, shelving, and other fixture mounted on partitions. Screw steel blocking channels to studs.
- H. Suspended Ceilings and Soffits:
 1. Secure hangers to structure or to anchorage devices so that full strength of hanger can be achieved.
 - a. Install ceiling channels at spacing indicated or required, but not greater than permitted by ASTM C 754.
 - b. Secure furring members to ceiling channels by means of clips or wire ties.
 2. Level ceiling system to a tolerance of 1/8 inch in 12 feet, or to a higher tolerance if required by specific project conditions.
 3. Level soffits to a tolerance of 1/8 inch in 12 feet, or to a higher tolerance if required by specific project conditions.
 4. Reinforce openings and interruptions in horizontal framing system with additional furring channels. Ensure that entire suspension system is laterally braced.

3.03 ACOUSTIC INSULATION

- A. Acoustic Insulation: After gypsum board has been installed on one side, place insulation tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions. Fill cavities completely, using recommendations and details indicated in USG Corporation's "Gypsum Construction Handbook".

3.04 NOISE, AIR, AND DUST CONTROL

- A. General: Every partition dividing two spaces is a noise, air, and dust control partition.
 1. Seal noise, air, and dust control partitions in accordance with the requirements listed below.
 2. Seal gypsum panels used on the interior face of exterior walls in the same manner.
 3. Seal gypsum furring panels used on masonry in the same manner.
- B. Seal perimeter of partition with acoustical sealant, complying with recommendations and details in USG Corporation's "Gypsum Construction Handbook" and ASTM C 919. Do not install sealant under metal runners. Install 1/4-inch-round bead of sealant to in-place runners including those used at partition intersections. Immediately place gypsum panel so as to compress bead, leaving 1/8 inch of perimeter relief (or other dimension where indicated) between gypsum panel and adjacent construction.
 1. Relief Joints: Install sealant between metal edge trim and adjacent construction. Joint size 1/4 inch unless otherwise indicated.
 2. Install sealant beneath control joints.

3. Install sealant at metal door frames just before inserting face panel.
4. Carefully seal around penetrations such as electrical boxes, plumbing, cabinets, ducts, and other openings.

3.05 GYPSUM BOARD INSTALLATION

- A. Comply with ASTM C 840 and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-rated assemblies: Comply with requirements of tested assemblies.
- C. Apply ceiling boards prior to installation of wallboards. Arrange to minimize butt end joints near center of ceiling area.
- D. Install wallboards in a manner which will minimize butt end joints in center of wall area. Stagger vertical joints on opposite sides of walls.
- E. Butt all joints loosely, with maximum of 1/16 inch between boards.
- F. Size panels to provide perimeter relief and install over sealant as specified under noise control, above. Do not install panels unless and until sealant is properly installed.
- G. Place wrapped edges adjacent to one another; do not place cut edges or butt ends adjacent to wrapped edges.
- H. Support all edges and ends of each board on framing or by solid substrate, except that long edges at right angles to framing members in non-fire-rated construction may be left unsupported.
- I. Single-Layer: Install gypsum board vertically, with ends and edges occurring over firm bearing.
 1. On walls and partitions, plan installation so that the leading edge or end of gypsum board is attached to open end of stud flange first.
- J. Double-Layer Installation: Use gypsum backing board or gypsum wallboard for first layer, placed perpendicular to framing or furring members. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
 1. In ceiling work, install base layer with long edges perpendicular to framing members, with face layer in opposite direction, and with all joints offset.
 2. In wall work, install base layer with long edges parallel to framing members with face layer in opposite direction, and with all joints offset.
 3. Install face layer by means of screws at least 3/8 inch longer than total thickness of gypsum board layers, spaced as specified for the tested assembly.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Comply with manufacturer's recommendations for installation of trim items. Except for items intended by manufacturer to be left exposed or semiexposed, install trim units for concealment in joint finishing compound. Wherever possible, fasten metal trim items to substrate with same fasteners used to install gypsum board products.
- B. Control Joints: Where control joints are indicated on the drawings, place control joints as shown on the drawings. Where control joints are not indicated on the drawings, place control joints consistent with lines of building spaces and as follows:
 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 2. Install one-piece control joints at required locations. Do not remove tape until finishing operations are complete.

- C. Corner Beads: Install at external corners, unless details clearly indicate its omission at specific locations. Use longest practical lengths.
- D. Isolation Joints: Where gypsum board construction abuts cabinetry, windows, structural components, and other dissimilar materials, provide isolation by stopping board a minimum of 1/4 inch from structure, for finishing by means of exposed or semiexposed trim.

3.07 JOINT TREATMENT

- A. Finish gypsum board in scheduled areas in accordance with levels defined in ASTM C 840.
- B. Do not mix joint compounds except as specifically recommended by manufacturer.
- C. Penetrations in Wallboard: Fill cutouts and openings around fixtures and penetrations with joint compound.

3.08 CLEANING

- A. Promptly remove any residual gypsum drywall materials from adjacent or adjoining surfaces, leaving spaces ready for subsequent finishing operations and decorating.

3.09 FINISH LEVEL SCHEDULE

- A. Provide a Level 4 finish for surfaces not otherwise indicated.
- B. Level 1: Above finished ceilings concealed from view; from 8 inches (203 mm) above suspended ceilings to top of partition.
 - 1. Embed tape in joint compound at all joints and interior angles; provide accessories only as detailed.
 - 2. Provide surfaces free of excess joint compound; tool marks and ridges are acceptable.
- C. Level 4: Surfaces scheduled to receive the following:
 - 1. Flat or eggshell paint finish specified in Section 09 9100 - Paints and Coatings.
 - 2. Application:
 - a. Embed tape in joint compound at all joints and interior angles.
 - b. Provide three separate coats of compound at all joints, angles, fastener heads, and accessories.
 - c. Provide smooth surfaces free of tool marks and ridges.

END OF SECTION

SECTION 09 2236 - METAL LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal lath for gypsum plaster.
- B. Furring for metal lath.
- C. Metal ceiling framing.

1.02 REFERENCE STANDARDS

- A. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2003 (Reapproved 2008)e1.
- B. ASTM C847 - Standard Specification for Metal Lath; 2012.

1.03 SUBMITTALS

- A. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lath:
 - 1. Alabama Metal Industries Corporation: www.amico-online.com.
 - 2. Cemco: www.cemcosteel.com.
 - 3. Clarkwestern Dietrich Building System LLC: www.clarkdietrich.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Furring Channels: Formed steel, minimum 0.020 inch thick, 3/8 inch deep x 7/8 inch high, splicing permitted; galvanized.
- B. Main Ceiling Channels: Formed steel, minimum 0.05 inch thick, 3/4 inch deep x 1-1/2 inch high, single piece, no splicing; galvanized.
- C. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.

2.03 LATH

- A. Diamond Mesh Metal Lath: ASTM C847, galvanized; self-furring.
- B. Corner Mesh: Formed sheet steel, minimum 0.018 inch thick, perforated flanges shaped to permit complete embedding in plaster, minimum 2 inch size; same finish as lath.
- C. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, maximum possible lengths.
 - 1. Material: Formed galvanized sheet steel, expanded metal flanges.
 - 2. Casing Beads: Square edges.

2.04 ACCESSORIES

- A. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.

- B. Polyethylene Sheet: Clear, 6 mil thick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

- A. Install interior lath and furring in accordance with ASTM C841.

3.03 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.

3.04 CONTROL JOINTS

- A. Locate joints as indicated on drawings.
- B. Construct control joints of back-to-back casing beads set 1/4 inch apart. Set both beads over 6 inch wide strip of polyethylene sheet.

3.05 LATH INSTALLATION

- A. Apply metal lath taut, with long dimension perpendicular to supports.
- B. Lap ends minimum 1 inch. Secure end laps with tie wire where they occur between supports.
- C. Lap sides of diamond mesh lath minimum 1-1/2 inches.
- D. Attach metal lath to metal supports using tie wire at maximum 6 inches on center.
- E. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
- F. Place corner bead at external wall corners; fasten at outer edges of lath only.
- G. Place base screeds at termination of plaster areas; secure rigidly in place.
- H. Place 4 inch wide strips of metal lath centered over junctions of dissimilar backing materials. Secure rigidly in place.

- I. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
- J. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
- K. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

END OF SECTION

SECTION 09 2300 - GYPSUM PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Gypsum plaster over metal lath and masonry.

1.02 REFERENCE STANDARDS

- A. ASTM C28/C28M - Standard Specification for Gypsum Plasters; 2010.
- B. ASTM C842 - Standard Specification for Application of Interior Gypsum Plaster; 2005 (Reapproved 2010)e1.

1.03 SUBMITTALS

- A. Product Data: Provide data on plaster materials, characteristics, and limitations of products specified.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gypsum Plaster:
 - 1. National Gypsum Company.
 - 2. USG.
 - 3. Substitutions: See Section 01 6000 - Product requirements.

2.02 PLASTER MATERIALS

- A. Ready-Mixed Gypsum Plaster: ASTM C28/C28M; mill-mixed type, requiring only the addition of water. For application to monolithic concrete, provide bonding type.
- B. Ready-Mixed Finishing Plaster: Gypsum/Lime putty type, ASTM C28/C28M; mixture of gauging plaster and lime.
- C. Water: Clean, fresh, potable and free of mineral or organic matter that could adversely affect plaster.

2.03 PLASTER MIXES

- A. Direct applied over concrete masonry units: Two-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions.
- B. Over Metal Lath: Three-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions.
- C. Ready-Mixed Plaster Materials: Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing conditions are satisfactory before starting work.
- B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.
- C. Grounds and Blocking: Verify items within walls for other sections of work have been installed.
- D. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.
- E. Mechanical and Electrical: Verify services within walls have been tested and approved.

3.02 PREPARATION

- A. Dampen masonry surfaces to reduce excessive suction.

3.03 PLASTERING

- A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.
- B. Thickness of Plaster including Finish Coat:
 - 1. Over metal lath: 5/8 inch.
 - 2. Direct to unit masonry: 5/8 inch.
- C. Finish Texture: Float to a consistent and smooth finish. Match existing adjacent plaster texture.

END OF SECTION

SECTION 09 5100 - SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Accessories.

1.02 REFERENCES

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2004.
- B. ASTM C 636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2006.
- C. ASTM E 1264 - Standard Classification for Acoustical Ceiling Products; 1998 (Reapproved 2005).

1.03 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit three samples, minimum 6 inches by 6 inches, illustrating material and finish of acoustical units.
- D. Samples: Submit three samples each, 9 inches long, of suspension system main runner and perimeter molding.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

1.05 EXTRA MATERIALS

- A. Provide 3 percent of total acoustical unit area of each type of acoustical unit for Owner's use in maintenance of project.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers; General:
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. CertainTeed: www.certainteed.com.
 - 3. USG: www.usg.com.
- B. Manufacturers; Scrubbable Acoustical Panel:
 - 1. CertainTeed: www.certainteed.com.
 - 2. National Gypsum: www.nationalgypsum.com.
- C. Substitutions: See Section 01 6000 - Product Requirements.

D. Acoustical Units (AC1):

1. Acoustical Panel: Plastic or vinyl-faced mineral fiber, ASTM E 1264, Type IV, Class A, with the following characteristics determined as specified in ASTM E 1264.
 - a. Size: 24 x 24 inches.
 - b. Thickness: 3/4 inch.
 - c. Composition: Water felted.
 - d. Light Reflectance: Not less than 0.89.
 - e. Noise Reduction Coefficient (NRC): Not less than 0.60.
 - f. Ceiling Attenuation Class (CAC): Not less than 35.
 - g. Washable/Scrubbable.
2. Products:
 - a. Armstrong:
 - 1) Acoustical Panel: Ultima Tegular 1894, tegular edge.
 - 2) Suspension System: Prelude XL 15/16 Heavy Duty.
 - b. CertainTeed:
 - 1) Acoustical Panel: Symphony m 1222B-OVT-1, reveal edge.
 - 2) Suspension System: Classic Stab System 15/16 Heavy Duty.
 - c. USG:
 - 1) Acoustical Panel: Mars Climaplus 86785, shadow line tapered.
 - 2) Suspension System: DX 15/16 Heavy Duty.

E. Acoustical Units, Scrubbable (AC2):

1. Acoustical Panel: Vinyl-faced gypsum, ASTM E 1264, Type XX, Class A, with the following characteristics determined as specified in ASTM E 1264.
 - a. Size: 24 x 24 inches.
 - b. Thickness: Not less than 5/8 inch.
 - c. Light Reflectance: Not less than 0.75.
 - d. Noise Reduction Coefficient (NRC): N/A.
 - e. Ceiling Attenuation Class (CAC): Not less than 40.
2. Products:
 - a. Acoustical Panels:
 - 1) CertainTeed; Envirogard 1172-CRF-1, trim edge.
 - 2) Armstrong; Clean Room FL 1715.
 - 3) USG; Clean Room ClimaPlus 56060
 - b. Non-gasketed Suspension System:
 - 1) Armstrong Prelude XLFG, 15/16", heavy duty.
 - 2) USG DXLA, 15/16", heavy duty.
 - 3) CertainTeed Classic Environmental Stab 15/16", heavy duty.
3. Accessories:
 - a. Acoustical Unit Edge Sealer: As recommended by manufacturer.

2.02 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636 and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:240.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners in excess of 2 degrees.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Miter corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to shortest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges with manufacturer's recommended paint.
 - 4. Seal field cut edges with manufacturer's recommended sealer.
- H. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.04 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
 - 1. BASE BID: Resilient tile composition.
- B. Resilient base.
- C. Flooring Transitions.
- D. Installation accessories.

1.02 REFERENCES

- A. ASTM F 1066 - Standard Specification for Vinyl Composition Floor Tile; 2004.
- B. ASTM F 1861 - Standard Specification for Resilient Wall Base; 2002.
- C. ASTM F 1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004.
- D. RFCI - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; 1998.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- B. Test Reports: See requirements specified in Section 09 0561 - Preparation for Adhesively Installed Flooring.
- C. Verification Samples: Submit two samples, 6 by 6 inch in size illustrating color and pattern for each product specified.
- D. Welded Seams: Submit two samples of two adjoining 6 by 12 inch sections of resilient flooring welded as specified and mounted on back board for each product specified.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. 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.

1.05 EXTRA MATERIALS

- A. Provide 5 percent of installed resilient product of each type and color specified.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MATERIALS - SHEET FLOORING

- A. **BASE BID:** Resilient Vinyl Sheet Flooring 1, **RVS 1:** ASTM F 1913, vinyl sheet floor covering without backing, color and pattern throughout wear layer thickness.
 - 1. Total Thickness and Wear Layer Thickness: 0.080 inch nominal.
 - 2. Sheet Width: 72 inch minimum.

3. Seams: Heat welded.
 - a. Rod color: Manufacturer's recommended color to match sheet flooring.
 - 1) If there is more than one color section of heat weld from manufacturer for the specified rolled good. Provide options to architect/designer for selection.
4. Products:
 - a. **BASIS OF DESIGN:**
 - 1) Armstrong; Medintone: www.armstrong.com.
 - (a) Color: Architect/Designer to provide color from manufacturers standard colors.
 - b. Other Acceptable Manufacturers:
 - 1) Mannington; BioSpec MD: www.mannington.com.
 - (a) Color: Architect/Designer to provide color from manufacturers standard colors.
 - 2) Johnsonite; Aria: www.Johnsonite.com.
 - (a) Color: Architect/Designer to provide color from manufacturers standard colors.

2.03 MATERIALS - TILE FLOORING

- A. **BASE BID:** Resilient Tile Composition: ASTM F 1066, Class 2; homogeneous, with color extending throughout thickness.
 1. Thickness: 0.125 inch.
 2. Products:
 - a. **BASIS OF DESIGN:**
 - 1) Resilient Composition Tile 1; **RCT1**
 - (a) Armstrong World Industries, Inc; Striations BBT with BioStride: www.armstrong.com.
 - (1) Color: Honey, T3615
 - (2) Size: 12x24
 - 2) Resilient Composition Tile 2; **RCT2**
 - (a) Armstrong World Industries, Inc; Striations BBT with BioStride: www.armstrong.com.
 - (1) Saddle, T3607
 - (2) Size: 12x24
 - 3) Resilient Composition Tile 3; **RCT3**
 - (a) Armstrong World Industries, Inc; Striations BBT with BioStride: www.armstrong.com.
 - (1) Color: Forest Floor, T3617
 - (2) Size: 12x24
 - b. Other Acceptable Manufacturers:
 - 1) Resilient Composition Tile 1; RCT1
 - (a) Azrock by Tarkett Group; Azrock Textile VCT www.azrock.com.
 - (1) Color: Warm Wool, V-281
 - (2) Size: 12x24
 - (b) Mannington Commercial; Progressions : www.mannington.com.
 - (1) Color: Almond Buff, 55507
 - (2) Size: 12x12
 - 2) Resilient Composition Tile 2; RCT2
 - (a) Azrock by Tarkett Group; Azrock Textile VCT www.azrock.com.

- (1) Color: Polly Ester, V-295
- (2) Size: 12x24
- (b) Mannington Commercial; Progressions: www.mannington.com.
 - (1) Color: Pecan, 55178
 - (2) Size: 12x12
- 3) Resilient Composition Tile 3; RCT3
 - (a) Azrock by Tarkett Group; Azrock Textile VCT www.azrock.com.
 - (1) Color: Alpaca Brown, V-294
 - (b) Mannington Commercial; Progressions: www.mannington.com.
 - (1) Color: Toffee 55219
 - (2) Size: 12x12

2.04 MATERIALS - BASE

- A. Resilient Base: ASTM F 1861, Type TP thermoplastic rubber.
 - 1. Height: 6 inches.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Matte.
 - 4. Style: Cove.
 - 5. Length: Roll, 100-120 feet.
 - 6. Products:
 - a. Nora; Nora Wall Base: www.nora.com
 - b. BurkeMercer Flooring; Rubbermyte: www.burkemercer.com.
 - c. Flexco; Base 2000: www.flexcofloors.com.
 - d. Johnsonite, Inc; Traditional Rubber Wall DC: www.johnsonite.com.
 - e. Roppe Corp; 700 Series Wall Base: www.roppe.com.
 - 7. Color:
 - a. Nora: Color to be selected by designer/architect.
 - b. BurkeMercer: Color to be selected by designer/architect..
 - c. Flexco: Color to be selected by designer/architect.
 - d. Johnsonite: Color to be selected by designer/architect..
 - e. Roppe: Color to be selected by designer/architect..

2.05 TRANSITIONS

- A. Product Material:
 - 1. Match wall base material
- B. Type:
 - 1. Carpet to Sub-floor: 1/4" material to sub-floor Transition Strip
 - 2. Carpet to Resilient Floor material: 1/4" material to 1/8" material Adaptor
 - 3. Resilient to Sub-floor: 1/8" material to sub-floor Reducer
- C. Color: Color to match rubber base selected.

2.06 ACCESSORIES

- A. Subfloor Filler: Portland cement-based premix latex; type recommended by flooring manufacturers.
- B. Primers and Adhesives: Type recommended by flooring manufacturers.
 - 1. Where high moisture or pH conditions exist, see additional requirements specified in Section 09 0561 - Preparation for Adhesively Installed Flooring.
- C. Sealer and Wax/Finish Products: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are smooth and flat within the tolerances specified for that type of work, are free of substances which would impair bonding of adhesive materials, and are ready to receive resilient product.
- B. Verify that concrete subfloor surfaces are ready for resilient flooring installation by testing for moisture and alkalinity as specified in Section 09 0561 - repair for Adhesively installed Flooring. If test results are not within limits recommended by resilient flooring manufacturer, follow procedures specified in Section 09 0561.
- C. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Where existing floor covering has not already been removed by the Owner in advance of this project, remove existing coverings in accordance with RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.
- B. Remove existing adhesive residue.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is cured.
- E. Clean substrate.

3.03 INSTALLATION - SHEET FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Lay flooring with joints and seams parallel to longer room dimensions to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
- E. Underscribe sheet material and rout seams. Heat weld with manufacturer's recommended type welding rod.
- F. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Secure metal strips with stainless steel screws. Secure resilient strips with adhesive.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Mix tile from different containers to ensure shade variations are consistent when tile is placed.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern, unless indicated otherwise in drawings.

- F. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install transition strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.05 INSTALLATION - BASE

- A. Cut vertical joints and fit tightly. Maintain minimum dimension of 18 inches between joints.
- B. At external corners, v-cut back of base strip to two-thirds of its thickness and fold.
- C. Miter cut internal corners.
- D. Install base on solid backing. Bond tightly to surfaces.
- E. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and wax resilient composition tile flooring products in accordance with manufacturer's instructions.
 - 1. A minimum of three coats of polish are required.

3.07 PROTECTION OF FINISHED WORK

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. Protect installed products until completion of project.

END OF SECTION

SECTION 09 6723 - ALTERNATE #4; RESINOUS FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. ALTERNATE #4; Application of resinous flooring system.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's technical data, installation instructions, and general recommendations for each resinous flooring material required. Include certification indicating compliance of materials with requirements.
 - 1. Submit maximum amount of moisture content allowed in concrete substrate at time of installation covered under Warranty.
 - 2. Submit minimum surface tensile strength of concrete required under Warranty.
- B. Shop Drawings:
 - 1. Show on plans the location and extent of each flooring system. Indicate type of floor, color and pattern, locations of control joints, expansion joints, isolation joints, divider strips, and other joint conditions.
 - 2. furnish detail drawings illustrating each joint type and flooring terminations at walls, adjacent dissimilar flooring, door sills, door frames, pits and curbs, etc.
- C. Color and Texture Samples: Submit, for verification purposes, 10-inch square samples of each type of resinous flooring required, applied to a rigid backing, in color and texture indicated.
 - 1. For initial selection of colors and finishes, submit manufacturer's color charts showing full range of colors and textures available.
- D. Applicator Qualifications.
 - 1. Furnish the name of the installers' foreman who meets the qualifications set forth herein and who will be on-site full-time during the installation.
 - 2. Furnish the name of the manufacturer's employee who meets the qualifications set forth herein and who will be on-site full-time during the installation.
- E. Field Test results: Slab vapor transmission.
- F. Closeout Submittals:
 - 1. Warranty.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer shall have successfully provided products of the type specified for a period of at least 10 years.
 - 1. Manufacturer's technical representative shall be available on site to advise applicator on proper surface preparation and application techniques.
- B. Applicator's Qualifications: All work of this section shall be performed by an installer who shall be either employees of the resinous flooring manufacturer, or contract workers of the resinous flooring manufacturer who are specifically trained by the resinous flooring manufacturer. Applicator must have 5 years documented experience installing the manufacturer's product.

1.04 MOCK-UP

- A. Install Resinous Flooring System mock up in one room only, selected by the Architect, for verification of color and texture.

- B. If no rooms should be of suitable size for mock-up, provide 4-foot-square sample panels, constructed of concrete not less than 3-1/2 inches thick, in lieu of mock-up in actual room.
 - 1. Provide one 4-foot-square panel per floor color or type.
- C. Notify Architect prior to installation to schedule review of mock up.
- D. Do not proceed with remainder of the work without Architect's written approval of mock up.
- E. Adjust mock-up texture and appearance as directed by the Architect.
- F. Demolish and remove 4-foot-square sample panels after all resinous floor is complete, and approved. Obtain Architect's written approval to demolish and remove approved quality standard panels.
- G. Locate where directed.
- H. Approved Mock-up room may be incorporated into the Work.

1.05 PRE-INSTALLATION CONFERENCE:

- A. General Contractor shall arrange a meeting not less than ten days prior to starting work.
- B. Attendance:
 - 1. General Contractor.
 - 2. Architect's Representative.
 - 3. Owner's Representative.
 - 4. Manufacturer Representative.
 - 5. Installer's Foreman.
- C. Review floor substrate conditions, including but not limited to:
 - 1. Flatness.
 - 2. Obstructions.
 - 3. Grout, mortar droppings, divots, holes, and other defects.
 - 4. Joints.
 - 5. Cracks.
 - 6. Drains.
 - 7. Slope to drains.
 - 8. Floor-wall interfaces.
 - 9. Existing coatings, sealers, curing compounds, etc.
 - 10. Surface profile.

1.06 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Deliver materials in manufacturer's original containers bearing coating name and color, material composition data, date of manufacture, legal notices if applicable, and mixing, thinning, and application instructions.
- B. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.
- C. Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 60 and 90 degrees F.

1.07 PROJECT CONDITIONS

- A. Concrete substrate shall be properly cured for at least 30 days.
- B. Apply coatings only under the following environmental conditions:
 - 1. Air and surface temperatures are between 70 and 85 degrees F.

2. Relative humidity is less than 75 percent.
 3. Surface temperature is at least 5 degrees F above dew point.
 4. Permanent lighting system shall be functional, or provide temporary lighting providing with at least the level of lighting given by permanent lighting system.
- C. Job area to be free of other trades during, and for a period of 24 hours after, floor installation.
- D. Provide continuous ventilation and heating to prevent accumulation of hazardous fumes, and maintain surface and ambient temperatures above 70 degrees F for 24 hours before, during, and for 48 hours after application of finishes, or longer if required to obtain full cure as indicated by manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS

- A. Provide all products for each system specified in this section from or approved by a single manufacturer.

2.03 ALTERNATE #4; RESINOUS FLOORING SYSTEM

- A. Basis of Design:
1. "Stonshield HRI" with medium to light texture as manufactured by Stonhard Inc., Maple Shade, NJ, 800-854-0320. A custom texture will be required. Nominal 3/16 inch thick system comprising the following:
 - a. Penetrating two-component epoxy primer.
 - b. Three-component mortar consisting of epoxy resin, curing agent and finely graded silica aggregate.
 - c. Two-component epoxy undercoat.
 - d. Brightly colored quartz silica aggregate broadcast.
 - e. High performance two-component clear epoxy sealer.
 - f. Resinous Flooring Color: Driftwood
 - g. Texture: Samples of 4 variations (smooth, orange peel, grit, extra grit) of texture are to be provided for the architect and owner to select from.
- B. Other Acceptable Manufacturers:
1. Dudick.
 - a. Product: Match Basis of Design
 - b. Color: Match Basis of Design
 2. Tnemec.
 - a. Product: Match Basis of Design
 - b. Color: Match Basis of Design
- C. Provide one of the following systems:
1. "Stonclad GS" with "Stonkote GS4" top coat, and "Stonseal GS6" for finish coat as manufactured by Stonhard, Inc.
 - a. Primer: Stonhard Standard Primer.
 - b. Mortar Color: Refer to Section 09 0615.
 - c. Top coat color: Match mortar color.
 - d. Texture: Provide "texture level #2" as basis of mock-up.
- D. Vapor-Pressure-Resistant Grout:

1. Where on-site tests reveal the need for a pressure-resistant grout, provide "StonFil OP2", when directed by the Architect, without change in time or price of the work.

2.04 ACCESSORY MATERIALS

- A. Joint Sealant:
 1. Self-leveling: "Stonflex MP-7".
- B. Divider Strips:
 1. Material: Zinc metal.
 2. Metal Thickness: 16 gage.
 3. Cove Strip: Provide manufacturer's standard metal cove strip and divider strips at cove base.
 4. Divider Strip: Provide manufacturer's standard zinc metal divider strip.
 5. Expansion Strip: Back-to-back metal "L" strips bonded to 1/4-inch-wide black neoprene filler.
- C. Manufacturer's standard crack and joint treatment materials.

2.05 MIXING

- A. Mix materials according to manufacturer's latest printed instructions paying particular attention to mixing times and temperatures.
- B. Do not use materials beyond manufacturer's recommended pot life or shelf life.

PART 3 EXECUTION

3.01 PRE-WORK INSPECTION

- A. Examine surfaces to be coated and report conditions that would adversely affect appearance or performance of systems and which cannot be put into an acceptable condition by preparatory work specified.

3.02 PREPARATION

- A. Apply coatings to clean, properly prepared surfaces. Remove dirt, dust, grease, oils, and foreign matter. Prepare surface to achieve proper texture necessary for optimum coating adhesion and intended finished appearance. Plan cleaning, preparation, and coating operations to avoid contamination of freshly coated surfaces.
- B. Concrete Floor Substrate: Concrete preparation shall be by mechanical means and include the use of a shot blast machine for removal of bond inhibiting materials such as curing compounds, laitance, and previous coatings in their entirety. Acid etching is not acceptable.
- C. After blast cleaning of the substrate, test the vapor transmission of slabs on grade by means of a calcium chloride test in which a sample is weighed to the nearest 0.01 gram before and after exposure. A plastic film test alone is unacceptable. Report results to the Architect and the flooring manufacturer's representative. Tests required:
 1. 1 test for areas up to 250 SF.
 2. 2 tests for areas up to 500 SF.
 3. 3 tests for areas up to 1000 SF.
 4. 4 tests for areas up to 5000 SF.
 5. 1 additional test for each additional 5000 SF.
- D. If required by the Architect, install vapor-pressure-resistant grout prior to installing finish flooring system.
- E. Treat cracks, joints, drains, edge of flooring without walls, and other conditions in accordance with this specification and with manufacturer's written instructions and details.

- F. Do not proceed with application until surface is acceptable and authorization to proceed is given by the Architect.

3.03 APPLICATION

A. General:

1. Apply each component of resinous flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of thickness indicated, uninterrupted except at divider strips, sawn joints or other types of joints (if any), indicated or required.
2. Do not install flooring without the Architect's prior approval of the mock-up.

B. Divider Strips and Interruptions: Manufacturer's standard methods that use cold joints without divider strips between adjacent pours are unacceptable.

1. Complete each entire room or space, in a single operation, without breaks or interruptions.
2. Incomplete rooms or spaces requiring joints are not acceptable, unless approved in advance in writing by the Architect.
3. Where size or configuration of space is impracticable to cover in a single pour given the crew size employed by the Contractor, obtain the Architect's written approval of the use of, and location of divider strips; or provide sufficient crew to achieve a single pour, as directed by the Architect, without change in contract time or price.
4. Separate every individual pour, from each adjacent pour, by means of a divider strip.
5. In doorways, locate divider strips centered beneath door, unless otherwise directed.
6. Install divider strips where epoxy flooring abuts other flooring materials.

C. Joints: Provide the following; unless otherwise detailed.

1. Install expansion strips over control and construction joints in slabs on grade, providing such joints are tied together with reinforcing wire or bars.
2. Where such joints are not tied, provide 2 back-to-back divider strips spaced 1/4 inch apart, install bond-breaker tape, and seal with sealant.
3. Where concrete expansion joint filler occurs in slab on grade floors, provide 2 back-to-back divider strips spaced to align with edge of concrete, install bond-breaker tape, and seal with sealant.
4. Where expansion joints occur in elevated slabs, extend flooring to the expansion joint cover assembly so as to make a neat, flush transition.

D. Integral Coved Base:

1. Provide integral coved base of same material as flooring at all wall and curb locations. Install base per manufacturer's instructions.
2. Base to be 4 inches high, and shall terminate with metal cove strip.
3. Install bead of clear sealant at joint between top of cove strip and wall.

E. Epoxy Flooring:

1. Apply in strict conformance with manufacturer's printed instructions.
2. Ensure that finished color, surface appearance, and surface texture match the approved mock-up.
3. Where flooring does not match approved mock-up, the Architect may direct either adjustment of appearance and texture of flooring, or the removal of the flooring in its entirety and reinstallation.

3.04 CURING, PROTECTION AND CLEANING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application to traffic of all types for a minimum of 24 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer.

END OF SECTION

SECTION 09 6800 - CARPET TILE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Accessories.

1.02 REFERENCES

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008.
- B. ASTM D 3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering; 2008
- C. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; www.carpet-rug.org; current edition.

1.03 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Samples: Submit two full size samples in size illustrating color and pattern for each carpet and cushion material specified.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet with minimum three years experience.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.
- B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.
- C. Ventilate installation area during installation and for 72 hours after installation.

1.06 MAINTENANCE

- A. Extra Materials
 - 1. Provide 5% of carpet tiles of each color and pattern selected.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS

- A. Carpet Tile 1; **CT1**:
 - 1. Tandus Flooring; Nonconform II: www.tandus-centiva.com.
 - a. Color: Golden Backdrop; ER3
 - b. Installation Method: Quarter Turn
 - c. Size: 24"x24"
 - d. Backing: Non-woven synthetic fiber

2. Mohawk Group; City Fragments: www.mohawkgroup.com.
 - a. Color: Industrial Patina
 - b. Installation Method: Quarter Turn
 - c. Size: 24"x24"
 - d. Backing: Non-woven synthetic fiber
3. Shaw Contract Group; Reed Tile: www.shawcontractgroup.com
 - a. Color: Sweet Clover
 - b. Installation Method: Quarter Turn
 - c. Size: 24"x24"
 - d. Backing: Non-woven synthetic fiber
4. Patcraft; Outside The Box: www.patcraft.com
 - a. Color: Actionable
 - b. Installation Method: Monolithic
 - c. Size: 24"x24"
 - d. Backing: Non-woven synthetic fiber

2.03 ACCESSORIES

- A. Sub-Floor Filler: Type recommended by carpet manufacturer.
- B. Adhesives: Type recommended by flooring manufacturers.
- C. Transitions:
 1. Refer to Section 09 6500 Resilient Flooring.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B. Verify that sub-floor surfaces are dust-free and free of substances which would impair bonding of adhesives to sub floor surfaces.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Clean substrate.

3.03 CARPET TILE INSTALLATION

- A. Install carpet tile in accordance with manufacturer's instructions and CRI 104.
- B. Blend carpet from different cartons to ensure minimal variation in color match.
- C. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- D. Locate change of color or pattern between rooms under door centerline.
- E. Fully adhere carpet tile to substrate.
- F. Trim carpet tile neatly at walls and around interruptions.

3.04 CLEANING

- A. Remove excess adhesive from floor and wall surfaces without damage.

- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 9100 - PAINTS AND COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Paints and Coatings on Interior Substrates.
 - 1. Concrete walls.
 - 2. Concrete masonry units.
 - 3. Ferrous metals.
 - 4. Galvanized metals.
 - 5. Gypsum board.
 - 6. Gypsum board ceilings.
- D. Paints and coatings on previously painted surfaces.
- E. See Schedules at end of this Section.

1.02 REFERENCES

- A. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2007.
- B. ASTM D 523 - Standard Test Method for Specular Gloss; 1989 (Reapproved 1999).
- C. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007.
- D. ASTM D 4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005.
- E. Steel Structures Painting Manual, Vol. 2; Systems and Specifications; Steel Structures Painting Council (SSPC); 2008 Edition.
 - 1. SSPC-SP 1 - Solvent Cleaning; 1982 (Ed. 2004) (Part of Steel Structures Painting Manual, Vol. Two).
 - 2. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
 - 3. SSPC-SP 3 - Power Tool Cleaning; 1982 (Ed. 2004).
 - 4. SSPC-SP 7 - Brush-Off Blast Cleaning; 2006.
 - 5. SSPC-SP 11 - Power Tool Cleaning to Bare Metal; 1987 (Ed. 2004) (Part of Steel Structures Painting Manual, Vol. Two).

1.03 DEFINITIONS

- A. Conform to ASTM D 16 for interpretation of terms used in this section.
- B. Gloss Ranges: Tested in accordance with ASTM D 523.
 - 1. Flat refers to a lusterless or matte finish with a gloss range between 0 and 5 when measured at a 60-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-to-medium-sheen finish with gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semi-gloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.04 SUBMITTALS

- A. Product Data: Provide data on all finishing products including:
 - 1. Manufacturer name.
 - 2. Product Type.
 - 3. Product Name.
 - 4. Product Number.
 - 5. Color.
- B. Samples: Submit two paper chip samples, 8x11 inch in size for each surface finishing product and color scheduled.

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing. Information shall be legible.
- C. Use of off-brand containers or mixing buckets will not be allowed on the site.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions. Protect from freezing.

1.06 PROJECT CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Application Temperatures for Waterborne Paints: Minimum 45 degrees F for interiors; minimum 50 degrees F for exterior; maximum 90 degrees F (32 degrees C), unless required otherwise by manufacturer's instructions. Maintain interior temperatures until paint is completely dry and cured.
- C. Application Temperatures for Solvent Thinned Paints: Minimum 50 degrees F (10 degrees C) for interiors and exterior; maximum 95 degrees F (35 degrees C), unless required otherwise by manufacturer's instructions. Maintain interior temperatures until paint is completely dry and cured.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- E. Ventilation: Ventilate affected areas during paint application. Exhaust solvent vapors outdoors, away from air intakes and people.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS - PAINTS

- A. Benjamin Moore & Co: www.benjaminmoore.com.
- B. PPG Architectural Finishes, Inc.: www.ppgaf.com.
- C. The Sherwin-Williams Co: www.sherwin-williams.com.
- D. Colors:

1. Prior to purchasing and submitting colors for approval confirm colors have not changed with designer/architect. Colors of paint may change based on awarded flooring finishes. Paint colors noted below are based on BASIS OF DESIGN specifications.
2. Paint Coating Color 1A; PC1A - Match Sherwin Williams, Toque White SW7003(Labs Spaces Only)
3. Paint Coating Color 1B; PC1B - Match Sherwin Williams, Navajo White SW7693. (Field Paint for all Non-Lab Spaces Only)
4. Paint Coating Color 2; PC2 - Match Sherwin Williams, Spiced Cider SW7702

2.03 MANUFACTURER - METAL CLEANER

- A. Chemetall Oakite; Oakite 31: www.oakite.com.metal cleaner

2.04 PAINTS AND COATINGS - GENERAL

- A. Do not use insecticides in paint materials

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

- A. General:
 1. Start of the surface preparation or paint materials application will be construed as applicator's acceptance of the surfaces as satisfactory for application of materials.
 2. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
 3. Surfaces: Correct defects and clean surfaces of substances which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
 4. Marks: Seal with sealer compatible with primer and finish coats marks which may bleed through surface finishes.
 5. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
 6. Reduce the gloss of glossy surfaces to be painted.
 7. Fill nail holes, cracks, chips, spalls, and similar damaged areas to match adjacent undamaged areas.
 8. Paint Removal:
 - a. Remove flaking, cracking, blistering, peeling or otherwise deteriorated paint and paint failing adhesion testing, by scraping with hand scrapers.
 - b. After scraping, remove large areas of paint on architectural details using sanders, heat guns or heat plates, or chemical paint removers. Do not use flame heat devices.

- c. When chemical strippers are used, neutralize substrate after stripping to a pH of 5 to 8.5.
 - d. Remove paint to bare substrate or first sound paint layer.
 - e. Paint removal shall not damage or mar the substrate material.
 - f. After paint removal, featheredge and sand edges smooth of remaining chipped paint.
- B. Concrete Surfaces to be Painted:
1. Remove dirt, loose mortar, scale, salt or alkali powder, glaze, efflorescence, laitance, and other foreign matter.
 2. Remove oil and grease with a solution of trisodium phosphate; rinse well and allow to dry.
 3. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
 4. Detergent wash surfaces to receive paint, in accordance with ASTM D 4258. Rinse with water and allow to dry.
 5. Allow surfaces to dry at least 30 days before applying paint materials.
 6. Fill concrete surface voids. Dried filler shall be uniform and free of pinholes. Do not apply filler over joint sealers.
- C. Concrete Unit Masonry Surfaces to be Painted:
1. Remove dirt, efflorescence, laitance, and other foreign matter.
 2. Remove oil and grease with a solution of trisodium phosphate; rinse well and allow to dry.
 3. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
 4. Surface clean concrete masonry to receive paint, in accordance with ASTM D 4261. Rinse with water and allow to dry.
 5. Allow surfaces to dry at least 30 days before applying paint materials.
- D. Uncoated Ferrous Metal Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing in accordance with SSPC SP-2, or sandblasting in accordance with SSPC SP-7; clean by washing with solvent or detergent in accordance with SSPC SP-1. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- E. Shop-Primed Ferrous Metal Surfaces to be Finish Painted:
1. Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous.
 2. In flat, exposed surfaces to receive semi-gloss or gloss finish, fill dents, holes and similar voids and depressions in flat exposed surfaces with metal filler compound. Finish flush with adjacent surfaces.
 3. Clean surfaces with solvent in accordance with SSPC SP-1.
 4. Prime bare steel surfaces immediately upon detection.
- F. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent in accordance with SSPC SP-1 or detergent. Wipe with metal cleaner, rinse, and wipe dry.
- G. Metal Piping: The semitransparent film applied at the mill to some piping and tubing is not considered a shop applied primer. Where indicated to be painted, overcoat with the specified ferrous metal primer.

- H. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation in accordance with SSPC SP-1 with metal cleaner and solvent or detergent washing.
- I. Gypsum Board Surfaces to be Painted:
 - 1. Fill minor defects with filler compound. Spot prime defects after repair.
 - 2. Remove loose dust and dirt by brushing with a soft brush, rubbing with a cloth, or vacuum cleaning. A damp cloth may be used when water based paint materials are to be applied. Allow to dry.
- J. Previously Painted Surfaces:
 - 1. Thoroughly remove all grease, dirt, dust or other foreign matter.
 - 2. Remove coatings that are blistering, cracking, flaking, peeling, or otherwise deteriorating.
 - 3. Roughen slick surfaces.
 - 4. Repair damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls with suitable material to match adjacent undamaged areas.
 - 5. Feather edge edges of chipped paint, and sand smooth.
 - 6. Clean metal surfaces in accordance with SSPC requirements using solvent, mechanical, or chemical cleaning methods to provide surfaces suitable for painting. Preparation of ferrous surfaces if not specified shall as recommended by coating manufacturer, but in no case less than SSPC SP-3.
 - 7. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

3.03 APPLICATION

- A. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- B. Thinning:
 - 1. When thinning is required to suit surface, temperature, weather conditions, or application methods, paints may be thinned in accordance with the manufacturer's directions.
 - 2. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds.
- C. Do not mix paint materials of different manufacturers.
- D. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Minimum Coating Thickness:

1. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness as recommended by manufacturer. Provide total dry film thickness of the entire system as recommended by manufacturer.
2. Strip paint to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.
3. Apply each coat of paint so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete. If application thickness or color and opacity of the paint do not achieve complete hiding, apply additional coat(s) to achieve complete hiding without change in contract price.

3.04 INTERIOR WALL AND CEILING JOINTS

- A. Sealant-Type Expansion Joints in Gypsum Wallboard:
 1. Ensure that backer rod and joint sealant (specified in Division 7) are completed and cured prior to application of paint.
- B. Control and Expansion Joints in Concrete and CMU:
 1. Apply coatings to the joint face (approximately 1/2 inch deep) and allow to cure before installing backer and joint sealant specified in Division 7.
- C. Fillet Joints between Hollow Metal Door Frames and Adjacent Walls (and similar locations):
 1. Ensure that backer rod and joint sealant (specified in Division 7) are completed and cured prior to application of paint.

3.05 REPAIR AND RESTORATION

- A. Reinstall electrical plates, hardware, light fixture trim, escutcheons, and fittings that were removed prior to preparing surfaces or finishing.
- B. Restore to original condition surfaces damaged or marred by painting materials application.
- C. Remove, refinish, or repaint work not complying with approved samples and other specified requirements.

3.06 PROTECTION AND CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.07 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
 1. Items fully factory-finished unless specifically noted.
 2. UL, FMG, or other code required labels; fire rating labels; and equipment name, identification, performance rating, serial number and capacity labels.
 3. Stainless steel items.
- B. Paint the surfaces described in Schedules at the end of this Section and as follows:
 1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with primer only.
 2. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 3. Finish exterior field-finished doors on tops, bottoms, and side edges the same as exterior faces.
 4. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.

5. Paint both sides and edges of plywood panel backers for electrical and telephone equipment before installing equipment.
- C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
 1. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment occurring in finished areas to match background surfaces, unless otherwise indicated.
 2. Paint shop-primed items occurring in finished areas.
 3. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.

3.08 INTERIOR PRIMERS, SEALERS, AND FILLERS

- A. Interior Acrylic Primer for Concrete and Plaster:
 1. Benjamin Moore & Co.; 231 EcoSpec Interior Latex Primer Sealer (0 g/l).
 2. PPG Architectural Finishes, Inc.; 4-603 PERMA-CRETE® Interior/Exterior Alkali Resistant Primer. (88 g/l)
 3. The Sherwin-Williams Co.; B11W900 Harmony Interior Latex Primer. (0 g/l)
- B. Interior Block Filler for Concrete Masonry Units:
 1. Benjamin Moore & Co.; 285 Moorcraft Super Craft Latex Block Filler. (57 g/l)
 2. PPG Architectural Finishes, Inc.; 6-7 Speedhide Latex Masonry Block Filler. (18 g/l)
 3. The Sherwin-Williams Co.; B25W25 PrepRite Acrylic Latex Block Filler. (42 g/l)
- C. Interior Acrylic Primer for Gypsum Board:
 1. Benjamin Moore & Co.; 231 EcoSpec Interior Latex Primer Sealer. (0 g/l)
 2. PPG Architectural Finishes, Inc.; 9-900 Pure Performance Interior Latex Primer. (0 g/l)
 3. The Sherwin-Williams Co.; B11W900 Harmony Interior Latex Primer. (0 g/l)
- D. Interior Acrylic Primer for Ferrous Metal:
 1. Benjamin Moore & Co.; M04 IMC Acrylic Metal Primer. (54 g/l)
 2. PPG Architectural Finishes, Inc.; 90-712 Pitt-Tech Primer/Finish DTM Industrial Enamel. (123 g/l)
 3. The Sherwin-Williams Co.; B66W1 Direct To Metal Acrylic Primer & Finish. (138 g/l)
- E. Interior Acrylic Primer for Galvanized Metal:
 1. Benjamin Moore & Co.; M04 IMC. Acrylic Metal Primer. (54 g/l)
 2. PPG Architectural Finishes, Inc.; 90-712 Pitt-Tech Primer/Finish DTM Industrial Enamel. (123 g/l)
 3. The Sherwin-Williams Co.; B66W1 DTM Primer/Finish. (138 g/l)

3.09 INTERIOR FINISH COATS

- A. Flat Acrylic Finish Coats for Concrete, Plaster, Concrete Masonry Units, Gypsum Board, Wood:
 1. Benjamin Moore & Co.; 219 Eco Spec Interior Latex Flat. (0 g/l)
 2. PPG Architectural Finishes, Inc.; 9-100 Pure Performance Flat Interior Latex. (0 g/l)
 3. The Sherwin-Williams Co.; ProMar 200 Zero VOC Flat, B30-2600. (0 g/l)
- B. Eggshell Acrylic Finish Coats for Concrete, Plaster, Concrete Masonry Units, Gypsum Board, Wood:
 1. Benjamin Moore & Co.; 223 Eco Spec Interior Latex Eggshell Enamel. (0 g/l)
 2. PPG Architectural Finishes, Inc.; 9-300 Series Pure Performance Interior Eggshell Latex. (0 g/l)
 3. The Sherwin-Williams Co.; ProMar 200 Zero VOC Eg-Shel, B20-2600. (0 g/l)

C. Semi-Gloss Acrylic Finish Coats for Ferrous Metal:

1. Benjamin Moore & Co.; IMC M29 DTM Acrylic Semi-Gloss Enamel. (207 g/l)
2. PPG Architectural Finishes, Inc.; 90-474 Pitt-Tech Int/Ext Satin DTM Industrial Enamel. (227 g/l)
3. The Sherwin-Williams Co.; B66-200 Series DTM Acrylic Coating, Semi Gloss. (208 g/l)

D. Semi-Gloss Acrylic Finish Coats for Galvanized Metal:

1. Benjamin Moore & Co.; IMC M29 DTM Acrylic Semi-Gloss Enamel. (207 g/l)
2. PPG Architectural Finishes, Inc.; 90-474 Pitt-Tech Int/Ext Satin DTM Industrial Enamel. (227 g/l)
3. The Sherwin-Williams Co.; B66-200 DTM Series Acrylic Coating, Semi Gloss. (208 g/l)

3.10 PRIMER, INTERMEDIATE, AND TOP COAT COLORS

- A. Except where coating materials cannot be tinted, tint each successive (primer, intermediate, top) coat of paint a sufficiently contrasting color to facilitate identification of complete coating coverage. The preceding coat may be in the same color family, but shall be noticeably different. Provide additional top coats without change in Contract Price if necessary to achieve complete hiding and uniform sheen.
- B. Top coat colors are indicated on the drawings and schedules. For approval of actual colors, see sample and mock-up requirements specified above.
- C. Top coat colors of manufacturers listed on the Finish Schedule (or elsewhere) indicate the required color, only, and do not indicate the required brand name product, which shall be as specified in above.

3.11 PAINT SYSTEMS - INTERIOR

- A. Concrete and Plaster:
 1. First Coat: Acrylic primer.
 2. Two Top Coats: Eggshell acrylic finish.
- B. Concrete Masonry Units:
 1. First Coat: Acrylic Block Filler.
 2. Two Top Coats: Eggshell acrylic finish.
- C. Ferrous Metals:
 1. First Coat: Primer.
 2. Two Top Coats: Semi-gloss acrylic finish.
- D. Galvanized Metal:
 1. First Coat: Acrylic primer.
 2. Two Top Coats: Semi-gloss acrylic finish.
- E. Gypsum Board:
 1. First Coat: Acrylic primer.
 2. Two Top Coats: Eggshell acrylic enamel finish.
- F. Gypsum Board Ceilings:
 1. First Coat: Acrylic primer.
 2. Two Top Coats: Flat latex paint finish.

END OF SECTION

SECTION 09 9610 - RECOATING OF LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Surface preparation.
 - 2. Application of primers, intermediate coats, and top coats for each coating system.

1.02 REFERENCES

- A. Steel Structures Painting Manual, Vol. 2; Systems and Specifications; Steel Structures Painting Council (SSPC); 2008 Edition.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's technical data sheets for each coating.
 - 1. Material analysis including vehicle type and percentage by weight and by volume of vehicle, resin, and pigment.
 - 2. Application instructions including mixing, surface preparation, compatible primers and topcoats, recommended wet and dry film thickness, recommended application methods.
- B. Color and Texture Samples:
 - 1. Provide for each coating system, color, and texture and applied to representative substrate samples.
 - 2. Label each sample with coating name and color.
 - 3. Prepare samples to show bare, prepared surface and each successive coat.

1.04 QUALITY ASSURANCE

- A. Installer: A company skilled in the application of special coatings whose installations have performed in a satisfactory manner under comparable conditions.
- B. Mock-up:
 - 1. Apply full coating systems, including required textures and colors, to mock-up. In interior spaces, provide completed lighting, or similar, for viewing of mock-up.
 - 2. Apply coatings to mock-ups in locations as directed by the Architect.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original containers bearing coating name and color, material composition data, date of manufacture, legal notices if applicable, and mixing, thinning, and application instructions.
- B. Storage:
 - 1. Store materials in an orderly fashion and in clean, well-closed containers with labels intact.
 - 2. Maintain above 40 degrees F. Do not allow materials to freeze.

1.06 PROJECT CONDITIONS

- A. Apply coatings only under the following environmental conditions:
 - 1. Air and surface temperatures are between 50 and 120 degrees F, or more restrictive when recommended by coatings manufacturer.
 - 2. Surface temperature is at least 5 degrees F above dew point, or more restrictive when recommended by coatings manufacturer.
 - 3. Relative humidity is less than 85 percent, or more restrictive when recommended by coatings manufacturer.
- B. Do not apply coatings during inclement weather except within enclosed, conditioned spaces.

- C. Provide temporary lighting to achieve a well-lit surface with a level of not less than 80 footcandles measured mid-height.
- D. Provide continuous ventilation and heating to prevent accumulation of hazardous fumes, and maintain surface and ambient temperatures as specified above for 24 hours before, during, and for 48 hours after application of finishes (or longer if required to obtain full cure as indicated by manufacturer's instructions).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all products of this section from a single manufacturer.
- B. The brand-name products listed in the schedule at the end of this section and made by the following are the basis of the contract documents.
 - 1. Tnemec Company, Inc.
 - 2. Carboline.
 - 3. PPG Architectural Finishes.
- C. Provide the products listed.

PART 3 EXECUTION

3.01 PREPARATION

- A. Do not apply coatings to labels that identify equipment, fire-resistance ratings, etc.
- B. Remove hardware, switch and outlet plates, lighting fixtures, etc., before applying coatings. After application of coatings, reinstall removed items. Employ only skilled workmen for removal and replacement of such items.
- C. Provide protection for non-removable items not scheduled for coating.
- D. Protect surfaces not scheduled for coating. Clean, repair, or replace to the satisfaction of the Architect any surfaces inadvertently spattered or coated.

3.02 SURFACE PREPARATION

- A. General: Clean and prepare surfaces as specified. Achieve the surface profile recommended by the coating manufacturer for optimum adhesion and proper appearance.
- B. All Surfaces: Ensure surfaces are clean, dry and free of oil, grease and other contaminants.
- C. Ferrous Metal:
 - 1. Clean and prepare surface profile in accordance with applicable SSPC specifications:
 - a. Remove the existing coating from the entire surface to be recoated.
 - b. Power tool clean to a SSPC SP3 standard to remove all visible rusty areas. Lightly abrade the entire substrate to be painted. Prior to painting the substrate must be clean dry and free of all contaminants.

3.03 APPLICATION

- A. General:
 - 1. Full, uniform coverage is required.
 - 2. Employ only application equipment that is clean, properly adjusted, in good working order, and of the type recommended by the coating manufacturer.
 - 3. Apply successive coats after adequate cure of the preceding coat and within the recommended recoating time.

- B. Film Thickness: Apply each coat to achieve the dry film mil (DFM) thickness per coat indicated in the schedule at the end of this section. Application rates of excess thickness and fewer numbers of coats than specified will not be accepted.
 - 1. The dry film mil thicknesses shown in the schedule are per each coat.
 - 2. Where a thickness range is specified, the dry film thickness actually applied shall fall within the specified range when measured at any point, and the average dry film thickness actually applied to the entire surface shall be equal to the midpoint of the range specified plus or minus 10 percent.
 - 3. Where a single thickness value is specified, the dry film thickness actually applied, when measured at any point, shall be equal to the specified value plus or minus 10 percent.
- C. Apply coatings to using spray application to achieve a smooth, uniform finish without drips, runs, orange peel or other defects.
- D. Remove coatings not in compliance with this specification, reclean and re-prepare surfaces as specified, and apply coatings to comply with the contract documents.

3.04 CLEANING

- A. Clean work area on a daily basis; dispose of spent materials and empty containers. If requested, turn over to the Architect all empty coatings containers used during the course of each day.
- B. Remove all trace of coatings inadvertently applied to adjacent surfaces not scheduled to be coated. Remove by appropriate methods that do not damage surfaces.

3.05 PROTECTION

- A. Protect work against damage until fully cured. Provide signs identifying wet surfaces until surfaces are adequately cured.
- B. Shortly before final completion of the project, examine surfaces for damage to coatings and restore coatings to new, undamaged condition.
 - 1. Touch-up of minor damage will be acceptable where, in the opinion of the Architect, the result is not visibly different from surrounding surfaces. Recoat entire surface where result is different either in color, sheen, or texture.

3.06 SCHEDULE

- A. PRIMER, INTERMEDIATE, AND TOP COAT COLORS
 - 1. Except where coating materials cannot be tinted, tint each successive (primer, intermediate, top) coat of paint a sufficiently contrasting color to facilitate identification of complete coating coverage. The preceding coat may be in the same color family, but shall be noticeably different. Provide additional top coats without change in Contract Price if necessary to achieve complete hiding and uniform sheen.
- B. RECOATING FUME HOODS
 - 1. System:
 - a. Steel:
 - 1) Steel primer.
 - 2) Top coat.
 - 2. Tnemec:
 - a. Primers:
 - 1) Steel Primer:
 - (a) Series N69 Hi-Build Epoxoline II, DFT 3.0 mils. (285 g/l)
 - b. Top Coats:

- 1) Low Gloss (Satin) Epoxy: LE material designation on Finish Schedule.
 - (a) Series N69 Hi-Build Epoxoline II, DFT 3.0 mils. (285 g/l)
3. Carboline:
 - a. Primers:
 - 1) Steel Primer:
 - (a) Carboguard 890, DFT 4.0 to 6.0 mils. (214 g/l)
 - b. Top Coats:
 - 1) Low Gloss (Satin) Epoxy: LE material designation on Finish Schedule.
 - (a) Carboguard 893GB, DFT 4.0 to 6.0 mils. (336 g/l)
4. PPG:
 - a. Primers:
 - 1) Steel Primer:
 - (a) PittGuard DTR Epoxy Coating 97-145, DFT 2.0 to 3.0 mils. (128 g/l)
 - b. Top Coats:
 - 1) Low Gloss (Satin) Epoxy: LE material designation on Finish Schedule.
 - (a) Aquapon HG Epoxy Semi-Gloss 97-130 Series, DFT 4.0 to 6.0 mils. (325 g/l)

END OF SECTION

SECTION 10 2601 - WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Corner Guards - Surface Mounted: One-piece unit without splices, installed with screws.
 - 1. Material: Type 304 stainless steel, No. 4 finish.
 - 2. Thickness: 18 gage, 0.05 inch.
 - 3. Width of Wings: 3-1/2 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.

END OF SECTION

SECTION 10 2800 - TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Accessories for toilet rooms and laboratories.

1.02 SUBMITTALS

- A. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

PART 2 PRODUCTS

2.01 ACCESSORIES

- A. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
 - 1. Capacity: 300 C-fold minimum.
 - 2. Product: B-262 manufactured by Bobrick.
- B. Lab Coat Hooks: Double prong with 6 pronged hood, wall mounted, chrome finish.
 - 1. Product: KES-A3061 by KES Coat Hook Rack/Rail.

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 the drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.03 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 - FIRE EXTINGUISHERS AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.

1.02 REFERENCES

- A. UL 299 - Dry Chemical Fire Extinguisher; 2002.
- B. Warnock Hersey, "Certification Listings."

1.03 PERFORMANCE REQUIREMENTS

- A. Provide extinguishers classified and labeled by testing firm acceptable to the authority having jurisdiction for the purpose specified and indicated.

1.04 SUBMITTALS

- A. Product Data.
- B. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 MANUFACTURERS

- A. Fire Extinguishers, Cabinets and Accessories:
 - 1. JL Industries, Inc.: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co.: www.larsensmfg.com.
 - 3. Potter-Roemer: www.potterroemer.com.

2.03 FIRE EXTINGUISHERS

- A. Provide units complying with UL 299.
- B. Dry Chemical Multi-Purpose Type: Steel cylinder.
 - 1. Size: 4A60BC.
 - 2. Diameter: 5 inches.
 - 3. Finish: Powder coat, red color.

2.04 CABINETS FOR DRY TYPE MULTI-PURPOSE FIRE EXTINGUISHERS

- A. Style: Vertical Duo.
- B. Trim: Flat, 1 inch-wide face.
- C. Recessed Cabinet (non-fire-rated box):
 - 1. Exterior nominal dimensions of 9 to 10 1/2 inches wide x 24 inches high x 6 inches deep.
 - 2. Finish: Primed for Field Paint Finish.
 - a. J.L.; Ambassador 1015.
 - b. Larsen's; Architectural 2409-R2.
 - c. Potter-Roemer; Alta Steel 7020DV.
- D. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon catch.
- E. Door Glazing: Tempered Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.

- F. Finish of Cabinet Interior: White enamel.
- G. Cabinet Signage: FIRE EXTINGUISHER in black vertical letters parallel to vertical-duo window.

2.05 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level, 34 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.

END OF SECTION

SECTION 11 5300 - LABORATORY EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Laboratory equipment to be furnished by the Contractor or Owner and installed by the Contractor or Owner.
- B. Connection to utilities.

1.02 DEFINITIONS

- A. Equipment responsibilities:
 - 1. CFCI: Contractor Furnished, Contractor Installed.
 - 2. OFCI: Owner Furnished, Contractor Installed.
 - 3. OFOI: Owner Furnished, Owner Installed.
- B. Rough-In-Point: Individual or common supply of mechanical, electrical, and heating, ventilation and air conditioning (HVAC) through wall, floor, or ceiling, generally located within the equipment chase.

1.03 SUBMITTALS

- A. Product Data: Provide equipment dimensions and construction, equipment capacities, physical dimensions, utility and service requirements and locations, point loads.
- B. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, clearances required.
- C. Manufacturer's Installation Instructions: Indicate special installation requirements.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Operation Data: Include description of equipment operation and required adjusting and testing.
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and spare part sources.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

- A. Warrant that equipment is free of defective materials, design and workmanship
- B. Warrant that equipment and material conforms to this Specification and agrees to make changes, adjustments, or replacements required to meet the Specifications at no cost to Owner.
- C. Warranty Period: See individual equipment.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 EQ_04 - STERILIZER 20" X 20" X 38".

- A. Responsibility: CFCI.
- B. Manufacturers: Provide products from one of the following manufacturers.

1. Getinge USA, Inc.; Rochester, NY. 800-475-9040. www.getingeproducts.com.
2. Consolidated Sterilizer Systems; Boston MA. 617-782-6072. www.consteril.com
3. Primus Sterilizer Company, Inc.; Omaha, NE. 402-344-4200. www.primus-sterilizer.com.
- C. Basis of Design: Primus Sterilizer Company, Inc.
 1. Primus: 20 x 20 x 38. Model PSS5-A-MSSD with a PSS500 controller.
- D. Features: Unit includes but is not limited to the following features.
 1. Nominal internal chamber dimensions: 20"Wx20"Hx38"D.
 2. Nominal chamber volume: 8.8 cu ft.
 3. Door configuration: Single door, vertical-sliding.
 4. Mounting: Free-standing cabinet.
 5. Service Side: Right Side only.
 6. Operational Type: Pre-vacuum.
 7. Stainless Steel chamber and doors construction.
 8. Steam System: House steam.
 9. Drain cooling system: Drain discharge shall be indirectly cooled down to reduce the effluent temperature to 140 degrees F (60 degrees Celsius) or less.
 10. Touch padd controller, providing seven fully programmable cycles for sterilization of wrapped goods, hard goods, liquids and test cycles. Gravity, Vacuum and liquid cycle settings included. Cycle test parameters displayed and recorded each cycle. Controller to provide output for remote alarms and remote data reporting.
 - a. Model: Primus PSS500 controller.
 11. Integral water recirculation tank and feed pump, piping and valving.
 - a. Model: Primus Pri-Saver Water Conservation.
 12. Utilities: Available utilities for equipment connection.
 - a. Steam: 35-40 psig.
 - b. Purified Water: N/A.
 - c. Electrical for control panel: 120V, 60Hz, 1Ph.
 - d. Cold Water: 50 psig.
 - e. Drain: 12 inch by 12 inch floor sink with 3 inch drain.
 13. Warranty Period: One year from date of Substantial Completion.
 14. Maintenance Service during warranty period:
 - a. Provided by Manufacturer's field service technician or Manufacturer's trained and authorized field service representative.
 - b. Includes emergency repair and preventative maintenance service.
 - c. Includes emergency parts replacement.
 - d. Emergency Service:
 - 1) Repair and replace defective parts.
 - 2) Guaranteed 4 hour verbal response during normal working hours.
 - 3) Guaranteed 48 hours on site response.
 - e. Preventative Maintenance:
 - 1) Periodic maintenance of components and adjustment of operation.
 - 2) Includes not less than 4 visits by field service personnel.
 - f. Provide parts and supplies as used in the manufacture and installation of original equipment.
 - g. Spare parts: Available on for on site replacement within 48 hours.

2.03 EQ_03 - BIOLOGICAL SAFETY CABINET- CLASS II, TYPE A2

A. Responsibility: OFOI

B. Existing to be relocated by owner.

2.04 EQ-01 - DOWNDRAFT STATION

A. Responsibility: CFCI.

B. Manufacturers: Provide products from one of the following manufacturers.

1. Mopec, Oak Park MI. www.mopec.com
2. TBJ, Inc., Chambersburg, PA. www.tbjinc.com

C. Model: 34-60-S LSS-DD Downdraft Station, Basis of Design.

D. Features: Unit includes but is not limited to following features.

1. Size:
 - a. Overall dimensions: 34 inch deep by 60 inch long.
 - b. Work surface: 34 inch high.
 - c. Downdraft work area: 27 inch by 38 inch.
 - d. Duct connection: 4 inch by 30 inch.
2. Construction: All welded stainless steel construction, T316 with #4 satin finish. Marine edge work. All welds to be heliarc. All exposed welds to be ground to a seamless polished finish.
3. Table: Removable perforated work surface panles. Panels recessed 1/4 inch below the table perimeter to prevent fluids from escaping the work area.
 - a. Drain pan shall be sloped to one end, under the exhaust plenum, for complete drainage and shall be designed for ease in cleanability to prevent build-up of debris and bacteria.
 - b. Control valve, vacuum breaker and (2) flush down manifolds which horizontally run the length of each side of the table, below the work surface to rinse away fluids and debris.
 - c. Stainless steel, precision engineered removable internal baffling system to create an uniform downdraft air velocity across the entire perforated work surface.
 - d. Double pedestal design; option of stool height or seating height.
4. Lighting: Fluorescent fixture, off-on switch located on the lower front of the station.
5. Accessories:
 - a. Ground fault circuit interrupter (GFCI) receptacle.
 - b. Disposer: 1 HP.
 - c. Eye wash hose / spray assembly.
 - d. Manual push-button height adjustability.
 - e. Removable shelf.
 - f. Adjustable arm swivel type surgical light mounted on a stainless steel pole.
6. Sink: Removable stainless steel single compartment sink.
7. Fittings:
 - a. Hot and cold water faucet, with vacuum breaker, swing spout and clear phenolic finish.
 - b. Spray gun assembly with 8 ft. recoil hose for table clean-up.
8. Utilities: Factory pre-plumbed and pre-wired ready for single point connection of utilities on site.
 - a. Hot water: 1/2 inch I.P.S., 20-50 psig.
 - b. Cold water: 3/4 inch I.P.S., 20-50 psig.
 - c. Drain: 1-1/2 inch I.P.S.
 - d. Exhaust: 4 inch by 30 inch outside diameter, 450 CFM.

- e. Electrical: 115V, 1 ph, 60 hz, 15 amp.

2.05 EQ-02 - UNDERCOUNTER GLASSWARE WASHER

- A. Responsibility: CFCI
- B. Manufacturers: Provide products from one of the following manufacturers.
 - 1. Miele Inc., Princeton, NJ, 800-843-7231, www.miele.com.
 - 2. Lancer USA Inc., Winter Springs, FL, 800-332-1855, www.lancer.com.
 - 3. Labconco Corp., Kansas City, MO, 800-821-5525, www.labconco.com.
- C. Model
 - 1. Labconco FlaskScrubber Model 4420320 Basis of Design.
- D. Features: Unit includes but is not limited to following features.
 - 1. On board steam generator
 - 2. 304 stainless steel interior
 - 3. Mounting Configuration: 1 door undercounter cabinet housing.
 - 4. Door:
 - a. Front, drop-down, spring counter balance.
 - 5. Selectable automatic wash programs.
 - 6. Water Heater: Steam-heated.
 - 7. Accessories:
 - a. For each chamber, provide 1 manufacturer standard modular rack system to allow for modular basket inserts.
 - b. For each chamber, provide 1 basket insert or spindle rack with direct injection capability for washing small and medium glassware.
 - c. Provide 1 rack insert with direct injection capability for washing large glassware and plastic items.
 - 8. Utilities: The following utilities will be available for equipment connection.
 - a. Electrical: 120V, 60 Hz, 16 Amps
 - b. Hot water: 50 psig.
 - c. Cold water: 50 psig.
 - d. Purified water for final rinse
 - e. Drain: 12 inch by 12 inch floor sink with 3 inch drain.
- E. Warranty Period: One year from date of Substantial Completion.
- F. Maintenance Service during warranty period:
 - 1. Provided by Manufacturer's field service technician or Manufacturer's trained and authorized field service representative.
 - 2. Includes emergency repair and preventative maintenance service.
 - 3. Includes emergency parts replacement.
 - 4. Emergency Service:
 - a. Repair and replacement defective parts.
 - b. Guaranteed 4 hour verbal response during normal working hours.
 - c. Guaranteed 48 hours on site response.
 - 5. Preventative Maintenance:
 - a. Periodic maintenance of components and adjustment of operation.
 - b. Includes not less than 4 visits by field service personnel.
 - 6. Provide parts and supplies as used in the manufacture and installation of original equipment.
- G. Spare parts: Available for on site replacement within 48 hours.

2.06 UNDERCOUNTER GLASSWARE WASHER, EXISTING TO BE RELOCATED TO LAB
3023-A BID ALTERNATE

- A. Relocate and install existing unit
 - 1. Utilities: The following utilities will be available for equipment connection.
 - a. Electrical: 120V, 60 Hz, 16 Amps
 - b. Hot water: 50 psig.
 - c. Cold water: 50 psig.
 - d. Purified water for final rinse
 - e. Drain: 12 inch by 12 inch floor sink with 3 inch drain.

PART 3 EXECUTION

3.01 EXAMINATION

- A. General: Examine surfaces designated to receive work for conditions, which would adversely affect the finished work. Repair or replace surfaces not meeting tolerances or quality requirement governing substrate construction prior to start of work.
- B. Utilities: Inspect and verify that necessary utilities have been roughed in prior to equipment installation.

3.02 PREPARATION

- A. Provide rough-in frame and anchors for placement by other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Sequence installations to ensure utility connections are achieved in an orderly and expeditious manner.

END OF SECTION

SECTION 11 5313 - LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Bench mounted laboratory fume hoods.
 - 2. Fume hood work surface.
 - 3. Fume hood base cabinets.
 - 4. Laboratory sinks and cup sinks in fume hoods.
 - 5. Water, laboratory gas, and electrical service fittings and fixtures in fume hoods.
 - 6. Fume hood alarm system.
 - 7. Accessories and safety signage.
 - 8. Fume hood commissioning.

1.02 REFERENCES

- A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2009.
- B. ASHRAE Std 110 - Method of Testing Performance of Laboratory Fume Hoods; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1995.
- C. ASTM A 1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability; 2013.
- D. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; 2011.
- E. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; 2009.
- F. CSA International (DIR) - Directory of Certified Appliances and Accessories; current edition.
- G. NFPA 30 - Flammable and Combustible Liquids Code; 2012.
- H. NFPA 45 - Standard for Fire Protection for Laboratories Using Chemicals; 2011.
- I. SEFA 1 - Laboratory Fume Hoods; Scientific Equipment and Furniture Association; 2010.
- J. SEFA 8 - Laboratory Furniture Casework, Shelving and Tables Recommended Practices; 2010.

1.03 PERFORMANCE REQUIREMENTS

- A. Casework components shall withstand the following minimum loads without damage to the component or to the casework operation when tested in accordance with SEFA 8.
 - 1. Steel base unit load capacity:
 - a. 200 lb per square foot of cabinet top area.
 - b. Leveling bolts: 500 lb each; minimum one per corner of each base cabinet.
 - 2. Drawers in a cabinet: 150 lb uniform load with smooth operation for minimum 10,000 cycles of opening and closing.
 - 3. Shelves: Shelves of base units, wall cases and tall cases: 100 lb.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's catalog data, specification sheets, and product manuals.
- B. Shop Drawings:
 - 1. Submit shop drawings for fume hoods showing the following:
 - a. Plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto.
 - b. Details and location of anchorages and fitting to floors, walls, and base.

- c. Layout of units with relation to surrounding walls, doors, windows, lighting and air conditioning fixtures, and building components.
 - d. Connection to hood exhaust system; location of access doors, cutoff valves, and junction boxes.
 - e. Coordinate shop drawings with other work involved.
 - f. Indicate in-wall blocking and rough-in requirements for coordination with other trades.
- 2. Provide rough-in drawings for mechanical and electrical services.
- 3. Provide face opening, air volume, and static pressure drop.
- C. Samples: Samples will be reviewed for color, texture, and pattern only.
 - 1. Hood enclosure: 6 inch x 6 inch, two samples of each color specified.
 - 2. Front panel: 6 inch x 6 inch, two samples of each color specified.
 - 3. Liner: 6 inch x 6 inch, two samples of each material and color specified.
 - 4. Operation signage: One actual size sample of each sign.
- D. Certificates:
 - 1. Certify compliance with ASHRAE Std 110.
 - 2. Certify that fume hoods meet the performance requirements specified herein.
- E. Operation Data: Submit two copies of operating and maintenance instructions for each fume hood, provided in booklet form providing information on adjustment, operation, and maintenance of hoods.

1.05 QUALITY ASSURANCE

- A. Fume Hood Standard: Provide fume hoods complying with the requirements of SEFA 1, "Laboratory Fume Hoods - Recommended Practices."
- B. Provide factory testing of each type of fume hood specified to demonstrate fume hood performance. Provide testing facility, instruments, equipments, and materials needed for tests.
- C. Maintain testing facility at manufacturer's place of business for testing and evaluating laboratory fume hoods under both ideal and adverse conditions, in accordance with ASHRAE Std 110.
- D. Make manufacturing facility, testing facility, and quality control procedures available for owner inspection.
- E. Manufacturer Qualifications:
 - 1. Minimum five years of manufacturing fume hoods as a principal product.
 - 2. Ten installations of equal or larger size and requirements.
- F. Installer Qualifications:
 - 1. Factory certified by manufacturer.
 - 2. Ten installations of equal or larger size and requirements.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver fume hoods, work surfaces, and accessories free of damage.
- B. Ship fume hoods disassembled to fit easily through corridors and doorways at the site.
- C. Store and handle in a manner to prevent damage to fume hoods, work surfaces, accessories, or adjacent work.

1.07 PROJECT CONDITIONS

- A. Coordinate fume hood and service fitting installation with size, location and installation of service utilities.

- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Rooms in which fume hoods are to be installed shall be broom clean.

1.08 WARRANTY

- A. Special Project Warranty: Provide special project warranty, signed by Contractor, Installer, and Manufacturer, agreeing to replace, repair, or restore defective materials and workmanship of laboratory fume hoods during warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the terms and conditions of the Contract Documents.
- B. Warranty against defects in materials and workmanship on fume hoods, work surfaces, and accessories; include labor and replacement parts (except lamps).
- C. Warranty Period: One year from date of Substantial Completion or two years from date of purchase, whichever is sooner.
- D. Provide a five year warranty to include coverage for delamination of laminated glass and replacement of same.

PART 2 PRODUCTS

2.01 PRODUCT OUTLINE

- A. FH-1 - General Purpose Fume Hood.
 - 1. Physical Type: Bench Mounted.
 - 2. Operational Features:
 - a. Operational Type: Constant Volume with Open Bypass.
 - b. Face Velocity: 100 ft per minute
 - 3. Sash:
 - a. Sash Type: Vertical Rising, Frameless Sash.
 - b. Sash Stop: Manual type at 18 inches.
 - 1) Manual Type.
 - 2) Location: 18 inches
 - 4. Size:
 - a. Depth: 36 inch; Width: 60 inch.
 - 5. Exterior Material: Painted, 18 gauge cold rolled steel.
 - 6. Exterior Color: As selected by Architect from manufacturer standard.
 - 7. Interior Liner: Polyresin.
 - 8. Work Surface: Cast Epoxy Resin.
 - 9. Base Cabinet:
 - a. Left Side: 30 inch wide, Vacuum Storage Cabinet.
 - b. Right Side: 30 inch wide, Acid Storage Cabinet.
 - 10. Service Fixtures:
 - a. For unit up to 60 inch wide
 - 1) Left Side: Air, Gas, Vacuum, and 120V GFI Duplex Outlet
 - 2) Right Side: Air, Gas, Cold Water, Vacuum, and 120V GFI Duplex Outlet
 - 3) Cup Sink Location: Per plans
 - 11. Safety Monitor/Alarm System:
 - a. Measure face velocity.
 - b. Local visual and audible alarm.
- B. FH-2 - General Purpose Fume Hood.

1. Existing fume hood to remain or to be relocated. Remove base cabinets.
 - a. Contractor to verify if Asbestos Containing Material (ACM) is present. If ACM is found, fume hood to be abated by Asbestos Contractor and fume hood to be replaced with new food specified herein.
 2. New Fume Hood FH-2, if replaced:
 - a. Physical Type: Bench Mounted.
 - b. Operational Features:
 - 1) Operational Type: Constant Volume with Open Bypass.
 - 2) Face Velocity: 100 ft per minute.
 - c. Sash:
 - 1) Sash Type: Vertical Rising, Frameless Sash.
 - 2) Sash Stop: Manual type at 16 inches. If sash stop for existing FH-3 is other than 16", adjust to 16".
 - d. Size:
 - 1) Depth: 36 inch; Width: 60 inch.
 - e. Exterior Material: Painted, 18 gauge cold rolled steel.
 - f. Exterior Color: As selected by Architect from manufacturer standard.
 - 1) Interior Liner: Polyresin.
 - 2) Work Surface: Cast Epoxy Resin.
 3. Base Cabinet: Replace existing cabinets.
 - a. Left Side: 30 inch wide, Acid Storage Cabinet.
 - b. Right Side: 30 inch wide, Flammable Storage Cabinet.
 4. Service Fixtures:
 - a. For unit up to 72 inch wide
 - 1) Left Side: Air, Gas, and 120V GIF Duplex Outlet
 - 2) Right Side: Air, Gas, Cold Water, and 120V GFI Duplex Outlet
 - 3) Contractor to determine if existing FH-3 requires valves and or faucets, and provide if they do
 - 4) Cup Sink Location: Right Rear.
 5. Safety Monitor/Alarm System:
 - a. Measure face velocity.
 - b. Local visual and audible alarm.
- C. FH-3 - General Purpose Fume Hood.
1. Existing fume hood to remain or to be relocated. Remove base cabinets.
 - a. Contractor to verify if Asbestos Containing Material (ACM) is present. If ACM is found, fume hood to be abated by Asbestos Contractor and fume hood to be replaced with new food specified herein.
 2. New Fume Hood FH-3, if replaced:
 - a. Physical Type: Bench Mounted.
 - b. Operational Features:
 - 1) Operational Type: Constant Volume with Open Bypass.
 - 2) Face Velocity: 100 ft per minute.
 - c. Sash:
 - 1) Sash Type: Vertical Rising, Frameless Sash.
 - 2) Sash Stop: Manual type at 16 inches. If sash stop for existing FH-3 is other than 16", adjust to 16".
 - d. Size:
 - 1) Depth: 36 inch; Width: 60 inch.

- e. Exterior Material: Painted, 18 gauge cold rolled steel.
 - f. Exterior Color: As selected by Architect from manufacturer standard.
 - 1) Interior Liner: Polyresin.
 - 2) Work Surface: Cast Epoxy Resin.
 - 3. Base Cabinet: Replace existing cabinets.
 - a. Left Side: 30 inch wide, Vacuum Storage Cabinet.
 - b. Right Side: 30 inch wide, Acid Storage Cabinet.
 - 4. Service Fixtures:
 - a. For unit up to 72 inch wide
 - 1) Left Side: Air, Gas, Vacuum, and 120V GIF Duplex Outlet
 - 2) Right Side: Air, Gas, Cold Water, Vacuum, and 120V GFI Duplex Outlet
 - 3) contractor to determine if existing FH-3 requires valves and or faucets, and provide if they do
 - 4) Cup Sink Location: Right Rear.
 - 5. Safety Monitor/Alarm System:
 - a. Measure face velocity.
 - b. Local visual and audible alarm.
- D. Provide factory installed pipes and wires for plumbing and electrical services as indicated above.
- 1. Pre-piped Configuration: Piped to 6 inch above top of hood.
 - 2. Pre-piped material:
 - a. Water: Copper.
 - b. Air: Copper.
 - c. Natural Gas: Black Iron.
 - d. Vacuum: Copper.

2.02 MANUFACTURERS

- A. Acceptable Manufacturer includes:
- 1. Kewaunee Scientific Corporation, Statesville, NC, 704-873-7202, www.kewaunee.com.
 - 2. Mott Manufacturing Ltd, Brantford, Ontario, Canada, 519-752-2895, www.mott.ca.
 - 3. CiF Lab Solutions, Ontario, Canada, www.cifsolutions.com.

2.03 OPERATIONAL FEATURES

- A. Open Bypass Fume Hood for Use with Constant Volume (CV) Exhaust System:
- 1. Open Bypass Fume Hood shall incorporate an automatic air bypass feature above sash opening, which open as sash is closed, to limit the increase in face velocity.
 - 2. Face velocity at the sash shall not exceed 120 cfm.
 - 3. Face velocity, when measured at the sash opened 6 inches, shall be no more than 3 times the velocity at the sash fully open.
- B. Two-State Control: Sash switches are used to change the flow based on the open area of the fume hood sash.

2.04 FABRICATION/MATERIAL-BENCH MOUNTED HOODS

- A. Enclosure Construction:
- 1. Exterior Shell Material: Cold-rolled sheet steel; ASTM A 1008, Designation CS; minimum 18 gauge.
 - 2. Fabricate fume hoods in double wall construction, prefinished, cold-rolled steel exterior shell, with an interior liner and baffle of chemical resistant material as noted.

3. Framework: Frame shall be heavy gauge, welded steel members, reinforced, braced and assembled with exterior shell and interior liner to form a rigid, self-supporting enclosure unit.
 4. Screw together component parts to allow removal of interior liner, end panels, front end fascia pieces, top fascia and air foil strips, and to allow access to plumbing lines and service fixtures.
 5. End Panels:
 - a. Double wall construction; not more than 5 inches wide; without projecting corner posts or obstructions to interfere with smooth, even flow of air.
 - b. The area between double walls shall house and conceal framing, attaching brackets, remote operating service fixture mechanisms, sash counterbalances and vent pipes, if necessary, from base cabinets.
 - c. Access panel to service fixture mechanisms concealed between walls shall be provided by full overlap design, removable gasketed (70 durometer polyvinylchloride or equivalent) access panels on the inside liner walls, or through front corner covers.
 - d. Terminate end panels flush with interior lining.
 6. Corner Covers:
 - a. Prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
 - b. 20 gauge stainless steel, prepunched and plugged to accommodate up to four service fixtures and two electrical boxes on each side.
 - c. Mount corner covers vertically on each side of hood sash openings to access plumbing lines and valve connections from front of hoods.
 7. Face Opening: Splay or radius top and of face opening to provide an aerodynamic airfoil section to ensure smooth, even flow into the hood.
- B. Airfoil Vane:
1. Low profile, ergonomically designed to provide obstruction-free access to hood interior.
 2. Mounted flush to top front edge of work surface.
 3. Airfoil design shall assure a flow of air rearward along work surface at all hood operating face velocities.
 4. On all bench mounted and distillation hoods, provide a removable airfoil vane across bottom of face opening. Profile of airfoil shall match profile of side sections.
 5. Mount airfoil with minimum 3/4 inch air space between the foil and top front edge of the work surface to direct positive flow of air across the work surface and to prevent backflow. Extend airfoil under sash line so that sash closes on top of foil.
 6. Provide power cord/tube pass-through 3 inch square holes near each side post.
 7. Material and finish: 14 gauge stainless steel; No. 4 satin finish.
- C. Plenum Chamber:
1. Provide plenum with adequate volume for hood dimensions, extending full width of hood to equalize incoming air flow.
- D. Bypass Grilles:
1. Provide bypass grilles to conceal plenum.
 2. Bypass grilles shall be low resistance type, directionally louvered upward, or can function from above with non-directional grill in the Ceiling closure panel.
- E. Interior Liners Material:
1. Polyresin:

- a. Material: Chemical and abrasion resistant, 1/4 inch thick, fiber reinforced thermoset composite material, defined as any of the following:
 - 1) White modified epoxy resin with fiberglass reinforced sheet.
 - 2) White polyester with fiberglass reinforced sheet.
 - 3) White press-molded, heat-converted catalyzed glass polyester sheet.
 - b. Fabrication: Chemically welded seams.
 2. Joints: Back-up joints with angles or cleats and coat joints with chemical resistant mastic before assembly to prevent open joints or spaces.
- F. Baffles:
 1. Same material as hood liner.
 2. Multiple sections with continuous horizontal slot at the work surface.
 3. Baffle position shall be factory-set for optimal airflow characteristic. Field adjustment shall not be required.
 4. Each baffle panel shall be easily removable from the interior, without requiring liner disassembly.
 5. Configuration: Full width, with adjustable openings at top and bottom to allow adjusted flow of air through hood to compensate for type of gas, apparatus, or heat source used. Baffles shall be removable for cleaning.
 6. Adjustment:
 - a. Stop: Provide stop at baffle openings to provide a minimum opening of 1 inch.
 - b. Flow restriction limits: The baffle design shall be such that it is impossible, by adjustment, to restrict the volume of air exhausted through the fume hood by more than 20 percent.
 - c. Adjustment: Control airflow at top or bottom from a single point, with acid resistant plastic or stainless steel knobs mounted on within end panel enclosure and near front of fume hood.
 - d. Baffle designs that require insertion of the operator's head or shoulders for adjustment are not acceptable.
 7. Accessories:
 - a. Fasteners:
 - 1) Enclosure panel assembly: Stainless steel truss head screws or rivets; not countersunk type.
 - 2) Hood baffle to cleats: Stainless steel screws.
 - b. Removable plug buttons for holes not used for fixtures.
- G. Sash:
 1. Vertical Rising Sash:
 - a. Vertical rising 1/4 inch thick laminated safety float glass sash, epoxy-coated steel sash track, single counterbalance weight.
 2. Glazing:
 - a. Glass: Safety glass composed of two sheets of double-strength "B" quality, clear sheet glass permanently laminated with a sheet of clear plasticized polyvinyl butyral.
 - 1) Laminated with 0.015 inch thick clear, plasticized, polyvinyl butyral interlayer; comply with ASTM C 1172.
 - 2) Comply with ASTM C 1048, Condition A uncoated, Type 1, transparent, clear, flat, Class 1, q5 Glazing B Quality.
 - 3) Comply with ANSI Z97.1.
 3. Sash Stops:
 - a. Factory installed, cam style permanent sash stops.

- b. Location: 18 inch above the fume hood work surface.
- 4. Signage: Provide label on fume hood at this point and a sign to read. "Operating conditions 100 fpm - do not work in hood with sash bottom above this mark."
- 5. Alarm console: The alarm console shall produce an alarm signal if sash stops are overridden.
- H. Exhaust:
 - 1. Entry Cones and Exhaust Connection: Hood manufacturer shall supply and install an acoustical duct transition from hood exhaust collar to the size required for building exhaust duct. Verify diameter dimension of exhaust duct size and location with mechanical drawings.
 - 2. Transition to be equivalent material and finish to building exhaust duct and to conform to industrial ventilation standards. On fume hoods where two exhaust points exist, provide transition as required to accept two exhaust points to mate, as described above, with mechanical system.
- I. Utility Service Fittings and Fixtures:
 - 1. Orient needle valves to the rear of fume hoods.
 - 2. Orient needle valves to be readily accessible without exposing operator's breathing zone to fume hood interior.
 - 3. Factory installed for services as indicated in Product Outline above.
 - 4. Operation: Remote control as specified in Section 12 3553- Laboratory Casework.
 - 5. Finish : As specified in Section 12 3553- Laboratory Casework.
 - 6. Fixtures Location: Plumbing service fixtures shall be located maximum 12 inch from the inside of the sash and shall be on a common vertical centerline.
 - 7. Hose Connectors for Conventional Bench Mounted Fume Hoods: Injection molded PVDF - Kynar®.
 - 8. Hood Service Fittings: 1/4 inch copper tubing, forged brass valves and seats, TFE-coated silicone bronze stem, TFE packing, and injection-molded PVDF 10-serration hose connectors.
 - a. Fixture Handles: Anti-snag, round plastic without projections; color-code and label for designated service.
 - 9. Gas Valves: CSA International labeled with brass-lined copper service lines.
- J. Lights:
 - 1. Type: Two-tube, rapid-start fluorescent light fixture of longest practicable length.
 - 2. Ballast: Electronic ballast and be suitable for T-8 lamps.
 - 3. Shield: 1/4 inch thick safety glass or 1/8 inch thick tempered glass panel, sealed air tight into hood body with chemical resistant rubber channels.
 - 4. Lamps: Furnished in accordance with requirements of the electrical Specifications.
 - 5. Include light switch, controls interface, and all internal wiring to circuit junction boxes located in upper right and/or left front of plenum area.
 - 6. Toggle Switch: Refer to the electrical Specifications for switch installation requirements. Location shall be on top left sash post.
 - 7. Set units so that fluorescent tubes are replaceable from outside hood.
 - 8. Provide only fixtures that carry UL label.
 - 9. Average interior illumination levels of the work area: 80-foot candles minimum.
- K. Electrical Services:
 - 1. Type: Vapor proof.

2. Electrical Outlets: Prewire fume hoods for a single point connection. Receptacles to be GFIC type.
3. Closure Strips: Metal to match adjoining surfaces. Provide to close openings between fume hood base cabinet and super-structure and adjacent building wall.
4. Holes: Provide holes for passage of piping, conduit, fixtures, and fittings furnished elsewhere.
5. Fasteners: Stainless steel where exposed to fumes in hood.
6. Signs:
 - a. Type: Corrosion resistant plate.
 - b. Location: Fume hood exterior.
 - c. Content: Condensed information covering recommended locations for apparatus and accessories, baffle settings, and use of sash.

2.05 FINISHES

- A. Exterior Sheet Steel Surfaces: Properly prepared and coated, electrostatically applied.
 1. Hood Exterior: Epoxy coating, dry powder.
 2. Hood Front Panel: Same color and finish with hood exterior shell.
 3. Color: As indicated in product outline above.
- B. Chemical and Physical Resistance of Finishes: Test finishes for resistance to chemical reagents in accordance with SEFA 8, and meets Level 1 rating - slight change in color or gloss, and with no loss of adhesion and no loss of film protection.
 1. Finishes to meet testing requirements:
 - a. Exterior fume hood finish.
 - b. Liners.
 - c. Work surfaces.
 - d. Storage cabinet finishes.
 2. Moisture Resistance: No visible effect when finish surface exposed to the following:
 - a. Tested in accordance with SEFA 8.
 - b. Constant Moisture using a 2 inch x 3 inch x 1 inch cellulose sponge, soaked with water, in contact with surface for 100 hours.
 3. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 degrees F for 60 minutes to 125 degrees F for 60 minutes.
 4. Adhesion and Flexibility:
 - a. Adhesion: Tested in accordance with SEFA 8; ninety or more squares of the test sample shall remain coated after the scratch adhesion test.
 - b. Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a 1/2 inch diameter mandrel.
 5. Hardness: Tested in accordance with SEFA 8 for surface hardness equivalent to 4H or 5H pencil.
 6. Abrasion resistance: Maximum weight loss of 5.5 mg. per 100 cycle when tested on a Taber Abrasion Tester #E40101 with 1000 gm wheel pressure and Calibrate #CS10 wheel.
 7. Humidity resistance: Withstand 1000 hour exposure in saturated humidity at 100 degrees F.
 8. Salt spray: Withstand minimum 200 hour salt spray test.

2.06 WORK SURFACE

- A. Cast Epoxy Resin Work Surface:
 1. Material: Cast epoxy resin.

2. Thickness: 1 inch.
3. Color: Black.
4. Fabrication:
 - a. 3/8 inch deep dish rim to contain spills.
 - b. Front edge: 6 inch wide by 1/2 inch thick raised edge.
 - c. Edge at sides and rear: 1/2 inch wide by 1/2 inch thick raised edge.
 - d. Edge attachment: Bond to working surface to make a watertight retaining pan.
5. Epoxy Resin Cup Sink:
 - a. 6 inch by 3 inch oval epoxy cupsink with 1-1/2 inch drain connection.
 - b. Mount flush with recessed top of work surface.

2.07 FUME HOOD BASE CABINETS

A. Material

1. Sheet Steel:
 - a. Mild, cold rolled and leveled unfinished steel.
 - b. Minimum gauges:
 - 1) 20 gauge: Interior door fronts, filler panels, shelves.
 - 2) 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, and uprights.
 - 3) 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails.
 - 4) 14 gauge: Door and case hinge reinforcements and front corner reinforcements.
2. Sound Deadening Material: Inorganic, for sandwich panel fabrication.

B. Design: Flush Front.

C. Color and Finish: Match fume hood.

D. Acid Storage Cabinets:

1. One piece corrosion resistant interior liner, including the backside of doors and shelf surfaces.
2. One-piece corrosion resistant insert tray with 2 inch lip for containment of spills at bottom of cabinet.
3. One shelf with 1 inch lip, adjustable on 1 inch increments.
4. Vented with a minimum 1-1/2 inch I.D. corrosion resistant vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the working surface.
5. Vent pipe shall be close to rear of hood as possible. Seal opening between working surface and pipe with chemical resistant material.
6. Exhaust ports shall have fire screens.
7. Non-metal door catch or strike plate.
8. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "ACID".

E. Flammable Liquids Storage Cabinets:

1. Identified for flammable and combustible liquids shall be constructed in compliance with UL, OSHA, NFPA Standard No. 30, and UFC Article 79.
2. Self closing and self latching doors synchronized so that both doors will always fully close.
3. Bottom of the cabinet liquid tight to a height of 2 inches.
4. Cabinet shall not have vent outlet.
5. Front of cabinet labeled with minimum 1 inch high, 1/4 inch stroke red letters: "FLAMMABLE - KEEP FIRE AWAY".

F. Vacuum Pump Cabinets:

1. Interior lined with 1 inch thick neoprene foam for sound deadening..

2. No bottom, toe kick attached to door(s).
3. Louver on door.
4. Furnished with 120VAC, 20 amp duplex receptacle mounted on the inside cabinet back and a pilot lighted toggle switch mounted on the top front rail.
5. Vented with a minimum 1-1/2 inch I.D. vent pipe at rear of cabinet terminating inside of fume hood 2 inch above the working surface.

2.08 SASH POSITION MONITOR

- A. Operation:
 1. Measures and digitally displays energy consumption level.
 2. Signals damper to open quickly when sash is raised abruptly.
 3. Secondary damper control to face velocity monitor.
 4. Power requirements: 120 volt AC; prewired to the fume hood.

2.09 SAFETY MONITOR/ALARM SYSTEM

- A. By HVAC Contractor.
- B. Type:
 1. Hot wire anemometer sensor.
- C. Operation:
 1. Measure and digitally display linear feet per minute of airflow.
 2. Measure and record fume face velocity.
 3. Signals unsafe operating conditions whenever fume hood exhaust volumes fall below or above a user determined level.
 4. Signals unsafe operating conditions whenever fume hood exhaust volumes fall below 80% of that specified for the fume hood or as indicated. Set to activate alarm whenever face velocity deviates from the following:
 - a. Sash in position for operating condition: Less than 80 ft/min; greater than 120 ft/min.
 5. Remote alarm relay output capability.
 6. Alarm delay capability.
 7. Primary damper control.
 8. Power requirements: 120 volt AC; prewired to the fume hood.
- D. Components:
 1. Alarms:
 - a. Digital Display: Liquid crystal display indicating current status.
 - b. Audible Alarm Indicator: Minimum intensity of 80 decibels at 4 inch.
 - c. Visual Alarm Indicator: Green LED light for normal condition, Red LED warning light for low flow and high flow.
 - d. Audible alarm and red warning light shall operate simultaneously to indicate an unsafe operating condition.
 2. Silencer switch: When the silencer switch is activated, the red warning light shall remain "ON" until the unsafe condition is corrected and the alarm unit is manually reset.
- E. System Adjustment: Adjust the fume hood alarm system after the building air handling system has been balanced.
- F. Console Mounting: Mounted on the front of the fume hood as shown on drawings, facing front of hood.
- G. Cut-out for Alarm Interface Panel: Provide factory, template to be provided by alarm system installer.

- H. Notification Plate: Mount plate on the front of the fume hood housing, adjacent to safety alarm console. Notification shall read as follows:
- Alarm will activate when unsafe exhaust condition exists.
 - Red lamp and audible alarm will activate.
 - SHUT DOWN EXPERIMENT AS RAPIDLY AS POSSIBLE.
 - Close sash.
 - Report condition to Safety Office personnel.
- I. Signage:
1. Lettering: Manufacturer's standard lettering, background colors, and mounting.
 2. Signage Messages: In accordance with requirements of NFPA 45.

2.10 ACCESSORIES

- A. Fume Hood Identification Plate: Provide corrosive resistant metal plate attached to the fume hood exterior with condensed information covering fume hood identification and initial performance label completed by the performance testing (ASHRAE 110) contractor.
1. Each fume hood that passes the performance tests shall be labeled with the following baseline information inscribed into the tag:
 - Date tested
 - Name of Inspector
 - Company Inspecting
 - Testing protocol used (such as ASHRAE 110-1995 smoke visualization)
 - Average face velocity at the specified maximum operating sash height (measured from bench top to bottom of sash; for combination sashes, horizontal sashes are close during testing).
 - Hood static pressure in inches of water.
 - Hood exhaust volume.
 - Type of exhaust system: VAV, CAV and Diversity if less than 100%.
 - Fan identification tag number.
 - Hood Tag number (PP#).
 - Hood Location: Building name and Room Number.

2.11 SOURCE QUALITY CONTROL

- A. Test one fume hood of each type manufactured according approved shop drawing before shipment.
- B. Factory Testing Requirements:
1. Test Room: Set up test hood in a test room of sufficient size with a minimum of 5 feet clear space in front of the hood and on both sides of the hood for viewing the test.
 2. ASHRAE 110- As Manufactured (AM) test shall includes.
 - a. Exhaust Stability Test
 - b. Local Visualization Challenge (Low -Volume Smoke Test).
 - c. Large-Volume Visualization Challenge (High-Volume Smoke Test).
 - d. Face Velocity Testing:
 - 1) 100 ft/min; with deviation of plus or minus 20 ft/min.
 - e. Tracer Gas Containment Testing:
 - 1) Test to a control level of AM 0.05 ppm or better.
- C. Static Pressure Loss for Bench Mounted Fume Hoods:
1. Face velocity of 100 ft/min: Maximum 1/2 inch of water gauge.

2. Constant volume fume hoods with bypass: Static pressure and exhaust volume shall be relatively constant regardless of sash position.
- D. Face Velocity at Sash Opened 6 inch: Maximum 3 times face velocity at sash fully opened.
- E. Provide documentation showing the test result. Report of tests previously performed on the same design are acceptable.
- F. Field Test Requirements:
 1. ASHRAE 110- As Manufactured (AM) test shall includes.
 - a. Exhaust Stability Test
 - b. Large-Volume Visualization Challenge (High-Volume Smoke Test).
 - c. Face Velocity Testing:
 - 1) 100 ft/min; with deviation of plus or minus 20 ft/min.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify equipment rough-in before proceeding with work, including rough opening dimensions required for fume hood installation.
- B. Coordinate for proper installation of plumbing and electrical services.

3.02 PREPARATION

- A. Repair, replace, and fix irregularities that will affect the quality of the execution of the work specified.

3.03 INSTALLATION

- A. Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in locations indicated.
- B. Provide filler panels between top of hood and ceiling.
- C. Provide enclosure panels as indicated.
- D. Securely attach access panels but provide for easy removal and secure re attachment.
- E. Do not install any damaged units.
- F. Affix one copy each of the following to an unobscured exterior side panel of each fume hood prior to Substantial Completion.
 1. "The Fume Hood Operating and Safety Manual," Jerry Koenigsberg, Denville, NJ: Norst Enterprises, 1984: www.gprplanners.com.
 2. "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Research Council, Washington, DC.; National Academy Press, 1995: www.nap.com.

3.04 INTERFACE WITH OTHER WORK

- A. Coordinate with the schedule and other requirements of other work being performed in the area including, but not limited to, casework and work surface installation, mechanical and electrical connections to and in the fume hoods.

3.05 FIELD QUALITY CONTROL

- A. Fume Hood Performance Testing Requirements:
 1. Test fume hoods after installation of fume hoods is complete, and the building ventilation and control system has been balanced, and utilities and services connections have been made.
 2. Test fume hood in accordance with SEFA 1 recommendations.

3. Use ANSI/ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods to determine a benchmark performance.
 4. Owner reserves the right to require a modified version of ASHRAE 110 test or additional testing requirements.
- B. Testing Responsibilities:
1. ASHRAE 110, As Installed (AI) test: By Fume hood Manufacturer.
 - a. Test all fume hood units installed in the Work of this Project.
 - b. (AI) Test methods includes:
 - 1) Exhaust System Stability Test.
 - 2) Local Visualization Challenge (Low -Volume Smoke Test).
 - 3) Large-Volume Visualization Challenge (High-Volume Smoke Test).
 - 4) Face Velocity Measurements.
 - (a) Face velocity grid test: 100 ft/min; with deviation of plus or minus 20 ft/min.
 2. ASHRAE 110, As Used (AU) test: By Fume hood Manufacturer.
 - a. ASHRAE 110, As Used (AU) test shall be performed by independent testing agency approved by Owner but paid for by Fume hood Manufacturer.
 - b. Test a random sample of 20 percent of the installed fume hood units, but not less than one unit of each type installed.
 - c. (AU) Test methods includes:
 - 1) Tracer Gas Containment Test.
 - (a) Test to a control level of AI 0.1 ppm or better.
- C. Correcting Deficiencies and Retest:
1. If test results of testing specified above are not satisfactory, Fume hood manufacturer and Contractor shall take the following actions:
 - a. Determine probable cause of deficiencies.
 - b. Generate solutions for the problems determined in step "a" above.
 - c. Implement a mitigation plan that include the solutions in step "b" above.
 2. Retest the fume hoods and compare the pre- and post-mitigation results to determine the effectiveness of the remedial work on the fume hoods.
 3. Repeat the effort until test result is accepted by owner.
 4. Remedial work and retest shall not add cost and time delay to the Owner.

3.06 ADJUSTING AND CLEANING

- A. Adjust operating equipment and moving parts, with the exception of air handling motors, for smooth and efficient operation for intended use.
 1. Sashes: Smooth, near-silent, and accurate operation with one hand and uniform contact of rubber bumpers. Ensure counterbalances operate without interference.
 2. Vertical-Rising Sashes: Operate smoothly without tilting when raised or lowered from either end; remain at rest in any open position.
 3. Horizontal Sliding Sashes: Operate smoothly without binding.
 4. Baffles: Set with all openings adjusted to maximum open position.
- B. Clean equipment, casework, work surfaces, light fixture lens, both sides of sash, and other surfaces as recommended by manufacturers, rendering work in new and unused appearance.
- C. Clean adjacent construction and surfaces soiled in the course of installation of this work.
- D. Touch up minor damaged surfaces caused by installation.
- E. Replace damaged and defective components that cannot be repaired to new condition.

3.07 PROTECTION

- A. Provide protective measures to prevent equipment and surfaces from exposure to other construction activity.

3.08 DEMONSTRATION AND TRAINING

- A. Demonstrate fume hood operations and functions to Owner designated representatives at completion of installation.
- B. Conduct on-site fume hood seminar, including providing instructional materials for use, cleaning, and maintenance.
 - 1. Location and time with Owner.
 - 2. Seminar shall be available to all employees designated by Owner.
 - 3. Instructional materials shall include, but not be limited to, minimum 10 copies each:
 - a. "The Fume Hood Operating and Safety Manual," Jerry Koenigsberg, Denville, NJ: Norst Enterprises, 1984: www.gprplanners.com.
 - b. "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Research Council, Washington, DC.; National Academy Press, 1995: www.nap.com.

END OF SECTION

SECTION 12 2113 - HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.02 REFERENCE STANDARDS

- A. WCMA A100.1 - Safety of Corded Window Covering Products; Window Covering Manufacturers Association; 2012. (ANSI/WCMA A100.1).

1.03 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.
- C. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, cord type and color.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal Louver Blinds Without Side Guides:
 - 1. Hunter Douglas; ____: www.hunterdouglas.com.
 - 2. Levolor Contract; ____: www.levolorcontract.com.
 - 3. SWFcontract, a division of Spring Window Fashions, LLC.; ____: www.swfcontract.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BLINDS WITHOUT SIDE GUIDES

- A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B. Metal Slats: Spring tempered pre-finished aluminum; square slat corners, with manufacturing burrs removed.
 - 1. Width: 1 inch.
 - 2. Thickness: 0.006 inch.
 - 3. Color: As selected by Architect.
- C. Slat Support: Woven polypropylene cord, ladder configuration.
- D. 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.
- E. Lift Cord: Braided nylon; continuous loop; complying with WCMA A100.1.
 - 1. Free end weighted.
- F. Headrail Attachment: Ceiling brackets.

G. Accessory Hardware: Type recommended by blind manufacturer.

2.03 FABRICATION

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.
- C. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between blinds, located at window mullion centers.

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. 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

SECTION 12 2413 - WINDOW SHADE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manually-operated window shades and accessories.

1.02 REFERENCES

- A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 1996 (Reapproved 2002).
- B. NFPA 70 - Fire Tests for Flame-Resistant Textiles; 2004.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's catalog data, product descriptions, installation instructions, detail sheets, and specifications for each type system specified.
- B. Samples for Verification: Shade fabric sample and paint finish as selected.
- C. Shop Drawings: Show dimensions and interface with other products.
 - 1. Room schedule including field-verified dimensions of each opening to receive window shade system.
 - 2. Indicate model number, operator, fabric selection, and mounting type.
 - 3. Indicate control type and provide zone schedule if necessary.
- D. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, and instructions for operating hardware and controls.
- E. Roller Shade Schedule: Use same room designations as indicated on Drawings and include opening sizes and key to typical mounting details.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience installing products comparable to those specified in this section.
- B. Mock-up: Provide a mock-up of each window shade system for evaluation of mounting, appearance and accessories.
 - 1. Mock-up may remain as part of the work.
 - 2. Locate mock-up in window designated by Architect.
 - 3. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.05 WARRANTY

- A. Roller shade hardware, chain and shade fabric: Manufacturer's standard warranty.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original cartons.
- B. Individually package and mark shades with room number and opening number.
- C. Inspect the materials upon delivery to assure that specified products have been received.
- D. Store and handle shades to prevent damage to fabrics, finishes, and operators prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Mechoshade: www.mechoshade.com.
- B. Hunter Douglass Contract: www.hunterdouglascontract.com.
- C. Draper: www.draperinc.com
- D. Lutron: www.lutron.com

2.02 SHADE SYSTEMS

System 1: Manual window shade, Fabric 1, regular roll direction, mounted inside window frame, chain operated control.

2.03 FABRIC

- A. Fabric 1: Solar Control.
 - 1. Mechoshade, Mecho/5 :
 - a. Openness factor: 0-3%
 - b. Pattern: EcoVeil 1550 Series
 - c. Color: to be selected by designer/architect
 - 2. Hunter Douglas Contract, RB 500 Roller Shade:
 - a. Openness factor: 0-3%
 - b. Pattern: Sheerweave Series
 - c. Color: to be selected by designer/architect
 - 3. Draper, Dual Roller Flexshade:
 - a. Openness factor: 0-3%
 - b. Pattern: Infinity II
 - c. Color: to be selected by designer/architect
 - 4. Lutron, Roller 100:
 - a. Openness factor: 0-3%
 - b. Pattern: to be selected by designer/architect
 - c. Color: to be selected by designer/architect

2.04 MANUALLY OPERATED WINDOW SHADE SYSTEM

- A. Products:
 - 1. Mechoshade; Mecho/5.
 - 2. Hunter Douglas Contract; RB 500 Roller Shade
 - 3. Draper; Dual Roller Flexshade
 - 4. Lutron; Roller 100
- B. Chain Operation: Bi-directional wrap spring clutch shall allow for shade to stop and hold at any position.
- C. Chain Operator Position: Right-hand side, unless otherwise noted on drawings.
- D. Bead Chain: No. 10 stainless steel.
- E. Clutch mechanism: Fabricated from high carbon steel.
 - 1. Components fabricated from styrene based plastics, polyester or reinforced polyester are not acceptable.

2.05 SHADE COMPONENTS

- A. Rollers:

1. Shade roller tube shall be extruded aluminum of diameter and wall thickness required to support shade fabric. Maximum allowable deflection $L/700$.
 2. Rollers shall be easy to remove from support brackets.
- B. Mounting Brackets: Stamped steel, custom fabricated as required for mounting style indicated.
- C. Hembar: Concealed.
1. Finish: Match window frame.

2.06 ACCESSORIES

- A. Finish for accessories, unless otherwise noted: Clear anodized aluminum.
- B. Fascia: L-shaped extruded aluminum shall conceal mounting hardware, roller tube, and fabric rolled on tube.
- C. Fascia/Pocket End Caps: Provide end caps where mounting conditions expose outside of roller shade brackets.

2.07 SHADE FABRICATION

- A. Shades mounted inside window frame: Window shade system shall completely fill opening from head to sill. Provide 1/4 inch clearance between each side of the shade and jamb, unless indicated otherwise.
- B. Shade fabric shall hang flat without buckling or distortion and in the same direction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify contractor of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Verify that blocking and framing necessary to carry shade assembly hardware is properly installed and secure.

3.03 INSTALLATION

- A. Install window shade systems level, plumb, square and true according to manufacturer's written instructions and these specifications.
- B. Adjust and balance roller shades to operate smoothly, safely and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- D. Installer to train owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.04 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 12 3553 - LABORATORY CASEWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Wood laboratory casework, doors and drawer fronts only
 - 2. Metal laboratory casework.
 - 3. Laboratory work surfaces.
 - 4. Laboratory sinks.
 - 5. Water and laboratory gas services fittings.
 - 6. General laboratory accessories.
 - 7. Free-standing safety storage cabinet.
 - 8. Overhead Service Carrier (Bid Alternate no. 2).

1.02 REFERENCES

- A. AHA A135.4 - Basic Hardboard; American Hardboard Association; 2012.
- B. ANSI Z535.2 - Environmental and Facility Safety Signs; 2011.
- C. ANSI Z535.3 - Criteria for Safety Symbols; 2011.
- D. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- E. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- F. ASTM C 1036 - Standard Specification for Flat Glass; 2011e1.
- G. AWI/AWMAC (QSI) - Architectural Woodwork Standards; Architectural Woodwork Institute and Architectural Woodwork Manufacturers Association of Canada; 2009, Edition 1.
- H. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- I. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009 (ANSI/HPVA HP-1).
- K. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- L. NFPA 30 - Flammable and Combustible Liquids Code; 2012.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.
- O. SEFA 2.3 - Installation of Scientific Laboratory Furniture and Equipment recommended Practices; 2010.
- P. SEFA 3 - Work Surfaces Recommended Practices; 2010.
- Q. SEFA 7 - Laboratory and Hospital Fixtures Recommended Practices; 2010.
- R. SEFA 8M - Laboratory Grade Metal Casework; 2010.
- S. SEFA 8W - Laboratory Grade Wood Casework; 2010.
- T. UL (ECMD) - Electrical Construction Materials Directory; current edition.

- U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- V. UL 3101-1 - Electrical Equipment for Laboratory Use; Part 1: General Requirements; Current Edition, Including All Revisions.

1.03 DEFINITIONS

- A. Abbreviations:
 - 1. CFM:Cubic feet per minute.
 - 2. MDF:Medium-density fiber board.
 - 3. PSI:Pound per square inch.
- B. Broom clean: A condition in an interior area in which surface debris has been removed by dry methods.
- C. Service fittings and fixtures: Service fittings include gas, air, vacuum, and special gas valves including factory piped turrets when mounted on work surfaces; hot, cold, reagent grade water faucets; remote control valves for fume hoods; and vacuum breakers.
- D. Service lines: Conduit, junction boxes, conduit fittings, wire disconnect switches and fuse or circuit breakers necessary to carry electrical services from building roughing-in outlets in floors or walls through equipment to service fixtures.
- E. Rough-in point: Individual or common supply of mechanical, electrical, and heating, ventilating and air conditioning (HVAC) through wall, floor, or ceiling, generally located within the utility umbilical, equipment chase, or service space behind cabinets.
- F. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, tops of cabinets less than 72 inches above floor, and visible surfaces in open cabinets or behind glazed doors.
 - 1. Ends of cabinets visible when the full installation is completed, shall be considered exposed.
- G. Semi-exposed Surfaces of Casework: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interiors faces of doors. Tops of cabinets 72 inches or more above floor, back panel in knee spaces, the three non-visible edges of adjustable shelves, holes and openings including notches at shelving and grommets shall be considered semi-exposed. Toe space shall be considered semi-exposed.
- H. Concealed Surfaces of Casework: Includes sleepers, web frames, dust panels, and other surfaces not visible after installation.
 - 1. Ends of cabinets installed directly against and completely concealed by walls or other cabinets after installation shall be considered concealed.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's data and installation instructions for each type of laboratory casework unit, service fixtures, and accessories.
 - 1. Certification by an independent testing laboratory indicating that applied finish complies with specified chemical and physical resistance requirements.
 - 2. Certification by an independent testing laboratory that the casework complies with the specified requirements.
- B. Shop Drawings: Large scale plans, elevations, cross sections, and details indicating layouts, dimensions, service run spaces, and attachment to other works.
 - 1. Indicate locations of hardware .
 - 2. Indicate locations and type of service fittings.

3. Indicate locations of blocking and reinforcements required for installing casework.
 4. Include details of utility spaces showing supports for conduits and pipings.
 5. Include details of support framing system.
 6. Include coordinated dimensions for laboratory fume hoods specified in other Sections.
- C. Samples for Initial Selection:
1. Factory-applied finishes and other materials requiring color selection.
- D. Samples for Verification:
1. Two of each type of casework material with each type of specified finish.
 2. Two of each type of work surface material with each type of specified finish.
 3. One 18 inch wide, full size of finished base cabinet unit complete with hardware, doors and drawers, with specified shelving shipped loose.
 4. One 18 inch wide, full size sample of finished mobile base cabinet unit complete with hardware, doors and drawers, casters, and removable top drawer unit.
 5. One 18 inch long shelving unit complete with end bracket.
 6. One mixing water fixture, one fumehood gas fixture, and one mounting type of each panel mounted fixture for each type of laboratory gas specified.
 7. Finished wood samples shall be submitted to establish acceptable range of color, grain characteristics and quality of wood veneers and finishes. Finish samples shall be furnished on same material as intended installation items.
 8. Acceptable samples will be used for comparison inspections at project. Retain acceptable sample units in building until completion of work and remove sample units from premises when directed by Architect.
- E. Contract Closeout Submittals:
1. Project Record Documents:
 - a. Provide 1 set of record documents including plans, elevations, cross sections, and details indicating layouts, dimensions, service run spaces, and locations and types of service fixtures.
 - b. Marked up shop drawings and documents will not be acceptable.
 2. Cleaning Data: Manufacturer's instructions for cleaning casework finishes and work surfaces
 3. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide laboratory casework with tops, sinks, service fixtures, and accessories, manufactured or furnished by a single laboratory casework company.
- B. Integrate fume hoods specified in Section 11 5313 with casework as shown on drawings.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.
- D. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- E. PRE-INSTALLATION MEETING
 1. Convene 1 month before starting work of this section.

1.06 DELIVERY, STORAGE, AND PROTECTION

- A. Storage:

1. If installation cannot commence in a timely manner after delivery, casework and equipment may be placed in storage. Additional costs for handling, shipping, and storage shall be borne by the Contractor.
 2. In the case of items, such as service fittings, that may be shipped to the job site on larger projects and used over the course of several months installation, provide a secure, locked storage area for use to safeguard this equipment at the job site prior to installation.
- B. Protection:
1. Protect finished surfaces from soiling and damage during delivery, storage, and handling. Cover with polyethylene film or other protective covering.
 2. Laboratory casework and counters are not to be used as workbenches, work platforms, and scaffolding for any portion of the work by any trade. Furniture and casework, as installed, is considered to be finished equipment and shall be protected from damage by all trades.
 3. The Contractor shall protect installed laboratory casework and equipment, especially the laboratory work surface, from debris, paint, and damage in the course of the construction sequence.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Interior spaces where casework, service fittings, and accessories are to be installed shall be conditioned to final design temperature and humidity level for minimum 24 hours prior to and continuously after installation, and in accordance with SEFA 2.3.
 2. Do not deliver or install casework, tops, service fittings, and accessories until the following conditions have been met:
 - a. Windows and doors are installed and the building is permanently closed in and weathertight.
 - b. Ceiling, overhead ductwork and lighting are installed.
 - c. All painting is completed and floor tile is installed.

1.08 SEQUENCING

- A. Casework:
1. Base cabinets:
 - a. On Resilient Flooring:
 - 1) Flooring with integral cove base: Install base cabinets after installation of finish flooring and cove.
 - 2) Flooring without integral cove base: Install base cabinets after installation of finish flooring, before rubber base.
 - b. On Resinous Flooring: Install base cabinets after installation of finish flooring and cove.
 2. Base and wall cabinets:
 - a. Painted walls: Install cabinets after last coat of paint.

1.09 WARRANTY

- A. Wood Casework: Provide written warranty signed by the manufacturer guaranteeing to correct failures in products which occur within one year commencing on the Date of Substantial Completion, without reducing or otherwise limiting any other rights to correction which the Owner may have under the Contract Documents. Correction may include repair or replacement.

- B. Solid Polymer Work Surface: Provide written 10 year warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.
- C. Warranties shall commence on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS

- A. Refer to Section 01 6000 - Product Requirements.

2.02 LEED REQUIREMENTS

2.03 MANUFACTURERS

- A. Wood Casework:
 - 1. Kewaunee Scientific Corporation; Statesville, NC, 704-873-7202: www.kewaunee.com.
 - 2. CiF Lab Casework Solutions; ON, Canada, 905-738-5821: www.cifsolutions.com
 - 3. Mott Manufacturing Ltd, Brantford, ON, Canada, 519-752-2895: www.mott.ca.
- B. Metal Casework:
 - 1. Kewaunee Scientific Corporation; Statesville, NC, 704-873-7202: www.kewaunee.com.
 - 2. Mott Manufacturing Ltd, Brantford, ON, Canada, 519-752-2895: www.mott.ca.
 - 3. CiF Lab Casework Solutions; ON, Canada, 905-738-5821: www.cifsolutions.com.
 - 4. A.T. Villa; Milwaukee WI, 800-554-9259: atvilla.com.
- C. Fixtures and Accessories:
 - 1. As listed by individual items below.

2.04 PERFORMANCE REQUIREMENTS

- A. Casework and Adjustable Shelving:
 - 1. Loading Requirements: Casework components shall withstand the following minimum loads without damage to the component or to the casework operation when tested in accordance with SEFA 8.
 - a. Base unit load capacity:
 - 1) 200 lb per square foot of cabinet top area.
 - 2) Leveling bolts: 500 lb each; minimum one per corner of each base cabinet.
 - b. Drawers in a cabinet: 150 lb uniform load with smooth operation for minimum 10,000 cycles of opening and closing.
 - c. Tables, 4 legged: 300 lb.
 - d. Hanging wall cases: 300 lb.
 - e. Shelves:
 - 1) Shelves inside base cabinets, wall and tall cabinets: 100 lb.
 - 2) 40 lb/sf up to a maximum of 200 lb with nominal temporary deflection, but without permanent set.
 - 2. Chemical Resistance Requirements: Test the exterior finish of laboratory casework and adjustable shelving for resistance to chemical reagents in accordance with SEFA 8, and meets Level 1 rating - slight change in color or gloss, and with no loss of adhesion and no loss of film protection.
 - a. Moisture Resistance: No visible effect when finish surface exposed to the following:
 - 1) Tested in accordance with SEFA 8.
 - 2) Constant Moisture using a 2 inch x 3 inch x 1 inch cellulose sponge, soaked with water, in contact with surface for 100 hours.

- b. Cold Crack: No effect when subjected to 10 cycles of temperature change from 20 degrees F for 60 minutes to 125 degrees F for 60 minutes.
 - 1) Adhesion: Tested in accordance with SEFA 8; ninety or more squares of the test sample shall remain coated after the scratch adhesion test.
 - 2) Flexibility: No peeling or cracking or exposure of metal when metal is bent 180 degrees over a 1/2 inch diameter mandrel.
- c. Hardness: Tested in accordance with SEFA 8 for surface hardness equivalent to 4H or 5H pencil.
- d. Abrasion resistance: Maximum weight loss of 5.5 mg. per 100 cycle when tested on a Taber Abrasion Tester #E40101 with 1000 gm wheel pressure and Calibrase #CS10 wheel.
- e. Humidity resistance: Withstand 1000 hour exposure in saturated humidity at 100 degrees F.
- f. Salt spray: Withstand minimum 200 hour salt spray test.

2.05 PRODUCT OUTLINE

- A. Numbering system indicated in the casework drawings legend are provided to indicate casework size, and configuration.
- B. Wood Doors and Drawers:
 - 1. Species: Refer to Materials Section.
 - 2. Grain Direction:
 - a. Door fronts and exposed sides of individual cabinets: Vertical.
 - 3. Grain Pattern:
 - a. Doors and Drawers: Book-matched, balanced and center matched, vertical, across door and drawer panel of individual cabinets where drawer is positioned on top of door. Center match on drawer where drawer is positioned above 2 doors.
 - b. Sides of Cabinet and Mobile Cabinets: Book-matched and balanced matched for sides of individual cabinets.
 - c. Adjacent cabinets are not required to be grain matched, however, similar grain patterns, color shades and tones are required.
 - 4. Finish: Clear, complying with SEFA 8.
- C. Metal Cabinets:
 - 1. Material: Cold rolled sheet steel.
 - 2. Design, Color, and Finish:
 - a. Cabinet Construction and Door Style: Flush inset metal door.
 - b. Finish: Powder coated, complying with SEFA 8.
 - c. Color: To be selected by architect from awarded manufacturer. Color BASIS OF DESIGN is CiF, Light Neutral

2.06 MATERIALS

- A. Hardwood Plywood: Comply with requirements of HPVA HP-1 or AWI Section 200.
 - 1. Face Species:
 - a. Exposed:
 - 1) Select White Maple, plain sliced.
 - b. Semi-Exposed:
 - 1) Select White Maple, rotary cut.
 - 2. Grade:
 - a. Exposed: Grade A faces and Grade J crossbands.

3. Core:
 - a. Veneer: Multi-ply veneer core, with cross and face plies bonded with Type II water resistant glue. Combo core is not acceptable.
 - b. Medium Density Fiberboard (MDF): 3-ply, ANSI A208.2-02 grade 130-MR50, 45-50 lb density, MDF core with veneer face and back.
 - c. Use of softwoods such as Fir and Pine is not permitted.
 4. Edgebanding: 1/8 inch hardwood of same species as exposed face veneers.
 - B. Solid Lumber:
 1. Species:
 - a. Exposed:
 - 1) Select White Maple.
 - b. Color: To be selected by architect from awarded manufacturer. Color BASIS OF DESIGN is CiF, White Maple Terracotta #9375
 2. Grade:
 - a. Exposed: Grade I, kiln dried to maximum 6 percent uniform moisture content.
 - C. Sheet Steel:
 1. Mild, cold rolled and leveled unfinished steel.
 2. Minimum gauges:
 - a. 20 gauge: Interior drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, access panels and sloping tops.
 - b. 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, and access panels.
 - c. 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails and stretchers.
 - d. 14 gauge: Drawer suspensions, door and case hinge reinforcements and front corner reinforcements.
 - e. 11 gauge: Table leg corner brackets and gussets for leveling screws.
 - D. Stainless Steel Sheet: ASTM A 666 Type 304.
 - E. Glass: ASTM C 1048, fully tempered using horizontal tempering; exposed edges ground, and cut or drilled to receive hardware.
 1. Framed doors: 1/8 inch thick glass.
 2. Unframed sliding glass doors: 1/4 inch thick glass.
 - F. Plastic Laminate Finish: NEMA LD 3; acid resistant.
 - G. Sound Deadening Material at Stainless Steel Work Surface: Inorganic, noncombustible, noncorrosive, sprayed on type.
 - H. Sealant: Sanitary type, specified in Section 07900.
- 2.07 CASEWORK HARDWARE:
- A. Drawer and Hinged Door Pulls: 4 inch wire pull type, surface mounted with through-bolt from back, Stainless steel, No. 4 finish. Provide 2 pulls for drawers over 24 inches in width. Pull shall meet State and Federal Handicapped Accessibility Regulations.
 - B. Hinges:
 1. Institutional type five knuckle, minimum 2-1/2 inch long, wrap around design.
 2. Finish: Stainless steel, No. 4.
 3. Provide two hinges for doors up to 36 inches; three hinges for doors over 36 inches high.
 - C. Roller catches: Adjustable type, spring actuated polyethylene roller and steel strike plates.

- D. Elbow catches: Spring type of cast aluminum with bronze finish, with strike.
 - E. Drawer Slides:
 - 1. Manufacturers:
 - a. Basis of Design: Accuride International, Inc.
 - b. Hafele America Co.
 - c. Knappe & Vogt Manufacturing Company.
 - 2. Light/Medium Duty Drawer Slides For Drawers 24 inches Wide or Less: Accuride 7434 with overtravel.
 - a. Overtravel: 1 inch.
 - b. Type: All ball bearing, full extension, rail-mounted, hold-in detent, smooth progressive movement.
 - c. Capacity: 100 pounds per pair for 18-inch slide length.
 - d. Finish: Clear zinc.
 - 3. Heavy Duty Drawer Slides For Drawers 48 inches Wide or Less and Standard File Drawers: Accuride 3640.
 - a. Type: All ball bearing, full extension, rail/bracket-mounted, hold-in detent, smooth progressive movement with 1 inch overtravel.
 - b. Capacity: 200 pounds per pair for 18-inch slide length.
 - c. Finish: Clear zinc.
 - 4. The drawer shall be removable without the use of tools and yet prevent inadvertent drawer removal.
 - F. Locks: Heavy duty cylinder type. Exposed lock noses shall be dull nickel, satin plated, and stamped with identifying numbers.
 - 1. Disk Tumbler: Locks shall have capacity for 225 primary key changes. Master key one level with the potential of 40 different, non-interchangeable master key groups.
 - 2. Pin Tumbler: Locks shall have capacity for 1000 primary key changes, and the capacity to be masterkeyed, grand-masterkeyed, sub-masterkeyed and mason keyed.
 - 3. Keys: Stamped brass available from manufacturer or local locksmith, and supplied in the following quantities unless otherwise specified:
 - a. Two for each keyed different lock.
 - b. Three for each group keyed alike locks.
 - c. Two for master keys for each system.
 - G. Shelf clips: Twin pin type for mounting on interior of cabinet end panels. Clips shall be corrosion resistant and shall retain shelves from accidental removal. Shelves shall be adjustable on 32 mm centers.
 - H. File followers: Metal back engaging in steel bottom channel, with spring positioning lock.
 - I. Floor glides, for movable open-leg tables, shall be a non-marring material at least 1 inch dia. to prevent indenting composition flooring and shall have at least a 5/8 inch height adjustment. Use of metal buttons will not be acceptable.
- 2.08 MODULAR FIXED BASE AND WALL MOUNTED CABINETS - (METAL AND METAL WITH WOOD DOORS).
- A. General Requirements:
 - 1. For flush overlay style cabinet:
 - a. Door and drawer design: Square edge flush. Door and drawer, when closed, shall rest against face of cabinet shell.
 - b. Apron: Flush with doors and drawers.

- 1) Provide applied panel at sink base.
- B. Base Cabinet:
 1. Cabinet Bottom and Bottom rail:
 - a. Formed of one piece of steel.
 - b. Formed down on side and back to create square edge transition welded to cabinet end panels.
 2. Back: Cupboard unit only shall be provided with removable back panel.
- C. Wall Cabinet- Up to 36 inches high:
 1. End Panels and Backs: Formed of one piece wrap around design with internal reinforcing front and rear posts.
 2. Tops and Bottoms: One piece with front edge formed into front rail.
- D. Knee Space Panels:
 1. Provide manufacturers standard apron rail at knee space panels
 2. Match finish of base cabinet body
 3. Grommet: Mockett black plastic, 6 inch by 2.5 inch oval, LO series, with flip top. Provide over knee space locations, forward of knee space panel depth.
- E. Wood Doors:
 1. Solid Doors: 3/4 inch thick, MDF or Particleboard core hardwood plywood.
 2. Stile and Rail at Glazed Doors: Solid hardwood with mortise and tenon or doweled connections, glued and screwed.
 3. Glazed doors: Interior head frame to be removable for installation and replacement of glass.
 4. Provide vinyl glazing retainer to receive glass.
 5. All other aspects of framed glazed door construction and quality shall match solid panel door.

2.09 VERTICAL CHASE UNIT (VCU)

- A. Closure panel material for metal casework:
 1. Material: Metal to match adjacent casework.
- B. Construction:
 1. Provide removable sections as indicated.
 2. Provide electrical, data, plumbing cutouts as indicated. Valves or cutout plug covers, if required, are specified in 12 3553. Electrical and data devices, if required, or cover plates if required, are specified in electrical section.
 3. Extend from floor to 10'-0" above finish floor, Unless Noted Otherwise.
 4. Fasteners: Concealed.
- C. Supports: Steel strut or tube shape fastened to floor or counter top and building structure above.

2.10 ADJUSTABLE SHELVES

- A. Steel Shelves: 16 ga.
 1. Form front and back edges down 1 inch; return back and up into a channel formation.
 2. Shelves over 48 inch long shall be reinforced with an additional 20 gauge steel hat channel welded to the underside.
 3. Reinforce shelves 12 inch deep and greater with an additional 20 gauge hat channel welded to the underside.
- B. Shelf Depth: Provide 12 inch shelf depths where indicated.

- C. Shelf Lengths: Shall be available in 6 inch increments to 72 inch length. Match the length of the structural module.
- D. Support System for Adjustable Shelves:
 - 1. Wall mounted shelf support: Double-slotted standards.
 - 2. Counter top mounted shelf support: Tubular shape with slotted holes.
 - 3. Adjustable height: Adjustable on 1 inch increments.
 - 4. It shall be the responsibility of the casework manufacturer to provide a guideline for the location of wall blocking to Contractor prior to the installation of the casework.
- E. Brackets: Book end type; stainless steel; 11 gauge; mount to inner slot of double slotted support module upright.
 - 1. Fasten shelves to brackets with two stainless steel screws per bracket.

2.11 MOVABLE BENCH SYSTEM (MB)

- A. Basis of Design: Enterprise Freestanding Workstation by Kewaunee Scientific Corporation.
- B. Other acceptable manufacturers:
 - 1. A. T. Villa; Forte.
 - 2. CiF Solutions; Ascent Series.
 - 3. Mott; Optima 2100 Series.
- C. Product Characteristics:
 - 1. Support Frames adjustable from 31" to 37" AFF, and a Rear Frame Support Structure, single or double sided, incorporating a vertical post and horizontal support. The vertical supports to incorporate individual slots for adjustable shelving and accessories. The vertical support to incorporate a chase for wiring of services.
 - 2. Pre-wired power service.
 - a. Power/Data: Provide wiremold with three duplex outlets for each 72 inch bench, two for each 60 inch table. Data port as indicated in the electrical drawings. Provide one NEMA L5-20R single receptacle on one back leg of each side of the movable bench. Each movable bench shall be provided with a 12 ft power cord terminating in a NEMA L5-20P plug. If islands or peninsulas are associated with a VCU, power cord is to extend from beneath the table to plug into either the adjacent table via the table-mounted outlet, or plug into the VCU per LC201 D5. If islands or peninsulas are not associated with a VCU, power cord is to extend from the top of the table vertical to plug UP.
 - 3. Worksurface Support Frame:
 - a. The frame to be a welded four sided assembly consisting of 11 gauge steel channel formations, front adjustable height legs, and rear attachment collars.
 - b. Front leg members shall be 11 gauge steel tubes, 2" outside diameter and 1.75" inner telescoping leg capable of vertical adjustment in 2" increments.
 - c. Legs shall include non-marring, 3/8" diameter, levelers.
 - d. Rear corners shall have 2.25" diameter x 6" high, 11 gauge half-round collars welded to the worksurface frame with supporting gussets and shall be mechanically fastened to the rear upright supports.
 - 4. Double-Sided Rear Frame Support Structure:
 - a. Height: 84".
 - b. Rear frame support structures to consist of four (4) 2" diameter full height vertical members, connected with a horizontal framing assembly that incorporates upper and lower horizontal cross rails. The upper cross rail to provide a utility trough the full

- length of the table. The lower cross rail shall support integral double sided power/data raceway.
- c. The 6" vertical member and the lower horizontal member shall have easily removable access panels, with noexposed fasteners.
5. Rear Frame Support Structure greater than 60 inches wide to have a center support to accommodate split shelving.
 6. Vertical members to have shelf / accessory slots punched on 1-inch increments starting at 55 inches above AFF to top of upright.
 7. Provide two top shelves per table, 15 inch depth and length equal the structural module. Provide four lower shelves, 12 inch depth and length equal the structural module.
 8. Design Loads: Per SEFA 8, with minimum of 100 pounds per linear foot of length to a maximum of 800lbs. With uniformly distributed load, the maximum allowable deflection shall be .125" measured at the center of the front rail.
 9. Task lights: provide fluorescent task lighting beneath each lower tier shelf in the widest available dimension that matches the lower tier shelf. Task lighting shall be UL listed, 120V/60 cycle operation, power cord prepared for hard wiring, 'A' sound rated ballast, with ON/OFF rocker switch. Task lights shall be hard-wired to on-board power rather than have independent plugs.
 10. Cable Tray: For each table, provide one cable tray, Cabofil Model CF54/150EQ, 6 inch by 2 inch, extending the full width of the table, less 5 inches each side. Coordinate cable tray location directly beneath grommet opening.
 11. Grommet: Mockett black plastic, 6 inch by 2.5 inch oval, LO series, with flip top. Coordinate grommet location over cable tray location.
 12. Finish: Acid-resistant, epoxy powder coated paint.
 - a. Color: As selected by Architect from manufacturer's standard.
 13. Mounting Height: mount worksurface at standing height
- 2.12 FREE STANDING, ADJUSTABLE HEIGHT TABLES- METAL, TBA, TB, TBM
- A. Material:
 1. Tops: 1 inch thick cast epoxy resin to match epoxy resin work surfaces.
 2. Aprons, legs and rails: Steel to match metal casework.
 - B. Table Frames:
 1. Front Apron: 2 inches high.
 2. Side and Back: Manufacturer's standard.
 - C. Rails and Stretchers: Provide sides and back rail as required. No stretcher rail.
 - D. Legs: 2 inch by 2 inch steel tube with stainless steel telescoping leg insert.
 1. Leg corner bracket: Welded construction with bolted attachment of leg to apron.
 - E. Adjustable at height from 31 inches to 38 inches inclusive of 1 inch table top.
 - F. Adjustable portion of legs shall be stainless steel, drilled at 1 inch increments. Provide 1 stainless steel pin insert with chain at each leg.
 - G. Design Loads: Per SEFA 8, with a minimum of 600 lb rating for a 72 inch x 30 inch at 36 inch high movable freestanding table.
 - H. Mounting Height: mount worksurface at standing height
- 2.13 WORK SURFACES
- A. General:
 1. Fabricate components in shop to greatest extent practical to sizes and shapes indicated.

2. Provide holes and cutouts for service fixtures, service fittings, and service outlets.
 3. Fabrication tolerances:
 - a. Size:
 - 1) Length: +/- 1/16 inch.
 - 2) Width: +/- 1/16 inch.
 - 3) Thickness: +/- 1/16 inch.
 - b. Cutouts:
 - 1) Sinks: +/- 1/8 inch.
 - 2) Cup sinks: +/- 1/8 inch.
 - 3) gem box: +/- 1/8 inch.
 - 4) Columns: + 1/8 inch, - 0 inch.
 - 5) Column cut-out, covered by applied curb: + 1/4 inch, - 0 inch.
 - 6) Service drilling: + 1/8 inch, - 0 inch.
 - B. Epoxy Resin Work Surface:
 1. Manufacturers:
 - a. Durcon Laboratory Tops, Inc.; Taylor, TX, 512-595-8000: www.labtops.com.
 - b. Epoxyn LLC; Mountain Home, AR. 870-425-4321. www.epoxyn.com.
 - c. Kewaunee Scientific Corp.; Stateville, NC. 704-873-7202. www.kewaunee.com.
 2. Material: Chemical and abrasion resistant, cast epoxy resins and inert products.
 3. Thickness: 1 inch.
 4. Color: Black.
 5. Finish: Matte.
 6. Back and Side Splash: Same material as top.
 - a. Height: 4 inches (102 mm).
 - b. Fabrication: Butt jointed and cemented to work surface.
 - c. Location: Where work surfaces abut walls. Include end curb where required.
 7. To be chosen at submittal from Manufacturers standard options
 - C. Grommet: Mockett black plastic, 6 inch by 2.5 inch oval, LO series, with flip top. Provide over knee space locations, forward of knee space panel depth.
 - D. Wood Work Surface:
 1. Materials: Solid, kiln dried hardwood strips, 3 inch maximum width.
 2. Fabrication: Build up hardwood strips; glue under heavy pressure in an electronic press with heat treated, water resistant resin glue. Stagger end joints 12 inches minimum.
 3. Edges and corners: Round to 3/16 inch radius.
 4. Thickness: 1-1/4 inch.
 5. Finish: Natural color, moisture and reagent resistant varnish, stain finish.
 - a. Exposed surfaces: Three coats.
 - b. Unexposed surfaces: Two coats.
- ## 2.14 LABORATORY SINKS AND CUP SINKS
- A. General:
 1. Sizes: See sink schedule on Laboratory Casework drawing.
 2. Provide overflow, strainer and tailpiece with sink.
 - B. Cast Epoxy Resin Sinks:
 1. Manufacturers: Same as epoxy resin surface.
 2. Molded in one piece with smooth surfaces, coved corners, and bottom sloped to drain.
 3. Material: Same as cast epoxy resin work surface.

4. Mounting: Drop-in.
- C. Outlets and Tailpiece:
 1. Inlet: 1/2 inch diameter.
 2. Tailpiece: Minimum 6 inch long with 1-1/2 inch NPT outlet.
 3. Accessory: Strainer.
 4. Material: Same material as sink.
- D. Overflows (not for cup sinks):
 1. Size: 2 inches less than sink depth.
 2. Material: Polypropylene.
 3. Configuration: Open top design.

2.15 LABORATORY SERVICE FITTINGS

- A. Manufacturers:
 1. WaterSaver Faucet Company: www.wsflab.com.
 2. Broen Corporation: www.broen.com.
 3. Chicago Faucet Company: www.chicagofaucets.com
- B. General Requirements:
 1. Provide fittings comply with SEFA 7.
 2. Provide fittings complete with washers, locknuts, wall flanges, deck flanges, escutcheons, and other installation accessories.
- C. Materials:
 1. Water and Gas Fittings: Cast or forged red brass containing minimum 85 percent copper.
 2. Pure Water Fittings: Brass body with pure tin interior lining.
- D. Design and Finishes: Forged brass, 4-arm style handle; Finish: Polished chrome.
- E. Service Indexes Color and Identification Code: Per SEFA standard and as listed below:
 1. Cold WaterColor: Dark greenCode: CW
 2. Hot WaterColor: RedCode: HW
 3. Air (Compress air)Color: OrangeCode: Air
 4. Gas (Burning)Color: Dark blueCode: Gas
 5. VacuumColor: YellowCode: Vac
 6. Purified WaterColor: WhiteColor: DW, DI
- F. Fabrication:
 1. Water Service Fittings (Faucets and valves):
 - a. Equipped with renewable compression valve unit or cartridge containing all working components subject to wear, including replaceable seat and integral volume control device.
 - b. Capable of being converted from compression to self-closing type.
 - c. Gooseneck: Separate brazed coupling outlet for attachment of aerator, serrated hose end and other outlet fittings.
 - d. Vacuum Breaker:
 - 1) Where required and indicated, shall be integral with gooseneck.
 - 2) Equipped with renewable seat and valve designed for fine flow control.
 - e. Meet requirements of ANSI/ASME A112.18.1M.
 2. Pure Water Service Fittings:
 3. Dry Service Fittings (Air, Gas, Vacuum and Special Gas):
 - a. Ball Valves:

- 1) Valve: Chrome plated ball and PTFE seals.
- 2) Handle: Black nylon, lever type with colored service index button.

G. Service Fittings Schedule:

1. HCW-1: Hot/Cold Water Mixing Faucet, Deck Mounted.
 - a. Features: 8 inch spread, rigid/swing gooseneck, vacuum breaker; Aerator; Wrist blade handle.
 - b. Model: WaterSaver L414VB-55-BH.
2. HCW-2: Hot/Cold Water Handwashing Faucet, Deck Mounted, Infrared Operation.
 - a. Features: rigid gooseneck, vacuum breaker; Aerator.
 - b. Model: WaterSaver L4511
 - c. Thermostatic mixing valve; User-adjustable temperature selection.
 - d. Hardwired 12V transformer.
3. PW-1: Panel mounted single pure water ball valve, manual control
 - a. Model: WaterSaver L4800F-225WSA-TL
4. PW-2: Deck mounted pure water faucet
 - a. Features tin lined brass, self-closing control, vacuum breaker, 6 inch gooseneck, ten serration hose end, wrist blade
 - b. Mount left side of sink, ADA accessible, 180 handle
 - c. Model: WaterSaver L681VB
5. EW-1: Eye Wash, Handicapped Accessible, Deck Mounted, AutoFlow 90 degree swing down.
 - a. Features: 2 spray heads side by side. Unit mounted at sink. Spray head swing down from storage to operational position, activating water flow.
 - b. Model: WaterSaver FE778L
6. G-1, A-1, V-1: Air, Gas & Vacuum Single Laboratory Ball Valve, Wall Mounted Turret.
 - a. Feature: Wall mounted turret base. Serrated hose end.
 - b. Model: WaterSaver L4200.
7. G-5, A-5, V-5: Air, Gas & Vacuum, Remote Control Valve; Panel Mounted.
 - a. Feature: Panel mounted valve for use with straight or angle faced fume hoods. Supply appropriate valve for service indicated.
 - b. Model: WaterSaver L3185X, X= provided fixture based on type of gas connected.
8. V2-3, A2-3: Air & Vacuum Double Laboratory Ball Valves, Panel Mounted.
 - a. Feature: Wye fitting, removable serrated hose end.
 - b. Model: WaterSaver L4100-141WSA.
9. ES-1: Emergency Shower, Horizontally Mounted.
 - a. Stainless steel shower head.
 - b. Model: WaterSaver ESBF643.

H. OVERHEAD SERVICE CARRIER (OHSC) (BID ALTERNATE NO. 2)

1. Overhead service distribution, pre-plumbed and pre-wired.
2. Basis of design: The Wing by CiF Solutions.
3. Formed steel, finish same as metal cabinets.
 - a. Dimensions: 5 inch high by 28 inch deep by 60 inch wide.
4. Umbilical Support to structure with removable chase enclosure panel.
5. Utilities:
 - a. (2) L6-20R Twist lock, 250 VAC, 20 amps.
 - b. (4) L5-20R Twist lock, 125 VAC, 20 amps.
 - c. (4) L5-20R Duplex, 125 VAC, 20 amps.

- d. (2) Data.
- e. (4) Pre-punched, blank for future lab gases.

2.16 ELECTRICAL FITTINGS

A. General:

- 1. All electrical fittings shall be UL labeled.
- 2. Provide power strip, minimum of 12 foot long cord.
 - a. Location: Equipment Lab room 3023, Bid Alternate no. 2.
 - b. Rated for 20 Amps, 120V; NEMA L5-20P with NEMA 5-20R, PC Grey. Provide loose for installation by owner.
 - 1) Number of power strip: One.
 - 2) Number of outlets: Six minimum.
 - c. Rated for 20 Amps, 220V; NEMA L6-20P with NEMA 6-20R, PC Grey. Provide loose installation by owner.
 - 1) Number of power strip: One.
 - 2) Number of outlets: Six minimum.

2.17 ACCESSORIES

A. Cast Epoxy Pegboards:

- 1. Pegboard:
 - a. Material: 1 inch thick cast epoxy resin.
 - b. Color: To match work surface.
 - c. One-piece body with 4 inch stainless steel drip trough.
- 2. Pegs: Removable 1/2 inch diameter, 6 inches long, black polypropylene. Mounted 30-degee.
- 3. Drip trough shall have drain tube connector.
- 4. Provide each wall mounted unit with wall hanger and stabilizer bracket kit.
- 5. Accessories: PVC drain tube to sink.

B. Cylinder Wall Bracket:

- 1. Size: 2 cylinders: 24 inches wide.
- 2. Components:
 - a. 11 gauge, epoxy powder coated steel channel bracket with non-marring edge guards.
 - b. Heavy duty strap and non-slip safety buckle for each cylinder.
- 3. Support cylinder from 4 to 12 inch diameter.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Floors shall be level to within 1/4 inch in 10 feet, noncumulative, in any one direction.
- B. Final floor finish shall be completed prior to casework installation.
- C. Wall systems shall be completely installed and be plumb for installation of wall cabinets. Install all blocking and supports for wall cabinets. Wall system finish shall be complete including final painting.
- D. The ceiling system shall be in place including suspension grid and ceiling panels except at fume hoods and utility umbilical drops at island benches.
- E. The ceiling system shall be in place including finishes of gypsum board.
- F. Branch electrical circuits, including grounding conductors, shall be in place.
- G. HVAC grilles, call systems, and sprinkler heads shall be installed.

- H. Overhead electrical fixtures shall be installed and connected. Provide adequate lighting for installation of casework.
- I. Overhead mechanical lines shall be tested for leaks before finished casework is installed in any area.
- J. Where mechanical, electrical and HVAC service lines will be behind or under casework, service access or stubs shall have been installed at the appropriate rough-in point.
- K. Service lines for water, gas, vacuum, and special gases shall be flushed clean of dirt and chips, capped and tested for leaks prior to the connection of service fittings.
- L. No standing water shall be evident on the floor. Water producing operations such as masonry, terrazzo, and plaster shall be completed and cured prior to casework installation.

3.02 CASEWORK INSTALLATION

- A. Install plumb, level, true and aligned with no distortions. Shim, using concealed shims. Where laboratory casework abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed. Fit scribe strips to irregularities of adjacent surfaces. Maximum gap opening shall be 0.025 inch.
- B. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16 inch (1.6 mm) of a single plane. Bolt continuous cabinets together. Fasten continuous cabinets to floor at toe space, with fasteners spaced 48 inches o.c. Secure individual cabinets with not less than two fasteners into floor, where they do not adjoin other cabinets. Assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- C. Wall Cabinets and Shelves: Fasten to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified herein for base cabinets. Reinforcement of stud walls to support wall-mounted cabinets and shelves will be done during wall erection by trade involved, but responsibility for accurate location and sizing of reinforcement is part of this work.
- D. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- E. Caulk between casework and wall .

3.03 WORK SURFACE INSTALLATION

- A. Field Jointing: Make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surfaces.
- B. Alignment: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in work surfaces.
- C. Installation Tolerances:
 - 1. Level: +/- 1/8 inch in 10 feet, noncumulative.
 - 2. Joint widths: 1/16 inch maximum wide at any location, flush with abutting edges. Horizontal alignment of top surface of all joints for their entire length shall be 1/32 inch. Fill joints.
 - 3. Front edges of all abutting units shall align.
 - 4. Visible gaps at cutouts with escutcheon or grommet: None.
- D. Cast Epoxy Resin Tops:

1. Fastening: Secure to cabinets with silicone adhesive applied at each corner and along perimeter edges at not more than 48" o.c. Adhesive, rather than epoxy cement, allows for future disassembly and relocation.
2. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices.
3. Tolerances: Provide joint widths not more than 1/16" wide at any location, filled and flush with abutting edges. Horizontal alignment of top surface of all joints for their entire length shall be within 1/32". Front edges of all abutting pieces shall align.
4. Surface Finish: After installation, dress joints smooth, remove any surface scratches, clean and polish entire surface.
5. Verify field dimensions and squareness of adjacent walls prior to installation.

3.04 SERVICE FIXTURES AND FITTINGS INSTALLATION

- A. Refer to the mechanical Specifications for final connection of plumbing fixtures and fittings.
- B. Sinks and Cup Sinks:
 1. Install sinks with integral rim or sink ring, set in mastic or sealant to form a positive seal with the work surface.
 2. Remove excess mastic and sealant after sink is set.
 3. Apply 1/8 inch thick, heat resistant underseal to undersink surfaces to prevent condensation and provide sound deadening.
 4. Cast epoxy resin sink installation in cast epoxy resin work surface:
 - a. Underslung installation:
 - 1) Supports: Steel channels attached to ends of sink cabinet, adjustable by screw type rods.
 - 2) Set top edge of sink tight to underside of work surface, in chemical resistant sealing compound, for a tight and leak proof joint.
 - 3) Adjust sink and support to prevent movement.
 - 4) Remove excess sealing compound after sink is set.
- C. Utility Chase Closure (Umbilicals)
 1. Fasten to work surface and building structure.
 2. Seal edges of collars at work surface and ceiling.

3.05 ACCESSORY INSTALLATION

- A. Install in a precise manner in accordance with manufacturer's directions.
- B. Turn screws to a flat seat; do not drive.
- C. Adjust moving parts to operate freely without excessive bind.

3.06 INTERFACE WITH OTHER WORK

- A. Where access is required through items of laboratory casework, remove access panels, drawers, and other components, where they occur; make connections; and replace components.
- B. Perform field inspection and testing in accordance with Section 01400.

3.07 ADJUSTING

- A. Adjust hardware and fittings for smooth operation.

3.08 CLEANING AND PROTECTION

- A. Clean shop-finished surfaces, touch-up and remove or refinish damaged or soiled areas.
- B. Clean and polish epoxy resin countertops.

- C. Protection: Protect materials and installed laboratory casework and fixtures from subsequent construction operations.
- D. Laboratory casework and counters are not to be used as workbenches or work platforms for any portion of the work by any trade. Furniture and casework, as installed, is considered to be finished equipment and shall be protected from damage.
- E. Repair or remove and replace defective work as directed by the Architect upon completion of installation.

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.02 SUMMARY

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

- A. The mechanical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
 - 1. AABC – Associated Air Balance Council.
 - 2. ABMA – American Boiler Manufacturers Association.
 - 3. ANSI – American National Standards Institute.
 - 4. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - 5. ASTM – American Society for Testing Materials.
 - 6. CDA – Copper Development Association.
 - 7. CGA – Compressed Gas Association.
 - 8. CSA – Canadian Standards Association.
 - 9. FMG – Factory Mutual Global Technologies LLC.
 - 10. HI – Hydraulic Institute.
 - 11. ITSNA – Intertek Testing Services NA.
 - 12. NAIMA – North American Insulation Manufacturers Association.
 - 13. NEBB – National Environmental Balancing Bureau.
 - 14. NEC – National Electrical Code.
 - 15. NFPA – National Fire Protection Association.
 - 16. NEMA – National Electrical Manufacturer's Association.
 - 17. SMACNA – Sheet Metal and Air Conditioning Contractors National Association.
 - 18. UL – Underwriter's Laboratories, Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating, and Air Conditioning Sections and as indicated on Drawings.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
 2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.
 3. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonable foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.
- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (ITSNA, CSA, etc.).
- 1.06 CODES, PERMITS AND FEES
- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- 1.07 DRAWINGS
- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or

differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. 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 with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
 - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appear-

- ance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.
- 1.11 SUBMITTALS
- A. Submit project specific submittals for review in compliance with Division 1.
 - B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 1 for submittal quantities.
 - C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
 - D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
 - E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
 - F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
 - G. Submit detailed shop drawings of piping systems showing pipe routing and types and locations of all pipe hangers.
 - H. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- 1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS
- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.
 - B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
 - C. Operation and maintenance instructional manuals shall be submitted a minimum of four (4) weeks prior to functional testing.
 - D. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 1. Routine maintenance procedures.

2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
3. Trouble-shooting procedures.
4. Contractor's telephone numbers for warranty repair service.
5. Submittals.
6. Recommended spare parts lists.
7. Names and telephone numbers of major material suppliers and subcontractors.
8. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 1.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new mechanical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

- A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 MECHANICAL DEMOLITION WORK

- A. All demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include all items such as, but not limited to, existing piping, pumps, ductwork, supports and equipment where such items are not required for the proper operation of the modified system.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner shall move and store these materials. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- E. Clean and flush the interior and exterior of all existing relocated equipment and its related piping, valves, and accessories that are to be reused of all mud, debris, pipe dope, oils, welding slag, loose mill scale, rust and other extraneous material so that the existing equipment and all accessories can be repainted and repaired as required to place in first-class working condition.
- F. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling or at mains.
- G. Provide sheet metal caps on ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation. Caps shall be of same material as service requiring such.

3.02 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.03 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 1.
- B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional expense.

3.04 WORK INVOLVING OTHER TRADES

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.05 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:
 - 1. Air Handling Systems
 - 2. Heating Systems
 - 3. Vacuum Systems
 - 4. Space Temperature Controls
 - 5. Lab Airflow Controls
 - 6. Exhaust Systems

END OF SECTION

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.02 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 20, 22 and 23 Mechanical Sections, and Division 1 Specification Sections.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the

Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.

1. Protect equipment and materials from theft, injury or damage.
2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
4. 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.
5. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- C. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
 1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 20 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.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
 1. Ferrous pipe: Malleable iron ground joint type unions.
 2. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
 1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
 2. Copper tube and pipe: Slip-on bronze flanges.
- D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
 - E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
 - F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
 - G. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 - H. 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.
 - I. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- 2.04 PIPE THREAD COMPOUNDS
- A. Pipe thread compounds for the fluid service compatible with piping materials provided.
 - B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
 - C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.
 1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."
 - b. Tnemec.
 - c. Koppers.
 - D. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.
 1. Manufacturers:
 - a. Cadillac Plastic.
 - b. Permacel.
 - c. Other approved.
- 2.05 TRANSITION FITTINGS
- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.

2.06 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions: For systems up to 286 deg F (141 deg C), on piping sizes NPS 2 (DN 50) and smaller.
- D. Dielectric Flanges: For piping sizes NPS 2-1/2 (DN 65) and larger, factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Water Technologies, Inc.; Watts Regulator Co.
- E. Dielectric-Flange Kits: For piping sizes NPS 2-1/2 (DN 65) and larger, 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. 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 (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.07 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Innerlynx.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
 - 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: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.08 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.09 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.
 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 LEAK DETECTOR SOLUTION

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
 1. American Gas and Chemicals Inc.; Leak Tec.
 2. Cole-Parmer Inst. Co.; Leak Detector.
 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

PART 3 EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

- C. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- D. Provide dielectric connections wherever joining dissimilar metals.
- E. Install piping to conserve building space and not interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Slope piping and arrange systems to drain at low points.
- I. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide clearance for installation of insulation and access to valves and fittings.
- N. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install piping to allow application of insulation.
- R. Select system components with pressure rating equal to or greater than system operating pressure.
- S. After completion, fill, clean, and treat systems. Refer to Division 22 Sections "Hydronic Piping".
- T. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- U. Install sleeves for pipes passing through walls, partitions, and floor slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces of walls.
 - a. Exception: Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
 - b. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
 - c. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
 - 3. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
 - 4. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
 - 5. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- V. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Specification Sections for materials.

- W. Seal openings around pipes in sleeves and around duct openings through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Fire and/or smoke barriers shall be UL listed firestopping and shall have a fire rating equal to or greater than the penetrated barrier. Refer to Division 7 Specification Sections for materials.
- X. Verify final equipment locations for roughing-in.
- Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- F. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- G. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- H. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- I. 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.
- J. 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.
- K. 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.
- L. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
 - 1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
 - 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat

face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

- M. 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. 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.
- N. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- O. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- P. 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.
- Q. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.03 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
 - 1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, where indicated on drawings, at final connection to each piece of equipment and at all control valves.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, where indicated on drawings, at final connection to each piece of equipment and at all control valves.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 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 mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 - D. Install equipment to allow right of way for piping installed at required slope.
 - E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
 - F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
 - G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.
- 3.06 CUTTING, CORING AND PATCHING
- A. Refer to Division 1 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
 - B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.
- 3.07 FLASHING
- A. Provide all flashing required for mechanical work. Refer to Division 7 Specification Sections.
- 3.08 LUBRICATION
- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.
- 3.09 CLEANING
- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.
 - B. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
 - C. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
 - D. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

SECTION 20 0513 - MOTORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 "Mechanical General Requirements."
 - 2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
 - 3. Division 20 Section "Variable Frequency Controllers".
 - 4. Division 26 Section "Enclosed Switches and Circuit Breakers".
 - 5. Division 26 Section "Enclosed Controllers".
 - 6. Division 26 Section "Fuses".

1.02 SUMMARY

- A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

- A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.05 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
 - 1. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
 - 2. Matched to torque and horsepower requirements of the load.
 - 3. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate electrical scope of work to be provided by Division 26 with this Section, related Division 20, 21, 22 and 23 Specifications, Division 26 Specifications and the Drawings.
- C. Electrical work provided under Division 20, 22 and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.
- D. Furnished and installed under Division 20, 22 and 23 and wired under Division 26 unless otherwise indicated:
 - 1. Motors required for mechanical equipment
 - 2. Packaged Self-Contained Equipment:
 - a. Provide equipment ready to accept a single electrical service connection.
 - b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.
 - 3. Variable frequency controllers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
1. Dayton.
 2. Toshiba Intl.
 3. Baldor Electric/Reliance.
 4. Rockwell Automation/Allen-Bradley.
 5. U.S. Motors.
 6. GE Motors.
 7. Regal Beloit/Leeson.
 8. Regal Beloit/Marathon.
 9. Emerson Motors.
 10. Siemens.

2.02 MOTOR REQUIREMENTS

- A. Motor requirements apply to factory-installed motors except as follows:
1. Different ratings, performance, or characteristics for a motor are specified in another Section.
 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.
- B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.
- C. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.03 MOTOR CHARACTERISTICS

- A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.
- B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Motors shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the N.E.M.A. MG1-12.53 standards and I.E.E.E. 112A-Method B. The nominal efficiencies shall meet or exceed Table A.

Table A
Nominal Efficiencies For "NEMA PremiumTM" Induction Motors
Rated 600 Volts or Less (Random Wound)

HP	Open Drip-Proof			Totally Enclosed Fan-Cooled		
	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5

- C. Stator: Copper windings, unless otherwise indicated.
 - 1. Multispeed motors shall have separate winding for each speed.
- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
 - 1. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
- I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
 - 1. Finish: Gray enamel.
- J. Sound Level: Not to exceed N.E.M.A. MG-1 12.54.

2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
 - 1. Finish: Chemical-resistant paint over corrosion-resistant primer.
- B. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
 - 1. Measure winding resistance.
 - 2. Read no-load current and speed at rated voltage and frequency.
 - 3. Measure locked rotor current at rated frequency.
 - 4. Perform high-potential test.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. All three phase motors ½ HP and above shall be tested by the Testing Agency.
- B. Prepare for acceptance tests as follows:
 - 1. Check motor nameplates for H.P., speed, phase and voltage.
 - 2. Check coupling alignment and shaft end play.

3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
 4. Test interlocks and control features for proper operation.
 5. Verify that current in each phase is within nameplate rating.
 - C. Testing: Perform the following field quality-control testing:
 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
 2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 3.02 ADJUSTING
- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.
 - B. Set field adjustable switches and circuit breaker trip ranges.
- 3.03 CLEANING
- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
 - B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 20 0523 - VALVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
 - 2. Division 22 piping Sections for specialty valves applicable to those Sections only.
 - 3. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. NRS: Nonrising stem.
 - 5. OS&Y: Outside screw and yoke.
 - 6. PTFE: Polytetrafluoroethylene plastic.
 - 7. RPTFE: Reinforced polytetrafluoroethylene plastic.
 - 8. SWP: Steam working pressure.
 - 9. TFE: Tetrafluoroethylene plastic.
 - 10. WOG: Water, oil, and gas.

1.03 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.04 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water, and sanitary waste piping 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 PRODUCTS

2.01 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- C. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated. Solder joint valves may be used for copper piped systems.
- D. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
 1. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Solder Joint: With sockets according to ASME B16.18.
 1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
- K. Threaded: With threads according to ASME B1.20.1.

2.02 BRONZE BALL VALVES

- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
- B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing, soldered or threaded ends; and 150 psig (1034 kPa) SWP and 600-psig (4140-kPa) CWP ratings.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Div.; Series 70-140.
 - b. Crane Valve Group; Crane Valves.
 - c. Metso Automation; Jamesbury Valves.
 - d. Milwaukee Valve Company; Model BA100S.
 - e. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
 - f. Watts Water Technologies, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.

3.03 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves may be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.

3.04 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

SECTION 20 0529 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 20 Section "Mechanical General Requirements."
 - 3. Division 20 Section "Basic Mechanical Materials and Methods."
 - 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 - 5. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
- C. MFMA: Metal Framing Manufacturers Association.

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 HANGER ROD MATERIAL

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
 - 1. Rod continuously threaded.
 - 2. Use of rod couplings is prohibited.

2.03 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. Anvil International, Inc.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. Carpenter & Paterson, Inc.
 - 4. Hilti USA.
 - 5. ERICO International Corp.
 - 6. PHD Manufacturing, Inc.
 - 7. Tolco; a brand of Nibco.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. Anvil International, Inc.; Anvil-Strut.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. Power-Strut Div.; Tyco International, Ltd.
 - 4. Unistrut Corp.; Tyco International, Ltd.
 - 5. Hilti USA.
 - 6. Tolco; a brand of Nibco; TOLStrut.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.07 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use padded hangers for piping that is subject to scratching.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Single Pipes
 - a. Support uninsulated pipe up to NPS 4 (DN 100) size with TYPE 1 or TYPE 10 attachments.
 - b. Support uninsulated pipe NPS 6 (DN 150) size through NPS 12 (DN 300) size with TYPE 1 attachments.
 - c. Support insulated pipe up to NPS 2 (DN 50) size with Type 1 attachments and insulation shield.
 - d. Support insulated hot piping up to and including NPS 2-1/2 (DN 65) size, and all other insulated piping NPS 2-1/2 (DN 65) to NPS 12 (DN 300) size with TYPE 1 attachment with pre-insulated shield/support.
 - e. Support insulated hot piping NPS 3 (DN 75) size through NPS 12 (DN 300) size with roller hangers TYPES 41, 43, 44 or 46 with pre-insulated shield/support designed for use with a pipe roller.
 2. Parallel Pipes:
 - a. Fabricate trapeze hangers from approved structural steel shapes in accordance with "Miscellaneous Materials" requirements or use commercially available proprietary design, rolled steel. Refer to applicable requirements for "Single Pipes" and "Metal Fabrications."

- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. MSS Type 8 or spring type to meet system requirements.
 - G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.
 - H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Beam Clamps
 - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 (DN 150) size or smaller only.
 - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 (DN 65) size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2 (DN 65).
 - I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields: 360 degree Type, of length recommended in writing by manufacturer to prevent crushing insulation. Use for insulated piping sized NPS 2 (DN 50) and smaller when supported on trapeze hangers.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation. Use for insulated piping sized NPS 2 (DN 50) and smaller.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe. Use for insulated piping sized NPS 2-1/2 (DN 65) and larger.
 - J. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
 - K. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
 - L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- 3.02 HANGER AND SUPPORT INSTALLATION
- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.
 - B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- H. Where necessary, brace piping and supports against reaction, sway and vibration.
- I. Do not hang piping from, floor decks, roof decks, equipment, ductwork, or other piping.
- J. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- K. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- L. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- M. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- N. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
- O. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
- P. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
- Q. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- R. Building structure shall not be reinforced except as approved by the Architect in writing.
- S. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - T. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - U. Fastener System Installation: Install fasteners according to manufacturer's written instructions.
 - V. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - W. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - X. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - Y. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - Z. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping
 - AA. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - BB. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
 - CC. Insulated Piping: Comply with the following:
 1. Pipe smaller than NPS 2 (DN 50): Install adjustable swivel ring or clevis type hangers with protection shield.
 2. Cold Pipe NPS 2-1/2 (DN 65) and larger: Install clevis type hangers with thermal hanger shields.
 3. Hot Pipe NPS 2-1/2 through NPS 5 (DN 65 through DN 125): Install single rod roller hanger with thermal hanger shield.
 4. Hot Pipe NPS 6 (DN 50) and larger: Install 2-rod roller hanger with thermal hanger shield.
 5. Trapeze Supported Pipe NPS 2 (DN 50) and smaller: Install with protection shield and secure to trapeze support with standard U-bolts and locknuts.
 6. Trapeze Supported Cold Pipe NPS 2-1/2 (DN 65) and larger: Install with thermal hanger shield and secure to trapeze support with standard U-bolts and locknuts.
 7. Trapeze Supported Hot Pipe NPS 2-1/2 (DN 65) and larger: Install thermal hanger shield and cradle pipe in adjustable cast iron roller support.
 - DD. Refer to individual piping sections for hanger spacing and hanger rod sizes.
- 3.03 EQUIPMENT SUPPORTS
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
 - B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
 - C. Provide lateral bracing, to prevent swaying, for equipment supports.
- 3.04 METAL FABRICATIONS
- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
 - B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
- 3.05 ADJUSTING
- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
 - B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

END OF SECTION

SECTION 20 0553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 20, 22, 23 And 26 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.03 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) 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.

1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Seton.
 - 2. Brady.
 - 3. EMED.
 - 4. Craftmark.
 - 5. Brimar Industries, Inc.
 - 6. Marking Services Inc. (MSI).

2.02 EQUIPMENT IDENTIFICATION DEVICES

- A. 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 (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- 2.03 PIPING IDENTIFICATION DEVICES
 - A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
 - 1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
 - 2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
 - 3. Legends: Spelled out in full or commonly used and accepted abbreviations.
 - 4. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
 - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- 2.04 DUCT IDENTIFICATION DEVICES
 - A. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).
- 2.05 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 (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, DO NOT OPERATE, and EQUIPMENT STARTED AND STOPPED BY BUILDING AUTOMATION SYSTEM.
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

- 3.01 APPLICATIONS, GENERAL
 - A. Products specified are for applications referenced in other Division 20, 22 and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.
- 3.02 EQUIPMENT IDENTIFICATION
 - A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fans, filters, terminal units.
 - B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary letter-

- ing two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fire department hose valves and hose stations.
 - c. Meters, gages, thermometers, and similar units.
 - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - g. Fans, blowers, primary balancing dampers, and mixing boxes.
 - h. Packaged HVAC central-station and zone-type units.
 - i. Tanks and pressure vessels.
 - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
 - C. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.
- 3.03 PIPING IDENTIFICATION
- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
 - B. Locate pipe markers as follows:
 1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 4. Near major equipment items and other points of origination and termination.
 5. Spaced at maximum intervals of 25 feet (15 m) along each run.
- 3.04 DUCT IDENTIFICATION
- A. Identify ductwork with vinyl markers and flow direction arrows.
 - B. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 25 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.
- 3.05 WARNING-TAG INSTALLATION
- A. Write required message on, and attach warning tags to, equipment and other items where required.
- 3.06 ADJUSTING
- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.07 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.08 SCHEDULES

PIPE LABELING AND COLOR CODING

<u>Pipe System Label</u>	<u>Drawing Ab- brev.</u>	<u>Labels</u>
Sanitary Sewer	SAN	White on Green
Sanitary Vent	V	White on Green
Acid Waste	AW	Black on Yellow
Acid Vent	AV	Black on Yellow
Domestic Cold Water	CW	White on Green
Domestic Hot Water	HW	Black on Yellow
Domestic Hot Water Return	HWR	Black on Yellow
Natural Gas	G	Black on Yellow
Compressed Air	A	Black on Yellow
Laboratory Vacuum	LVAC	Black on Yellow
Distilled Water	DI	White on Green
Steam	LPS	Black on Yellow
Steam greater than 15 PSIG	HPS	Black on Yellow
Condensate	CNDS	Black on Yellow

SHEET METAL WORK

<u>Service</u>	<u>Abbrev.</u>
Air Conditioning Supply	Supply Air
Exhaust Systems	Exhaust Air

END OF SECTION

SECTION 20 0700 - MECHANICAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Materials and Methods."
 - 3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
 - 4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.
 - 5. Division 22 Section "Medical Plumbing Fixtures" for protective shielding guards.
 - 6. Division 23 Section "Metal Ducts" for duct liners.

1.02 SUMMARY

- A. This Section includes mechanical insulation for pipe, duct, and equipment.
- B. After completion of asbestos abatement, reinsulate all existing systems including piping, fittings, ductwork, equipment, etc. which are remaining in service. Refer to Division 02 Section "Asbestos Remediation" and "Work Sequence and Phasing" in Division 01 Section "Summary of Work".

1.03 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVC: Polyvinyl Chloride.
- E. PVDC: Polyvinylidene chloride.
- F. SSL: Self-sealing lap.

1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.
- B. Hot Service Drains, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.
- C. Hot Service Vents, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.

1.05 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
 - 1. ESR Report: For fire-rated grease duct insulation.
- B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

1.07 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, 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.
- B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

1.09 COORDINATION

- A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.10 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Adhesives used shall be fire resistant in their dry states and UL listed.

2.02 PIPE INSULATION MATERIALS

- A. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
- B. Mineral-Wool, Preformed Pipe Insulation, Type II:
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Rock Wool Manufacturing Company; Delta PC and PF.
 - c. Roxul Inc.; 1200 Pipe Insulation.
 2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 DUCTWORK INSULATION MATERIALS

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket . Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap FSK.
 - e. Owens Corning; All-Service Duct Wrap.

2.04 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Thermal Ceramics; FireMaster FastWrap+.
 - b. 3M; Fire Barrier Wrap Products.
 - c. Unifrax Corporation; FyreWrap.

2.05 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.06 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 - f. Vimasco Corporation.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.07 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.08 FACTORY-APPLIED JACKETS

- A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

- A. Bands:
 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.
 - b. RPR Products, Inc.; Bands.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the products specified.
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

3.03 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install thermal hanger insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover thermal hanger inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
 - D. Insulation Installation at Interior Wall and Partition Penetrations that Are Not Fire Rated: Install insulation continuously through walls and partitions.
 - E. Insulation Installation at Fire-Rated Wall and Partition Penetrations:
 - 1. Terminate ductwork insulation at angle closure of fire damper sleeves.
 - 2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
 - F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."
- 3.05 GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
 - B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible Elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.06 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
 - a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
 3. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install PVC fitting covers when available.
 2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install PVC fitting covers when available.

2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.07 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive may be omitted from top surface of horizontal rectangular ducts.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins 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, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.08 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, install two layers in strict accordance with manufacturer's instructions, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Maintain a copy of insulation manufacturer's installation instructions on site for Code Official.
- C. Where fire-rated plenum wrap system is indicated, secure to system piping to maintain a continuous UL-listed fire rating.
- D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Through-Penetration Firestop Systems."

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
 - 3. Division 20 Section "Hangers and Supports."
 - 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
 - 5. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.03 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.04 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

1.06 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
 - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.04 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 20 Section "Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 EXECUTION

3.01 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Install domestic water piping level without pitch and plumb.

3.02 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.03 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install supports for vertical steel piping every 15 feet.
- F. Install hangers for drawn-temper 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.
- G. Install supports for vertical copper tubing every 10 feet.
- H. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.04 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.05 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.06 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.07 CLEANING AND DISINFECTION

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable and non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 4. Division 22 Section "Domestic Water Piping" for water meters.
 - 5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.

1.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.01 VACUUM BREAKERS

- A. Laboratory-Faucet Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Water Technologies, Inc.; Watts Regulator Co.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1035.
 - 3. Size: NPS 1/4 or NPS 3/8 (DN 8 or DN 10) matching faucet size.

4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

2.02 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install water hammer arresters in water piping according to PDI-WH 201.

3.02 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 22 Section "Chemical Waste Piping"
 - 4. Division 22 Section "Emergency Plumbing Fixtures."
 - 5. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
 - 6. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

PART 2 PRODUCTS

2.01 ARCHITECT-FURNISHED FIXTURES

- A. Provide supply connections to faucets with stop valves. Provide direct-connected drain piping: NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) acid resistant plastic grid strainer, P-trap, and tubular waste to wall with wall flange.
- B. For gas, air, and vacuum outlets provide direct connection to fixture.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water supply and drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Assemble plumbing fixture's trim, fittings, and other components according to manufacturers' written instructions.
- B. Install counter-mounting fixtures in and attached to casework.
- C. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- D. 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.
- E. Install corrosion resistant trap and tubular waste piping on drain outlet of each fixture to be directly connected to acid waste drainage system.
- F. 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.
- G. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 20, 22 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect fixtures with water supplies, stops, and risers, and with traps, acid waste, and acid vent piping. Use size fittings required to match fixtures.

3.04 FIELD QUALITY CONTROL

- A. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- B. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4500 - EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Domestic Water Piping Specialties" for backflow preventers and water filters.
 - 4. Division 23 Section "Drainage Piping Specialties" for floor drains and cleanouts.

1.02 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Tepid: Moderately warm.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For emergency plumbing fixtures to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ANSI Standard: Comply with ANSI Z358.1-2004, "Emergency Eyewash and Shower Equipment."
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" and "Americans with Disabilities Act" for plumbing fixtures for people with disabilities.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 PRODUCTS

2.01 HAND-HELD DRENCH HOSES

- A. Architect furnished fixture:
 - 1. Provide supply connections from water tempering equipment to fixture:

2.02 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc. (RADA)
 - b. Bradley Corporation.
 - c. Guardian Equipment Co.
 - d. Haws Corporation.
 - e. Lawler Manufacturing Co., Inc.; Model 911 E/F.
 - f. Leonard Valve Company.
 - g. Powers, a Watts Industries Co.; Model ES 150.
 - h. Speakman Company.
2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 85 deg F (29 deg C) tepid, potable water at a single emergency eyewash or eye/face wash fixture, to maintain temperature at plus or minus 5 deg F (3 deg C) throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

2.03 SOURCE QUALITY CONTROL

- ### A.
- Certify performance of emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- #### A.
- Examine roughing-in for piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 20 Section "Valves."
 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Locate tempering equipment in casework below fixture.

3.04 FIELD QUALITY CONTROL

- A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
- B. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
- C. Report test results in writing.

3.05 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 6113 - LABORATORY AIR, GAS, AND VACUUM PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 11 Section "Laboratory Fume Hoods" for laboratory fume hood outlets requiring laboratory air or vacuum service.
 - 2. Division 12 Section "Laboratory Casework" for casework and outlets requiring laboratory air or vacuum service.
 - 3. Division 20 Section "Mechanical General Requirements."
 - 4. Division 20 Section "Basic Mechanical Materials and Methods."
 - 5. Division 20 Section "Valves."

1.02 SUMMARY

- A. This Section includes piping for laboratory gases and vacuum, and related specialties.
 - 1. Laboratory Gases:
 - a. Compressed-air.
 - b. Natural gas.
 - c. CO2

1.03 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene plastic.
- B. TFE: Tetrafluoroethylene plastic.
- C. CGA: Compressed Gas Association.
- D. BAS: Building Automation System.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide laboratory gas and vacuum piping systems that comply with NFPA 99, Level 4 requirements for materials and installation.
- B. Components and installation shall be capable of withstanding the following minimum pressure, unless otherwise indicated:
 - 1. Laboratory Gas Piping: 125 psig (860 kPa).
 - 2. Laboratory Vacuum Piping: 15 psig (103 kPa).
 - 3. Laboratory CO2 Piping 125 psig (860 kPa).

1.05 SYSTEMS DESCRIPTIONS

- A. Laboratory Gases And Vacuum Piping Systems: Use tubing, fittings, and joining methods according to the following applications:
 - 1. Interior Laboratory Gases Pressure Piping: Use Type K, hard copper tubing, wrought copper pressure fittings, and brazed joints.
 - 2. Interior Laboratory Vacuum: Use Type L, hard copper tubing, wrought copper pressure fittings, and soldered joints.
- B. Drawings indicate valve types to be used for laboratory air and vacuum piping. If specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Valves NPS 3 (DN 80) and Smaller: Copper-alloy ball valve.

2. Check Valves NPS 3 (DN 80) and Smaller: Bronze.

1.06 SUBMITTALS

- A. Product Data: For the following:
 1. Laboratory gas and vacuum tubing and fittings.
 2. Laboratory gas and vacuum valves and valve boxes.
- B. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.
- C. Piping Material Certification: Signed by Installer certifying that laboratory gas and vacuum piping materials comply with NFPA 99 requirements.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For laboratory gas and vacuum piping and specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- B. Comply with NFPA 54, "National Fuel Gas Code."
- C. Comply with NFPA 99, "Health Care Facilities," for materials and installation.
- D. Comply with UL 544, "Medical and Dental Equipment," for laboratory gas and vacuum specialties.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBES, AND FITTINGS

- A. Copper Tube: ASTM B 89, Type K or L, seamless, hard drawn tubing.
 1. Fittings:
 - a. Copper Pressure Fittings: ASME B16.22, wrought-copper solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 300.
 - c. Copper Unions: ASME B16.22 or MSS SP-123.
- B. Copper Tube: ASTM B 819, Type K or L, seamless, drawn-temper, medical gas tube that has been factory cleaned, purged, and sealed for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
 1. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3.
 - a. Copper Pressure Fittings: ASME B16.22, wrought-copper solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 - b. Cast-Copper-Alloy Flanges: ASME B16.24, Class 300.

- c. Copper Unions: ASME B16.22 or MSS SP-123.

2.03 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.
- B. Brazing Filler Metals: AWS A5.8, BCuP series alloys. Flux is prohibited unless used with bronze fittings.
- C. Threaded-Joint Tape: PTFE.
- D. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos free, and suitable for service.

2.04 VALVES

- A. Valves, General: Refer to Division 20 Section "Valves."
- B. Copper-Alloy Ball Valves: Factory cleaned for oxygen service and bagged. MSS SP-110, 3-piece-body, full-port ball valve rated for 300-psig (2070-kPa) minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking-type handle designed for quarter turn between opened and closed positions.
 - 1. Manufacturers:
 - a. Allied Healthcare Products, Inc.; Chemetron Div.
 - b. Amico Corporation.
 - c. Beacon Medaes.
 - d. Conbraco Industries, Inc., Apollo Ball Valves.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Squire-Cogswell/Aeros Instruments.
- C. Bronze Check Valves: Straight-through-pattern, spring-loaded ball check valve; designed for 300-psig (2070-kPa) minimum working pressure.
- D. Natural Gas Valves, NPS 3 (DN 75) and Smaller: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 125-psig (860-kPa) minimum pressure rating.
 - 1. Manufacturers:
 - a. Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Watts Industries, Inc.; Water Products Div.
 - 2. Tamperproof Feature: Include design for locking.

2.05 MASTER GAS SHUT OFF VALVE AND VALVE BOX

- A. Manufacturers:
 - 1. BeaconMedaes.
 - 2. Squire-Cogswell/Aeros Instruments Inc.; Healthcair.
- B. Master Gas Shut-Off Valve Box: Formed steel, or formed or extruded aluminum for recessed mounting as indicated on the drawings, in sizes to permit manual operation of valves, with holes for piping and anchors.
 - 1. Interior Finish: Factory-applied white enamel.
 - 2. Cover Plate: Aluminum or extruded-anodized aluminum or stainless steel with NAAMM AMP 503, No. 4 finish with frangible or removable windows.
 - 3. Valve-Box Windows: Clear or tinted transparent plastic. Permanently affix the following to the window:

CAUTION
CLOSE ONLY IN EMERGENCY
MASTER GAS SHUT OFF VALVE

- C. Master gas shut off valve: Natural gas valve as specified in this Section.
- D. Provide union ahead of valve within box.

2.06 TEST GAS

- A. Description: Oil-free dry nitrogen complying with CGA P-9, for purging and testing of piping.

2.07 IDENTIFICATION

- A. Refer to Division 20 Section "Mechanical Identification" for identification of piping, valves, gages, alarms, and specialties.

PART 3 EXECUTION

3.01 PREPARATION

- A. Interruption of Existing Laboratory Air and Vacuum Services: Do not interrupt laboratory air and vacuum services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary laboratory air and vacuum services according to requirements indicated:
 - 1. Notify Owner not less than two weeks in advance of proposed interruption of laboratory air and vacuum services.
 - 2. Do not proceed with interruption of laboratory air and vacuum services without Owner's written permission.
- B. Cleaning of Piping: If factory-cleaned and -capped laboratory air and vacuum piping is not available or if precleaned piping must be recleaned because of exposure, perform the following procedures:
 - 1. Clean laboratory air and vacuum tubes and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
 - 2. Wash laboratory air and vacuum piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.02 PIPING SYSTEM INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.03 VALVE INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.
- B. Install shutoff valve at each connection to and from laboratory air and vacuum specialties and equipment.
- C. Install check valves to maintain correct direction of fluid flow to and from laboratory air and vacuum specialties and equipment.

- D. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

3.04 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Brazed Joints: Use silver- or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Brazed Joints"; or AWS D10.13, "Recommended Practices for the Brazing of Copper Pipe and Tubing for Medical Gas Systems."

3.05 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 20 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install supports and anchors according to Division 20 Section "Hangers and Supports," with spacing according to NFPA 99.
- F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

3.07 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for laboratory air and vacuum piping systems. Refer to Division 20 Section "Mechanical Identification" for labeling and identification materials.

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect, test, and certify completed laboratory gas and vacuum systems according to requirements in NFPA 99 specified. Inspect, test, and certify each piping system, including specialties, safety devices, and source equipment.
 - 2. Provide oil-free dry nitrogen, materials, and equipment required for testing.
 - 3. Laboratory Gas Piping Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped gas systems. Include the following:
 - a. Piping Integrity Tests:
 - 1) Blow Down: Clear piping before connecting service connections or outlets.
 - 2) Initial Pressure Tests: Subject each piping section to test pressure of 1.5 times system working pressure, but not less than 150 psig (1035 kPa), before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
 - 3) Purge Tests: Perform heavy intermittent purging of piping and full-flow purging of service connections.
 - b. Verification and Final Testing: Activate systems with compressed air at normal operating pressure.
 - 1) Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test. Verify that pressure differences comply with required calibration. Repair leaks with new materials and retest systems.
 - 2) Pressure Relief Valve Tests: Verify proper valve operation.
 - 3) Cross-Connection Tests: Activate only compressed-air system. Verify that air flows from each laboratory air outlet and does not flow from vacuum inlets. Repeat cross-connection test for laboratory vacuum system.
 - 4) Secondary Equipment Tests: Verify operation of equipment if available.
 - 5) Labeling: Verify correct labeling.
 - 4. Laboratory Vacuum Piping Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped vacuum systems. Include the following:
 - a. Blow Down: Clear piping before connecting service connections or inlets.
 - b. Pressure Tests: Subject each piping section to test pressure of 15 psig (103 kPa) for 24 hours. Verify that pressure drop does not exceed 5 psig (35 kPa). Repair leaks with new materials and retest systems.
 - c. Cross-Connection Tests: Perform as part of laboratory air piping testing.
 - d. Labeling: Verify correct labeling.
 - 5. Test and adjust controls and safeties.
- C. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - 1. Inspections performed.
 - 2. Procedures, materials, and gases used.
 - 3. Test methods used.
 - 4. Results of tests.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain laboratory air and vacuum alarm system. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION

SECTION 22 6653 - CHEMICAL-WASTE PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements".
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 DEFINITIONS

- A. PP: Polypropylene plastic.
- B. HSCI: High silicone cast iron.
- C. CPVC: Chlorinated polyvinyl chloride plastic.
- D. CR: Chlorosulfonated polyethylene synthetic rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.
- G. HDPE: High-density polyethylene plastic.
- H. PE: Polyethylene plastic.
- I. PTFE: Polytetrafluoroethylene plastic.
- J. PVC: Polyvinyl chloride plastic.
- K. PVDF: Polyvinylidene fluoride plastic.
- L. RTRF: Fiberglass (reinforced-thermosetting-resin fittings).
- M. RTRP: Fiberglass (reinforced-thermosetting-resin pipe).

1.03 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Rating: 10-foot (3-m) head of water.

1.04 SYSTEMS DESCRIPTIONS

- A. Above Floor Chemical-Waste Piping:
 - 1. NPS 1-1/2 to NPS 6 (DN 40 to DN 150): PP drainage piping and mechanical joints.

1.05 SUBMITTALS

- A. Product Data: For chemical-waste piping materials, components, and specialties.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain pipe, fittings, and joining materials for each piping system through one source from a single manufacturer.
- B. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
- C. Comply with ASME B31.3, "Process Piping."
- D. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 1 "Systems Descriptions" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES, TUBES, AND FITTINGS

- A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101. Include mechanical joint ends.
 - 1. Manufacturers:
 - a. Fischer, George, Inc.
 - b. Ipex Inc.
 - c. Orion Fittings, Inc.
 - d. Zurn Plumbing Products Group.

2.04 JOINING MATERIALS

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- B. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- C. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- D. Flanges: Assemblies of companion flanges gasket complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.05 SPECIALTIES

- A. Corrosion-Resistant Traps: P-trap ; NPS 1-1/2 or NPS 2 (DN 40 or DN 50), as required to match connected piping.
 - 1. PP: ASTM D 4101, PP resin, with mechanical-joint pipe connections.
- B. PP Sink Outlets: NPS 1-1/2 (DN 40), with clamping device and tailpiece.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install piping next to equipment, accessories, and specialties to allow service and maintenance.

3.02 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction. If specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.
- C. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 20 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- F. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 (DN 50): 33 inches (840 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 42 inches (1070 mm) with 1/2-inch (13-mm) rod.
- G. Install supports for vertical PP piping every 72 inches (1830 mm).

3.04 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in Division 20 Section "Mechanical Identification."

3.05 FIELD QUALITY CONTROL

- A. Chemical-Waste Piping Inspection:
 - 1. Do not enclose, cover, or put drainage and vent 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 system before concealing after system roughing-in and before setting fixtures and equipment.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspections: 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. Chemical-Waste Piping Testing: Test systems according to procedures of authorities having jurisdiction or, in absence of published procedure, according to the following:

1. Test for leaks and defects in new piping systems and parts of existing systems 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 system tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Rough Plumbing Test Procedure: Test piping at completion of piping roughing-in. Tightly close all openings in piping system, and fill with water to point of overflow, but not less than 10-foot (3-m) head of water. From 15 minutes before test starts through completion of test, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures and equipment have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves building, and introduce air into system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of fixture to measure pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.06 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Clean piping by flushing with potable water.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Testing, Adjusting, and Balancing."

1.02 SUMMARY

- A. This Section includes common requirements for fans and air moving equipment.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Fan bearings.
 - 2. V-belt fan drives.
 - 3. Direct drive couplings.

1.04 QUALITY ASSURANCE

- A. 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.
- B. Fan Performance Data: AMCA Standard 210.
- C. Sound Power Level Ratings:
 - 1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
 - 2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 FAN SHAFTS

- A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 FAN POWER TRANSMISSION

- A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.
- B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.
- C. Base horsepower rating of drive on minimum pitch diameter of small sheave.
- D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
- E. Adjust belt tension in accordance with the manufacturer's recommendations.
- F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 SHEAVES

- A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
- B. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.
- C. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

2.05 V-BELT FAN DRIVES

- A. Fan Drives: Multiple V-belt style with fixed pitch driver. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.
- B. Manufacturers:
 - 1. Emerson Power Transmission; Browning.
 - 2. Rockwell Automation; Dodge.
 - 3. T.B. Wood's Incorporated.

2.06 FAN DRIVE, SHAFT, AND COUPLING GUARDS

- A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.
- B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.
- C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
- D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.
- E. Centrifugal exhaust fans shall be provided with shaft seals.

2.07 BELT DRIVE GUARDS

- A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.
- B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.08 V-BELTS

- A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.
- B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.
- C. Manufacturers:
 - 1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
 - 2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
 - 3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.09 V-BELT DRIVE MOTOR BASES

- A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.
- B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

- A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.
- B. Provide sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each existing air handling system requiring rebalancing during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 MOTOR REQUIREMENTS

- A. Furnish motors in accordance with Division 20 Section "Motors."
- B. Brake horsepower input shall not exceed 90 percent of the rated motor horsepower.

2.12 FAN BEARINGS

- A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.
 2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.
- 2.13 IDENTIFICATION
- A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.
- 2.14 ACCESSORIES
- A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

PART 3 EXECUTION

- 3.01 INSTALLATION
- A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
 - B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.
 - C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 SUMMARY

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. Laboratory fume hood airflow balancing.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Absolut Balance Company, Inc.; South Lyon, MI.
 - b. Aerodynamics Inspecting Company; Dearborn, MI.
 - c. Aireconomics, Inc.; Grand Rapids, MI.
 - d. Airflow Testing Inc.; Lincoln Park, MI.
 - e. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - f. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - g. Hi-Tech Test & Balance; Freeland, MI.
 - h. Integrity Test & Balance, Inc.; Cedar, MI.
 - i. International Test & Balance Inc.; Southfield, MI.
- C. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
- D. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

- E. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
 - F. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
 - G. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.06 PROJECT CONDITIONS
- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.07 COORDINATION
- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
 - B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
 - C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- 1.08 WARRANTY
- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
 - B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm 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

3.01 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine strainers for clean screens and proper perforations.
- G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- H. Examine equipment for installation and for properly operating safety interlocks and controls.
- I. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- J. 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.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Perform the following field tests and inspections to new and renovated portions of duct systems according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 2. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than

- and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg (500 to 2500 Pa).
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balance, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 8. Windows and doors can be closed so indicated conditions for system operations can be met.
- 3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING
- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.
- 3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS
- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check for proper sealing of air-handling unit components.
- J. Check for proper sealing of air duct system.
- 3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS
- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure fan static pressures to determine actual static pressure as follows:

- a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 3. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly.
 4. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly.
 5. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
 - B. Measure terminal outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 - C. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.06 PROCEDURES FOR LABORATORY FUME HOODS
- A. Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood. Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.
 - B. Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.
 1. Verify that no air is by-passed within hood. Report if baffles require modification at designated sash height.
 - C. For laboratory fume hoods that are connected to centralized exhaust systems using automatic dampers, adjust the damper controller to obtain the indicated exhaust airflow.
 - D. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.

2. Measure and record the face velocity across the open sash face area. Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter of the opening.
 - a. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.
 - b. Calculate and report the average face velocity by averaging all velocity measurements.
 - c. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.
 - d. If the average face velocity is less than the indicated face velocity, retest the average face velocity and adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity.
 3. Check each laboratory fume hood for the capture and containment of smoke by using a hand-held emitting device. Observe the capture and containment of smoke flow pattern across the open face and inside the hood. Make adjustments necessary to achieve the desired results.
- E. With the room and laboratory fume hoods operating at indicated conditions, perform an "as-installed" performance test of the laboratory fume hood according to ASHRAE 110. Test each laboratory fume hood and document the test results.
- 3.07 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check the condition of coils.
 5. Check the operation of the drain pan and condensate drain trap.
 6. Check bearings and other lubricated parts for proper lubrication.
 7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
 2. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
 3. Air balance each air outlet.

3.08 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Air handling equipment and outlets: Plus or minus 5 percent.
 - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.

3.09 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: As Work progresses, prepare 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.

3.10 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB firm.
 - 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 firm 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. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:
 - a. Conditions of filters.
 - b. Fan drive settings including settings and percentage of maximum pitch diameter.
- E. 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 outside, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Terminal units.
 4. Balancing stations.
- F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).

- k. Barometric pressure in psig (Pa).
 - H. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft. (sq. m).
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
 - I. 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 (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - J. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.
- 3.11 INSPECTIONS
 - A. Initial Inspection:
 - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
 - B. Final Inspection:
 - 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 23 0911 - LABORATORY AIRFLOW CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."
 - 3. Division 23 Section "Metal Ducts" for installation of laboratory airflow terminal units.
 - 4. Division 23 Section "Temperature Controls."
 - 5. Division 23 Section "Testing, Adjusting, and Balancing."

1.02 SUMMARY

- A. This Section includes laboratory airflow controls.
- B. Products Supplied But Not Installed Under This Section:
 - 1. Laboratory airflow terminal units.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The laboratory airflow control systems shall be furnished and installed to control the airflow into and out of the laboratory rooms, laboratory auxiliary support rooms, and fume hoods where indicated on the drawings, and to balance the airflow (e.g. room pressurization).
 - 2. This system shall be constant volume.
 - 3. Temperature control shall be by electric thermostats and hydronic control valves.
 - 4. All laboratory airflow control system components shall be products of a single manufacturer to ensure single source responsibility. Substitutions will not be allowed.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. For each room, provide a schematic drawing showing the schematic arrangement of air terminal units, fume hoods, fume hood monitors, thermostats, and control valves. Indicate airflows, hood face velocity, and room supply/exhaust offset.
 - 2. For each room, provide a complete point-to-point wiring and instrumentation tubing diagram. Termination points at all control components within the room shall be labeled. Indicate jumpers where required, as well as factory installed wiring and instrumentation tubing. Identify wire types.
 - 3. For each room, provide written sequence of operation.
 - 4. Complete bill of materials to identify and quantify all devices.
 - 5. Component schedules with design data indicating size, flow, pressure drop and pressure rating for terminal units, hydronic control valves, etc.
- B. Product Data: Include description and complete engineering data for each system component.
- C. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- D. Project Record Documents:
 - 1. Drawings revised to reflect actual installation and operating sequences.
- E. Operation and Maintenance Data:

1. Include as-built schematic drawings.
2. Indicate setpoints, settings and adjustments of all components.
3. Include equipment catalog cuts and data sheets indicating installation, operation, maintenance, repair, calibration, calibration tolerances, inspection period, cleaning methods and cleaning materials for all components, including proprietary components.
4. Include operating instructions to allow operators to understand the systems and their interrelationships, limitations, and maintenance needs.
5. Complete diagnostic and trouble shooting procedures set in manual form.
6. Provide all proprietary and non-proprietary service bulletins to the Owner at no additional cost for the duration of the project and the warranty period.
7. Provide a list of recommended spare parts required to maintain the system for one year.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain laboratory airflow control system components through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. NEMA Compliance: comply with NEMA standards pertaining to components and devices for electrical control systems.
- D. NFPA Compliance: Laboratory airflow control system and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
- E. Comply with NFPA 70.
- F. Comply with NEMA 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."
- G. Comply with ASTM D1693, "Environmental Stress-Cracking of Ethylene Plastics."

1.06 COORDINATION

- A. Coordinate work under provisions of Division 20 Section "Mechanical General Requirements," and as supplemented in this Section.
- B. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- C. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, traps, valves and accessories as may be required to meet such conditions.
- D. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the function or serviceability of the systems, shall not be made without the written approval of the Architect.
- E. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect for resolution.
- F. Provide required supervision and instruction to ensure proper installation of all laboratory airflow controls.
- G. Ensure installation of components is complementary to installation of similar components in other systems.
- H. Coordinate installation of system components with installation of other mechanical systems equipment.

- I. Coordinate work with the temperature controls contractor as to items provided by the temperature controls contractor, and as to interface requirements such as locations and operating ranges of components, air supply requirements, pneumatic tubing requirements, etc.
 - J. Coordinate with Architectural Trades regarding location and exact dimensions of recessed components.
 - K. Cooperate fully with the Test and Balance Contractor and provide labor to operate the lab control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."
 - L. Ensure system is completed and commissioned.
- 1.07 WARRANTY
- A. Warranty Period: Two years.
 - B. Provide 24 hour per day service during the warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a service engineer and a software expert regarding problems.
- 1.08 OWNER INSTRUCTION AND TRAINING
- A. Provide a minimum of 4 hours of combined classroom and on-site instruction and training to the Owner on the operation of the control systems.
 - B. Instruction and training shall be performed by a competent contractor representative familiar with the control systems operation, maintenance and calibration.
 - C. Training shall take place during the commissioning period at a time mutually agreed upon by the Owner and Contractor.
- 1.09 COMMISSIONING
- A. The Laboratory Airflow Controls Contractor shall perform commissioning services on all equipment provided as part of the work of this section.
 - B. Verification testing of each system component shall be made on a laboratory by laboratory basis. Each component shall be tested and verified at its extreme operating range, as well as its normal operating range. Verify operation of all alarms. Verify fume hood average face velocity by doing an actual airflow traverse. Provide a standard commissioning report for each hood and each room.
- 1.10 EXTRA MATERIALS
- A. Provide a spare parts list and price list for the recommended spare parts to maintain the laboratory controls system after the second year of operation.
- 1.11 SPECIAL TOOLS
- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance.
- 1.12 PROTECTION OF PROPRIETARY INFORMATION
- A. All proprietary manuals subject to a non-disclosure agreement, shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 MANUFACTURERS/SUPPLIERS

- A. Integrated Laboratory Airflow Control System Manufacturer and Supplier: Subject to compliance with requirements, provide products as manufactured by one of the following:
 - 1. Siemens Building Technologies Laboratory Controls System; and as furnished and installed by Siemens Building Technologies; Livonia, Michigan, (800) 959-0233.

2.02 FUME HOOD MONITOR

- A. The fume hood monitor shall include a face velocity meter calibrated in feet per minute, visual indication for normal operation, and visual and audible alarms for unsafe flow conditions. Alarms shall reset automatically when alarm condition ceases.
- B. A push button switch shall be provided to mute the audible alarm. The mute mode is automatically reset when the alarm condition ceases.
- C. The fume hood monitor shall alarm an unsafe flow condition if any of the following conditions occur:
 - 1. The static pressure drop across the hood exhaust airflow terminal unit falls below the minimum controllable pressure drop, indicating a low flow condition.
 - 2. The alarm wire from the hood exhaust airflow terminal unit to the fume hood monitor breaks or becomes disconnected.
- D. Fume hood monitor shall be suitable for fully recessed mounting on the front of the fume hood.

2.03 LABORATORY AIRFLOW TERMINAL UNITS

- A. Laboratory airflow terminal unit shall control the exhaust flow out of a fume hood, the general exhaust or return airflow out of a room, or the make-up/supply airflow into a room.
- B. The airflow terminal units shall be of venturi control type utilizing a venturi section into which a cone shaped element slides to create a smoothly varying, annular orifice. All terminal units shall have an equal percentage flow characteristic to provide stable control at low flow values. Butterfly, opposed blade, or parallel blade style damper or VAV boxes are not acceptable.
- C. Terminal unit airflow control accuracy shall be plus or minus 5 percent of reading regardless of duct inlet or exit configurations over a turndown range of no less than 8 to 1 and over a pressure range of 0.3 inches WG to 3.0 inches WG (static pressure drop across the terminal unit).
- D. Terminal unit duct connections shall accommodate joining methods specified in Division 23 Section "Metal Ducts," and as indicated on the Drawings.
- E. The terminal unit construction shall be of the following type(s). Refer to the Laboratory Airflow Terminal Unit Schedule.
 - 1. Class A:
 - a. For non-corrosive airstreams such as supply and general exhaust shall be constructed of 16-gauge aluminum.
 - b. The device's shaft and shaft support brackets shall be made of Type 316 stainless steel.
 - c. The pivot arm and internal mounting link shall be made of aluminum.
 - d. The pressure independent air terminal and blade-style damper shall be stainless steel.
 - e. All shaft bearing surfaces shall be made of Teflon, polyester or PPS (polyphenylene sulfide) composite.
 - f. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24 gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.

2. Class B:
 - a. For corrosive airstreams, such as exhaust from fume hoods and biosafety cabinets shall have a baked-on, corrosion-resistant phenolic coating.
 - b. The device's shaft shall be made of Type 316 stainless steel with a Teflon coating.
 - c. The shaft support brackets shall be made of Type 316 stainless steel.
 - d. The pivot arm and internal mounting link shall be made of Type 316 or Type 303 stainless steel.
 - e. The pressure independent air terminal and blade-style damper shall be stainless steel.
 - f. The internal nuts, bolts and rivets shall be stainless steel.
 - g. All shaft bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.

2.04 INSTRUMENTATION TUBING

- A. Control and Instrumentation Tubing shall be furnished and installed in accordance with the requirements of Division 23 Section "Temperature Controls."

2.05 FACTORY IDENTIFYING AND MARKING

- A. Each laboratory airflow terminal unit shall be marked before shipment to the job site with a unique identifier corresponding to its location and function in the building. This identifier shall correspond to the plans and the shop drawings.
- B. Wiring shall be color coded.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Furnish fume hood monitor mounting bracket and exact cut-out dimensions to the fume hood supplier for factory mounting in a fashion to result in a fully recessed fume hood monitor on the front of the hood, neat in appearance.
- B. Install the fume hood monitor fully recessed on the front of the fume hood.
- C. Pneumatic tubing shall be furnished and installed in accordance with the requirements of Division 23 Section "Temperature Controls."
- D. All wiring shall be installed in raceway. Electrical wiring and raceway shall be furnished and installed in accordance with the requirements of the Division 26.

3.02 FIELD IDENTIFYING AND MARKING

- A. All sensors, switches, etc. shall be marked with the same identification number as used on the project record drawings. Marking shall be done with label maker with self-adhesive tape. Clean surface prior to applying label.
- B. Wiring shall be color coded according to functional use. Identify color coding format on project record drawings.
- C. Identify each wire as to ID number at each controller and field device.
- D. Identify control air tubing at each controller and field device.

3.03 ACCEPTANCE PROCEDURE

- A. Upon successful completion of calibration and start-up, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

3.04 TESTING, ADJUSTING AND BALANCING

- A. Laboratory Airflow Controls Contractor shall adjust laboratory airflow terminal units to achieve required air balance for each room.
- B. Coordinate work done under this section with the work of the Test & Balance Contractor.

END OF SECTION

SECTION 23 0953 - TEMPERATURE CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 DEFINITIONS

- A. BAS: Building Automation System.
- B. CAD: Computer Aided Design.
- C. DDC: Direct-digital controls.
- D. TC: Temperature Control.

1.04 SYSTEM DESCRIPTION

- A. Temperature control building automation system consisting of direct digital control system panels, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.
- B. BAS/DDC system programming, database and graphic display generation at the remote operator workstation.
- C. Pneumatic thermostats, components, control air tubing, etc.
- D. Control valves, dampers, operators, etc.
- E. Gauges, indicating devices, control accessories, and other control system devices.

1.05 SEQUENCE OF OPERATION

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 SUBMITTALS

- A. Submit under Division 20, 22 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control

- D. 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.
- E. Shop Drawings:
 - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Details of control panel faces and interior, including controls, instruments, termination blocks and labeling.
 - 5. Written sequence of operation for each controlled system.
 - 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
 - 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
 - 8. Complete bill of materials to identify and quantify all control components
 - 9. Schematic or floor plan details of major instrumentation tubing runs.
 - 10. Identify existing building TC Air source.
- F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
 - 1. Control valves:
 - a. Component tag.
 - b. Equipment served/function.
 - c. Media type.
 - d. Design flow rate (GPM).
 - e. Design pressure drop (ft. head) or (psi)
 - f. Calculated valve Cv
 - g. Selected valve Cv
 - h. Resultant pressure drop (ft. head) or (psi) with selected valve.
 - i. Valve size.
 - j. Line size to valve connection (excluding reducers).
 - k. Type (ball, butterfly, globe, etc.).
 - l. Configuration (2-way, 3-way mixing, 3-way diverting).
 - m. Normal position (normally open, normally closed, floating).
 - n. Actuator spring range (where applicable).
 - o. Actuator power requirement.
 - p. Valve shut-off rating (ft. head) or (psi)
 - q. Valve body pressure/temperature rating.
 - r. Valve manufacturer/model number.
 - s. Actuator manufacturer/model number.
- G. Samples: Temperature sensor or thermostat cover for each color required and guards if required.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
 - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
 - 2. Record actual locations of control components, including control units, thermostats, and sensors.

- K. Software and Firmware Operational Documentation: Include the following:
 - 1. DDC panel keypad operating instructions and DDC panel control override features.
 - 2. Device address list.
 - 3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - L. Maintenance Manuals: Include the following:
 - 1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
 - 2. Keypad illustrations and step-by-step procedures indexed for each operator function.
 - 3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 4. Calibration records and list of set points.
- 1.07 REFERENCES
- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
 - B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
 - C. ANSI/ASTM B32 - Solder Metal.
 - D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - E. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
 - F. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - G. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
 - H. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
 - I. NEMA DC 3 - Low-Voltage Room Thermostats.
 - J. ASTM E1 - Specification for ASTM Thermometers.
 - K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.
- 1.08 QUALITY ASSURANCE
- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
 - B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
 - C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- 1.09 DELIVERY, STORAGE, AND HANDLING
- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.
- 1.10 COORDINATION
- A. Coordinate work under Division 20 provisions and as supplemented in this section.
 - B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
 - C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.

- D. Ensure installation of components is complementary to installation of similar components in other systems.
 - E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
 - F. Coordinate work with the Laboratory Controls Contractor to provide air supply requirements.
 - G. Coordinate equipment with Division 13 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system
 - H. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout..
 - I. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."
- 1.11 WARRANTY
- A. Provide warranty per Division 20 Section "General Mechanical Requirements" and as supplemented in this section.
 - B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
 - C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
 - D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.
- 1.12 POSTED OPERATING INSTRUCTIONS
- A. Provide panel related as-built documents in protective binder or clear plastic display envelope for each control panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.
- 1.13 SPECIAL TOOLS
- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance.
- 1.14 PROTECTION OF PROPRIETARY INFORMATION
- A. All proprietary manuals and software shall be subject to a non-disclosure agreement, to be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

- 2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)
- A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based DDC panels shall be directly connected to HVAC equipment sensors and actuators.
 - B. Approved Manufacturer – System / Installer (Location):
 - 1. Siemens – Apogee 600 / Siemens Building Technologies, Inc. (Livonia, MI).

2.02 DDC INPUT/OUTPUT SENSORS

A. Air Static/Differential Pressure Transmitters:

1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: One percent of full scale.
5. Manufacturers:
 - a. Dwyer.
 - b. Setra.
 - c. Modus.
 - d. Air Monitor.

B. Current Switches:

1. Split-core donut transformer type for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. Current switches with digital output shall have adjustable trip settings. Field adjust current switches to trip at approximately 90% of normal motor operating amperage.
3. Manufacturers:
 - a. Johnson Controls.
 - b. NK Technologies.
 - c. Senva.
 - d. Setra.
 - e. Veris Industries.

2.03 CONTROL AIR SUPPLY

- A. The existing control air supply system shall be extended to serve the new controls.

2.04 CONTROL AND INSTRUMENTATION TUBING

- A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
1. Fittings: ANSI/ASME B16.22, wrought copper.
 2. Joints: ANSI/ASTM B32, 95-5 tin antimony.
- B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 2. Joints: Ball Sleeve compression type.
- C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
 2. Joints: Compression or barbed type.

2.05 CONTROL VALVES AND VALVE OPERATORS

A. Globe Pattern:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, single seated, screwed ends with backseating capability, repackable under pressure.
2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc, repackable under pressure.

3. Valve stem packing shall be tetrafluorethylene, spring loaded and self-adjusting. Packless construction is acceptable.
 4. Manufacturers:
 - a. Belimo.
 - b. Delta Control Products.
 - c. Honeywell.
 - d. Invensys.
 - e. Johnson Controls.
 - f. Siemens.
- B. Ball Valves:
1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
 2. Manufacturers:
 - a. Belimo.
 - b. Delta Control Products.
 - c. Honeywell.
 - d. Invensys.
 - e. Johnson Controls.
 - f. Siemens
- C. Pneumatic Operators:
1. Pneumatic, rolling diaphragm, spring loaded, piston type.
 2. Spring range shall be as indicated on drawings.
 3. Ratio relays or cumulators used for sequencing valves are not acceptable unless specifically indicated on the drawings.
 4. Positive positioning relays are not acceptable for use on room reheat and/or perimeter radiation control valves.
 5. Valves shall spring return to normal position as indicated.
 6. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.
 7. Select to provide smooth proportioning control under operating conditions normal to the system.
- D. Hydronic Systems:
1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section "Valves," and in Division 22 Section "Hydronic Piping."
 2. Valve minimum temperature ratings shall be 250 deg F.
 3. Replaceable plugs and seats of stainless steel or brass, selected for maximum lift under application conditions.
 4. Pressure Drop (except when using pressure independent control valves): As scheduled on the drawings. If not scheduled, primary HVAC equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5 psi), +/- 10%. If not scheduled, terminal equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5psi) with allowable minimum of 2.3 feet of head (1 psi) where flow rates are minimal and valve Cv choices are limited. TC Contractor shall use valves from listed manufacturers that meet the pressure drop requirements.
 5. Two way and three way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.

2.06 PNEUMATIC SYSTEMS ACCESSORIES

- A. Transmitter Gauges: Manufacturer's standard, black letters on white background, 3-1/2 inch diameter, suitable for flush mounting in control panel, with front calibrations screw, suitable dial range calibrated to match sensor, in appropriate units, and an accuracy of 1% of full scale or better.
- B. Instrument Pressure Gauges: Manufacturer's standard, black letters on white background, 1-1/4 inch diameter, stem mounted with suitable dial range.
- C. Gauge Cocks: Tee or lever handle, bronze, rated for 125 psig.
- D. Quick-Connect Test Valves: 1/4" Schrader (bicycle tire) type to allow quick pressurizing or depressurizing of pneumatic lines for system testing and re-calibration purposes.

2.07 PNEUMATIC THERMOSTATS

- A. Pneumatic Room Thermostats (single setpoint type): two-pipe, high volume, adjustable proportioning type, single setpoint, containing single bimetallic element, adjustable differential, minimum setting no greater than 1-1/2 deg F over a range of 55 deg F to 85 deg F. Provide locking covers with exposed setpoint indicator and exposed thermometer. Provide with concealed setpoint adjustment in public areas, and exposed setpoint adjustment in non-public areas.
- B. Manufacturers:
 - 1. Honeywell.
 - 2. Invensys.
 - 3. Johnson Controls.
 - 4. Siemens.

PART 3 EXECUTION

3.01 INSTALLATION - CONTROL SYSTEMS

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
- E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC panel as the associated output signal.
- F. Provide conduit and electrical wiring where required.
- G. All wiring in altered and unaltered areas shall be run concealed. Use of "wiremold" or exposed conduits will be permitted only where approved by the Architect.
- H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- J. Coil and conceal excess capillary on remote element instruments.
- K. Install thermometers in air duct systems on flanges.

- L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.
- M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.
- O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.
- P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
- Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.
- R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 60 seconds.
- V. Use copper tubing in mechanical rooms, where subject to damage or temperatures in excess of 200 degrees F, where adjacent to heating pipes passing through common sleeve, and where not readily accessible. Solder joint fittings shall be used for all copper tubing, except for final connection to control devices, where compression type fittings may be used. In mechanical rooms, factory bundled plastic tubing or individual plastic tubing run within tray or raceway may be used. Factory bundled plastic tubing shall be of the semi-rigid design with polyester film barrier and vinyl jacket not less than 0.062 inches thick, and suitable junction boxes. Connection to devices which may move, such as devices located on vibrating equipment, shall be made with a maximum of 12 inches of plastic tubing. Final pneumatic connection to all hot water or steam valves shall be made with at least 12 inches of copper tubing.
- W. Conceal tubing. Run exposed only in mechanical rooms, and other unfinished areas, in neat workmanlike manner, properly supported, parallel to building lines, in parallel banks and with 90 degree changes of direction.
- X. Mechanically attach tubing to supporting surfaces. Support tubing independently; however, tubing may be supported from water pipes (not fire protection), water pipe hangers (not fire protection) or duct hangers. Where tubing is in contact with threaded rods, wrap threaded rods with tape to protect tubing. Tubing shall not be supported from conduits with current-carrying conductors, fire protection piping or suspended ceiling hangers. Sleeve through concrete surfaces in minimum one inch sleeves, extended 6 inches above floors and one inch below bottom surface of slabs. Provide dielectric isolation between copper tubing and steel sleeves. Where water or vapor barrier sealing is required, provide 1/2 inch deep elastomer caulk.
- Y. Purge tubing with dry, oil-free compressed air before connecting controls.
- Z. Install instrument pressure gauges at all pneumatic outputs from DDC panels, at each valve and damper operator, at all connections to pneumatic controllers and at all other pneumatic devices

except room thermostats, room terminal units, terminal unit reheat valves and room radiation control valves.

- AA. Provide gauges on all control output signal lines at associated controller.
- BB. Provide gauges on all transmitter signal lines at associated controller.
- CC. Provide valve or damper operators with positive positioners where indicated or where required for positive shut-off or for sequencing with other controls. Positive positioners shall not be acceptable for use on room reheat or perimeter radiation control valves.
- DD. Provide all necessary pneumatic relays, boosters, restrictors, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.
- EE. All pneumatic valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 10 seconds. Provide booster relays if required.

3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS

- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.
- B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.
- C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
 1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
 2. Graphics generation requirements including special Owner requirements and schedule for completion.
 3. Owner training agenda and scheduling.
 4. TC/BAS system acceptance procedures.

3.03 IDENTIFICATION AND MARKING

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each control panel, field device, and splice.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached identifying it as control panel number, system served, area served, fed from lighting panel number, circuit number, etc.
- E. Identify all control air tubing at each control panel and field device.

3.04 OWNER INSTRUCTION AND TRAINING

- A. Provide a minimum of sixteen (16) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
- D. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.05 CALIBRATION AND START-UP

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.
- C. The Contractor shall maintain dated and initialed calibration and verification sheets for all DDC inputs and outputs, and shall provide a copy to the Owner.
 - 1. DDC sensor calibration sheets shall list, for each sensor, the following: point number, sensor location and type, initial sensor reading at DDC, actual measured variable reading (as determined by actual measurement using calibration equipment), and final sensor reading at DDC after calibration.
 - 2. DDC binary input verification sheet shall list, for each binary input, the following: point number, binary device monitored, binary device "on" state verification at DDC, binary device "off" state verification at DDC.
 - 3. DDC binary output verification sheets shall list, for each binary output, the following: point number, binary device controlled, binary device "on" command verification, binary device "off" command verification.
 - 4. DDC analog output verification sheets shall list, for each analog output, the following: point number, device controlled, "fully open" command verification, "fully close" command verification, stable control at setpoint verification.

3.06 ACCEPTANCE PROCEDURE

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

SECTION 23 3113 - METAL DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems in pressure classes from minus 6- to plus 6-inch wg (minus 1500 to plus 1500 Pa).
- B. Products Installed but Not Furnished Under This Section:
 - 1. Terminal boxes which are to be furnished by the Laboratory Airflow Controls Contractor shall be installed by the Mechanical Contractor. Refer to Division 23 Section "Laboratory Airflow Controls."

1.03 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. FRP: Fiberglass-reinforced plastic.
- E. NUSIG: National Uniform Seismic Installation Guidelines.
- F. PVC: Polyvinyl Chloride.

1.04 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.06 SUBMITTALS

- A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Duct layout indicating sizes and pressure classes.
 3. Elevations of top and bottom of ducts.
 4. Dimensions of main duct runs from building grid lines.
 5. Fittings.
 6. Reinforcement and spacing.
 7. Seam and joint construction.
 8. Penetrations through fire-rated and other partitions.
 9. Equipment installation based on equipment being used on Project.
 10. Duct accessories, including access doors and panels.
 11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
- B. Welding certificates.
- C. Field quality-control test reports.
- 1.07 QUALITY ASSURANCE
- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
 - B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
 - C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
 - D. NFPA Compliance:
 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- 1.08 COORDINATION
- A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
 - B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

PART 2 PRODUCTS

- 2.01 MANUFACTURERS
- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- 2.02 SHEET METAL MATERIALS
- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 (Z180) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 (Z180) coating designation. Factory-applied PVC coatings shall be 4 mils (0.10 mm) thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 4 mils (0.10 mm) thick on opposite surfaces.
- D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

2.03 SEALANTS AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Elastomeric Sealant Tape: 3 inches (75 mm) wide; modified butyl adhesive backed.
 - 1. Manufacturers:
 - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.
- C. Water-Based Joint and Seam Sealant:
 - 1. Manufacturers:
 - a. Hardcast; Flex-Grip 550 and Versa-Grip 181.
 - b. Polymer Adhesives; No. 11.
 - c. United McGill.
 - 2. Application Method: Brush on.
 - 3. Solids Content: Minimum 65 percent.
 - 4. Shore A Hardness: Minimum 20.
 - 5. Water resistant.
 - 6. Mold and mildew resistant.
 - 7. VOC: Maximum 75 g/L (less water).
 - 8. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 - 9. Service: Indoor or outdoor.
 - 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), 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. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch (3.2 mm) thick, full face, one piece vulcanized or dovetailed at joints.

2.04 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
 - 1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
 - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
- E. Load Rated Cable Suspension System: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
 - 1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
 - a. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
 - b. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
 - 2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
 - 3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
 - 4. Manufacturers:
 - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - b. Duro Dyne Corp.; Dyna-Tite System.
 - c. Gripple Inc.; Hang-Fast System.
- F. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

2.05 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

2.06 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Spiral Lock-Seam Ducts:
 - 1. Manufacturers:
 - a. Eastern Sheet Metal (ESM).
 - b. Foremost Duct, LLC.
 - c. LaPine Metal Products.
 - d. Lindab Inc.
 - e. McGill AirFlow Corporation.
 - f. SEMCO Incorporated.
 - g. Tangent Air, Inc.
 - h. Universal Spiral Air.
- C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
 - 1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- D. Duct Joints:
 - 1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
- E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
 - 1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 - 2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- F. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)
 - 1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
 - 2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
 - 3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
 - 4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- G. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- H. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- I. Fabricate elbows using die-formed, gored, or pleated construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
2. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
3. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
4. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).
- J. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
 1. Round Elbows 4 to 8 Inches (100 to 200 mm) in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
 2. Round Elbows 9 to 26 Inches (225 to 660 mm) in Diameter: Standing-seam construction.
 3. Round Elbows 28 to 60 Inches (710 to 1525 mm) in Diameter: Standard gored construction, riveted and bonded.
 4. Other Fittings: Riveted and bonded joints.
 5. Couplings: Slip-joint construction with a minimum 2-inch (50-mm) insertion length.

PART 3 EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).
 - N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
 - O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- 3.03 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS
- A. Repair damage to PVC coating with manufacturer's recommended materials.
- 3.04 SEAM AND JOINT SEALING
- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
 - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
 - 2. Seal ducts before external insulation is applied.
 - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for allowable leakage rates.
- 3.05 HANGING AND SUPPORTING
- A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
 - B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
 - C. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.
 - D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
 - E. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
 - F. Use load rated cable suspension system for round duct in exposed locations.
- 3.06 CONNECTIONS
- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
 - B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- 3.07 FIELD QUALITY CONTROL
- A. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 3300 - DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
 - 3. Division 23 Section "Temperature Controls" for motorized control dampers.

1.02 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Special fittings.
 - 2. Manual-volume damper installations.
 - 3. Wiring Diagrams: Power, signal, and control wiring.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

2.03 LOW PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating.
 - 2. Arrow United Industries.
 - 3. Greenheck.
 - 4. Krueger.
 - 5. Louvers and Dampers.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Company, Inc.
 - 9. Young Regulator Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

2.04 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

- A. Manufacturers:
 - 1. Flexmaster Type 8M, UL 181, Class 1.
 - 2. Automation Industries Thermaflex.
 - 3. Hart & Cooley.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
- C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.
- D. Acoustical performance tested in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

2.05 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
 - 1. Automation Industries Thermaflex; FlexFlow Elbow.
- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

PART 3 EXECUTION

3.01 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Provide balancing dampers where indicated on drawings. Install at a minimum of two duct widths from branch takeoff.
- D. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- G. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
 - 1. Use manufactured double-vane turning vanes unless otherwise specified.
 - 2. Seat outboard-most vane in heel of duct elbow.

3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
4. Use single-vane turning vanes in low pressure square elbows.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

3.03 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3500 - SPECIAL EXHAUST SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Motors."
 - 3. Division 23 Section "Common Work Results for HVAC" for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

- A. Operating Limits: Classify according to AMCA 99.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.06 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

PART 2 PRODUCTS

2.01 ROOF MOUNTED LABORATORY EXHAUST FANS

- A. Roof Mounted Laboratory Exhaust Fans (Bottom Inlet, Tubular Centrifugal):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Greenheck; Vektor-H.
 - b. Loren Cook Company: Vari-Plume TCNH-LE.
 - c. M.K. Plastics Corporation; KVC High Plume Fan.
 - 2. Description: Bottom inlet roof mounted laboratory exhaust fans:
 - a. Direct or V-belt driven as indicated on Drawings.
 - b. Equipped with lifting lugs.
 - c. Fan stand to be coated steel with a minimum of 4 mils of chemically resistant polyester resin or epoxy.
 - d. Fasteners: Type 316 stainless steel.
 - 3. Fan Housing and Outlet:
 - a. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 - b. Fan housing to be manufactured of coated steel with a minimum of 4 mils of chemically resistant polyester resin or epoxy. No uncoated metal fan parts shall be allowed.
 - c. High velocity conical discharge manufactured of coated steel with a minimum of 4 mils of chemically resistant polyester resin or epoxy.
 - d. Provide housing drain attached at the lowest point for condensation removal.
 - e. An access door or panel shall be supplied for impeller inspection and service.
 - f. Standard finish color to be light gray.
 - 4. Fan Impeller:
 - a. Fan impeller shall be centrifugal, backward inclined, of airfoil design with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically Grade G6.3 per AMCA Standard.
 - b. Fan impeller shall be manufactured of steel and coated with a minimum of 4 mils of chemically resistant polyester resin or epoxy.
 - 5. Fan Bypass Air Plenum:

- a. For constant volume systems, the fan shall be connected directly to the exhaust duct without the need of a bypass air plenum.
 - b. The plenum shall be constructed of fully welded steel, and coated with a minimum of 4 mils of chemically resistant polyester resin or epoxy, and mounted on roof curb as shown on the project drawings. Plenums that are fabricated of plastics or resins that are combustible and have mechanical properties less than steel shall not be acceptable.
 - c. The bypass air plenum shall be mounted on factory fabricated roof curb provided by the fan manufacturer, as shown on the project drawings.
 - d. Fan designs that use inlet flexible connectors that can leak causing loss of lab exhaust shall not be accepted.
 - e. A fan isolation damper, either gravity back draft or two position actuated, fabricated of steel or aluminum and coated with minimum 4 mils of chemically resistant polyester resin or epoxy, electro-statically applied and baked, shall be provided as shown on the project documents.
 - f. Blower/Plenum vibration isolation shall be limited to neoprene or cork vibration pads.
 6. Bypass Air Plenum Curb:
 - a. Exhaust system manufacturer shall supply a structural support curb for the plenum, of specified height, as shown on the drawings.
 - b. Curb shall be fabricated of a minimum of 12 gauge corrosion resistant coated steel and structurally reinforced.
 - c. Vertical exhaust inlet plenums shall have curbs that are insulated. Horizontal exhaust inlet plenums shall have un-insulated plenums.
 - d. When properly anchored to the roof structure, the standard curb / plenum / blower assembly shall withstand wind loads of up to 125 mph without additional structural support.
 7. Fan Motor and Drive
 - a. Motors: TEFC with a 1.15 service factor.
 - b. Shaft: ANSI C-1045 steel, protected with TECTYL 822B protective coating.
 - c. Refer to Division 20 Section "Motors" for additional requirements.
 8. Fan shaft bearings to be selected according to bearing manufacturers recommendations and be sized for an L_{10} life of 200,000 hours. Bearings shall be ball or spherical pillow block type, sealed to retain lubricant and exclude dust and air. Include assembly drawings, bearing data including replacement sizes and lubrication instructions. Provide full fan and bearing vibration signature data with maximum acceptable displacements and velocities at each bearing. Provide listing of each bearing ball pass, inner race, and outer race defect frequencies.
- 2.02 MOTORS
- A. Comply with requirements in Division 20 Section "Motors."
 - B. Enclosure Type: Totally enclosed, fan cooled.
- 2.03 SOURCE QUALITY CONTROL
- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install packaged exhausters level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 7 Section "Roof Accessories" for installation of roof curbs.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to packaged exhausters to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 9. Shut unit down and reconnect automatic temperature-control operators.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION

SECTION 23 3600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Metal Ducts."
 - 3. Division 23 Section "Temperature Controls."

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For air terminal units to include in operation and maintenance manuals. Include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.03 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.04 COORDINATION

- A. Coordinate layout and installation of air terminal units 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.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers:
 1. Anemostat; a Mestek Company.
 2. Krueger; Tomkins PLC.
 3. Nailor Industries of Texas Inc.
 4. Price Industries.
 5. Titus; Tomkins PLC.
 6. Tuttle & Bailey; Tomkins PLC.
- B. Configuration: Variable and constant volume, medium pressure terminal units with casing, 100 percent tight shutoff volume regulator, velocity sensor, and sound attenuating thermal insulation.
- C. Casing: Constructed of 0.034-inch mill galvanized steel or 0.032-inch aluminum.
 1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections, size matching inlet size.
 4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
- E. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.
- F. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."
- G. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.03 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- 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.

2.04 SOURCE QUALITY CONTROL

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.
- B. Verification of Performance: Rate air terminal units according to AHRI 880.
- C. Acoustical Applications and Sound Evaluation: Based on AHRI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

PART 3 EXECUTION

3.01 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.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Refer to Division 20 Section "Hangers and Supports" for additional information.
 - 1. Where practical, install concrete inserts before placing concrete.
- 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.

3.03 CONNECTIONS

- A. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 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.
- B. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

- A. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 2. Verify that controls and control enclosure are accessible.
 - 3. Verify that control connections are complete.
 - 4. Verify that nameplate and identification tag are visible.
 - 5. Verify that controls respond to inputs as specified.

3.06 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

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 23 Section "Duct Accessories" for volume-control dampers not integral to diffusers, registers, and grilles.

1.02 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.01 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Anemostat; a Mestek Company.
 - 2. Krueger; Tomkins PLC.
 - 3. Nailor Industries of Texas Inc.
 - 4. Price Industries.
 - 5. Titus; Tomkins PLC.
 - 6. Tuttle & Bailey; Tomkins PLC.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Air diffusion devices shall be standard off white baked enamel finish unless noted otherwise. Provide air diffusion device interior surfaces, including blank-offs, with black matte finish.
- D. Air pattern adjustments shall be made from the face of the device.
- E. Refer to drawings and schedules for quantities, types, and finishes.
- F. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.02 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."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 3900 - CANOPY HOODS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Canopy hoods.

1.02 REFERENCE STANDARDS

- A. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

1.03 SUBMITTALS

- A. 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 instructions, adjusting and balancing methods.
- B. Shop Drawings: For each custom fabricated unit, provide drawings showing details of construction, dimensions, and interfaces with adjacent construction.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.01 HOOD APPLICATIONS

- A. Canopy Hood: Custom-fabricated.
 - 1. Hood Configuration and Size: As indicated on the drawings.
 - 2. Exhaust Duct Size: Coordinate with size and connection indicated on HVAC drawings and specifications.

2.02 HOOD CONSTRUCTION

- A. Canopy Hoods: Provide hoods with all joints and seams liquid-tight.
 - 1. Inside the bottom perimeter provide an integral formed condensate gutter:
 - 2. Gutter Dimensions: 1 1/2 inches wide with 1 1/2 inch flange turned up at 90 degree angle.
 - 3. Drain: Stainless steel, one inch diameter, located in back corner of gutter. Provide drain line from gutter to adjacent drain, coordinate location with Architect.
- B. Construction: All materials, inside and out, stainless steel complying with ASTM A 666, Type 304, stretcher leveled; unless otherwise indicated.
 - 1. Sheet Thickness: 18 gage, 0.048 inch, minimum.
 - 2. Fabrication: Fabricate each individual hood in one piece, with all welds continuous, ground flush and finished to match (inside and out).
 - 3. Seams to be fully welded and ground smooth for the length of the seam. Tack welds are not acceptable.
 - 4. Finish on Surfaces Exposed to View: No.4 (brushed directional); provide stainless steel faces on all sides exposed to view.
 - 5. Finish on Concealed Surfaces: No.4 or No.2B (dull, matte).
 - 6. Duct Collars: For exhaust and make-up air openings, provide duct collar welded to hood unit; minimum of 8 inches extension from top or back face of unit, with minimum one inch 90 degree flange, unless otherwise indicated. Coordinate type of connection with HVAC exhaust ductwork.
 - 7. Supports: Stainless steel mounting brackets, struts, and threaded hanger rods.

- a. Hanger Rods: 3/8 inch diameter, minimum.
- b. Hanger Spacing: 48 inches on center, maximum.
- c. Attachment to Structure: Concealed mechanical fittings or inserts, stainless steel.
- 8. Accessory Panels: Where indicated, provide filler and closure panels of same construction as hoods, to close spaces between hoods and adjacent construction; mount with panel face flush with face of hood.
 - a. Where top of ceiling hung hood is lower than the finished ceiling, provide panels to close space between top of hood and ceiling.
 - b. Where back of hood must be set away from wall, provide filler panels to close space between hood and wall.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that overhead supports are installed in correct locations.
- B. Do not begin installation until substrates 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 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.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and NFPA 96.
- B. Install hoods level and plumb, securely fastened, with seismic restraints as specified, and free of vibration during normal operation.
- C. Continuously weld hood duct collars to ductwork, liquid-tight.
- D. Connect to utilities.
- E. Coordinate with other trades for connections and location of other utilities.
- F. Supports and attachments for supports are to be concealed above ceiling.

3.04 CLEANING

- A. Clean surfaces of equipment.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 23 8216 - HEATING AND COOLING COILS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. Division 20 Section "Basic Mechanical Materials and Methods."

1.02 SUMMARY

- A. This Section includes duct-mounted heating and cooling coils.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each coil. Include rated capacity and pressure drop for each coil.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance:
 - 1. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 - 2. Comply with applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 PRODUCTS

2.01 WATER COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerofin Corporation.
 - 2. McQuay International.
 - 3. York International.
- B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.
- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.020 inch wall thickness, and minimum 0.50 inch diameter.
- F. Fins: Aluminum, minimum 0.010 inch thick.

- G. Headers: Cast iron with cleaning plugs, and drain and air vent tappings or seamless copper tube with brazed joints, prime coated.
- H. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.0625 inch (1.6 mm) thick for slip-in mounting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.03 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 coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Laboratory Airflow Controls," and other piping specialties are specified in Division 22 Section "Hydronic Piping."

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SUMMARY

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
 - 1. A.N.S.I. - American National Standards Institute
 - 2. A.S.T.M. - American Society for Testing Materials
 - 3. I.C.E.A. - Insulated Cable Engineers Association
 - 4. I.E.E.E. - Institute of Electrical and Electronics Engineers
 - 5. N.E.C. - National Electrical Code
 - 6. N.E.C.A. - National Electrical Contractors Association
 - 7. N.E.M.A. - National Electrical Manufacturer's Association
 - 8. U.L. - Underwriters Laboratories, Inc.
 - 9. N.E.C.A. 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."

1.04 QUALITY ASSURANCE

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
 - 1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
 - 2. The Contractor understands that the work herein described shall be complete in every detail.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
 - 1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

1.05 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.06 DRAWINGS

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.
- C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 ITEMS REQUIRING PRIOR APPROVAL

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
 - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
 - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- D. Submit for approval shop drawings for all electrical systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical Specifications for additional requirements.
 - 1. Lighting Control Devices
 - 2. Fuses
 - 3. Interior Lighting
 - 4. Enclosed Controllers
 - 5. Enclosed Switches
 - 6. Communications Backbone Cabling
 - 7. Communications Horizontal Cabling
 - 8. Wireless Clock And Program System
 - 9. Fire Alarm

1.11 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
- C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Trouble-shooting procedures.
 - 3. Contractor's telephone numbers for warranty repair service.
 - 4. Submittals.
 - 5. Recommended spare parts lists.

6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.12 RECORD DRAWINGS

- A. Submit record drawings in compliance with Division 1.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.13 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.14 WARRANTY

- A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.
- C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.15 USE OF EQUIPMENT

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.16 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical 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 location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- C. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 DEMOLITION WORK

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or at the panels.
- F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.
- G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where approved by the Architect/Engineer.
- H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, relamped and reconditioned suitable for satisfactory operation and appearance.

3.03 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.04 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

3.05 DISPOSAL

- A. Fluorescent Lamps
 - 1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
 - 2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.
 - 3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
 - 4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.
- B. Ballasts
 - 1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
 - 2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
 - 3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
 - 4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

3.06 CHASES AND RECESSES

- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.07 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.

- B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.08 EQUIPMENT CONNECTIONS

- A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.09 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

3.11 EXTRA WORK

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, data box, specified surface raceway, fire alarm combination visual/audible notification appliance, fire alarm visual notification appliance, or other devices which may be required for any proposed extra work.

3.12 DRAWINGS AND MEASUREMENTS

- A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

SECTION 26 0519 - CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes:
 - 1. Building wires and cables rated 600V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 26 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 SUBMITTALS

- A. Field Quality-Control Test Reports

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for types THHN/THWN-2, and SO.
- C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Metal-clad cable, Type MC and Type SO with ground wire.
- D. Power Cable for Variable Frequency Controlled Motors: 600V and 2000V, three conductor, XLPE cable with three symmetrical positioned ground conductors and a continuous impervious corrugated aluminum armor and overall PVC jacket. Cable shield transfer impedance shall be less than 10 ohms per meter up to 30 MHZ when tested in accordance with NEMA WC 61.
 - 1. Approved manufacturers for VFC power cables:
 - a. Southwire Armor-x
 - b. Draka USA

2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 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. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFC cable, which shall be extra flexible stranded.
- C. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- D. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾"C.
- E. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.

3.02 CONDUCTOR AND INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Branch Circuits, including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- B. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway. Type THHN/THWN-2, single conductors in raceway and metal-clad cable, Type MC, for branch circuit drops to devices and within partition walls. MC cable shall not be run in ceiling space in lengths greater than 6'-0".
- C. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN/THWN-2, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
- E. Fire Alarm Circuits: Type THHN/THWN-2, in raceway and power-limited, fire-protective, signaling circuit cable.
- F. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.
- G. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.
- H. Connection between Variable Frequency Controllers and Motors: Use 600V rated VFC power cable for circuit lengths less than 50 feet and 2000V rated VFC power cable for circuit lengths 50 feet and greater. Support 5' on center, minimum. Terminate according to cable manufacturer's recommendations.

3.03 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 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

- G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.
- H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- J. Branch circuits may be combined up to 3 circuits in a homerun conduit.
- K. Provide a separate neutral conductor for each circuit.
- L. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable.
- M. Type MC cable shall be supported and secured at intervals not exceeding 4'-0".
- N. AC/MC cable shall not be used for home runs to receptacle or distribution panels.
- O. Where AC/MC cable is stacked in cable tray, or bundled, without spacing, the contractor shall apply the appropriate de-rating factors to the conductors.
- P. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.
- Q. Do not route conductors across roof without prior approval from engineer. Where approved, conductors shall be installed in rigid steel conduit and shall be de-rated for ambient temperature per the NEC.

3.04 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 and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
 - 2. Use compression type terminations for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
- D. Clean conductor surfaces before installing lugs and connectors.
- E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- G. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
- H. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 0553 "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.

3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.07 FIELD QUALITY CONTROL

- A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Visual and Mechanical Inspection
 - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
 - b. Test cable mechanical connections with an infrared survey.
 - c. Check cable color-coding against project Specifications and N.E.C. requirements.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Conductors and Cables".

1.03 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- G. IEEE 837: Qualifying Permanent Connections Used in Substation Grounding.
- H. IEEE 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
- I. IEEE C2: National Electrical Safety Code.
- J. NETA MTS – 2001: Maintenance Testing Specifications.
- K. NFPA 70: National Electrical Code.
- L. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- M. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- N. UL 467: Grounding and Bonding Equipment.
- O. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.
- C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- E. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".

- F. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 - 2. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.

2.02 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.

2.03 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.
- D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

PART 3 EXECUTION

3.01 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. In raceways, use insulated equipment grounding conductors.
- C. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- E. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- H. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.02 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations
 - 1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 - 2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- D. Tighten screws and bolts for grounding and bonding 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.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

3.03 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- C. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- D. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- E. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.
- F. Bond together metal building elements not attached to grounded structure; bond to ground.

3.04 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 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, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 4. Channel Dimensions: Selected for applicable load criteria.
 - B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
 - C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
 - D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) 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.
- 2.02 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 Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 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 or as scheduled in NECA 1. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support 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:
 - a. Two-bolt conduit clamps
 - b. Single-bolt conduit clamps

- D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 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 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:
 - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
 - c. Spring-tension clamps.
 - 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 support systems attached to substrate.
- E. Slotted support systems applications:
 - 1. Indoor dry and damp Locations: Painted Steel
 - 2. Corrosive Environments, including pool equipment rooms: Nonmetallic
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- H. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- I. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- J. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- K. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- L. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- M. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "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.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 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

SECTION 26 0533 - RACEWAYS AND BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
 - 2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.
- F. PVC: Polyvinyl Chloride.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.05 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflec Inc.
 - 3. Allied Tube Triangle Century.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. International Metal Hose.
 - 6. Electri-Flex Co
 - 7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.

9. Maverick.
 10. O-Z Gedney; unit of General Signal.
 11. Wheatland.
 - B. Rigid Steel Conduit: ANSI C80.1.
 - C. IMC: ANSI C80.6.
 - D. EMT: ANSI C80.3.
 - E. FMC: Zinc-coated steel.
 - F. LFMC: Flexible steel conduit with PVC jacket.
 - G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel, set-screw type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- 2.02 FIRE ALARM EMT
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allied Tube Triangle Century.
 - B. EMT conduit with bright red topcoat; Fire Alarm EMT.
 - C. EMT and Fittings: ANSI C80.3.
- 2.03 METAL WIREWAYS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hoffman.
 2. Square D.
 - B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.
 - C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
 - E. Wireway Covers: Screw-cover type.
 - F. Finish: Manufacturer's standard enamel finish.
- 2.04 SURFACE RACEWAYS
- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
 - e. Mono-Systems, Inc.
 - B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

2.06 SLEEVES FOR RACEWAYS

- 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 with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.07 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

3.01 RACEWAY APPLICATION

- A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.
- B. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- 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.
 - 2. EMT: Use setscrew, fittings. Comply with NEMA FB 2.10.
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Install surface raceways only where indicated on Drawings.

3.02 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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. 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.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- 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. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- R. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. 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.
- S. 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.
- T. Provide pull string and 25% spare capacity in every branch circuit conduit.
- U. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-

degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical conduit (LB's) are not permitted.
 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
 3. Conduits shall contain no continuous sections longer than 100 ft. without a pull point/box.
 4. The bend radius of conduit must be at least 6 times the internal diameter for a conduit 2 inches or less and a radius of 10 times the diameter for a conduit greater than two inches.
 5. All conduit ends shall have an insulated bushing.
- V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
 3. Where conduits pass between spaces that are maintained at two different vapor pressures.
 4. Where otherwise required by NFPA 70.
- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- X. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- Y. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Do not route feeders across roof.
- DD. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
- EE. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.
- 3.03 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS
- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."
 - 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. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
 - E. 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.
 - F. Cut sleeves to length for mounting flush with both surfaces of walls.
 - G. Extend sleeves installed in floors 2 inches above finished floor level.
 - H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
 - I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
 - J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
 - K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
 - L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- 3.04 FIRESTOPPING
- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."
- 3.05 PROTECTION
- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- 3.06 CLEANING
- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Equipment identification labels.
 - 4. Miscellaneous identification products.

1.03 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, 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

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 - 1. Power Circuits: Black letters on an orange field.
 - 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE 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. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch .

2.04 WIRING DEVICE IDENTIFICATION

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 EXECUTION

3.01 APPLICATION

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Fire Alarm System: Red.
 - 2. Security System: Blue and yellow.
 - 3. Telecommunication System: Green and yellow.
 - 4. Control Wiring: Green and red.
- B. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- D. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- E. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
 - 2. Equipment to Be Labeled: If included on project. All items may not be on project.
 - a. Access doors and panels for concealed electrical items.
 - b. Disconnect switches.

- c. Enclosed circuit breakers.
 - d. Motor starters.
 - e. Remote-controlled switches, dimmer modules, and control devices.
- H. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location:
 - 1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
 - 2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.
- C. Apply identification devices to surfaces after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color 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.
- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. 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.
- H. Label information arrangement for 3 lines of text.
 - 1. Line one shall describe the panel or equipment. Line one example: "DP-XX," "RP-XX," "T-XX," "EF-XX," etc.
 - 2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
 - 3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
 - 4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.

I. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100
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- J. Degrease and clean surface to receive nameplates.
- K. Install nameplate and labels parallel to equipment lines.
- L. Secure nameplate to equipment front using screws.
- M. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- N. Identify conduit using field painting where required.
- O. Paint red colored band on each fire alarm conduit and junction box if fire alarm EMT is not used.
- P. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor photoelectric control.
 - 2. Occupancy sensors.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements".
 - 2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.03 REFERENCES

- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
- C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 1449: Transient Voltage Surge Suppressors.
- G. UL 1598: Luminaires.
- H. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.
- C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
- D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
- E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated including physical data and electrical performance.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 - 2. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Description of operation and servicing procedures.

2. List of major components.
 3. Recommended spare parts.
 4. Programming instructions and system operation procedures.
- 1.06 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.
- 1.07 COORDINATION
- 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, fire-suppression system, and partition assemblies.
 - B. Coordinate interface of lighting control devices with temperature controls specified in Division 23
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to the site under provisions of Division 26 Section "Electrical General Requirements".
 - B. Store and protect products under provisions of Division 26 Section "Electrical General Requirements".

PART 2 PRODUCTS

- 2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS
- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.
- 2.02 OCCUPANCY SENSORS
- A. General
 1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
 2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
 3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
 4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
 5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.
 - B. Wall Switch Passive Infrared Occupancy Sensor
 1. Manufacturers:
 - a. Wattstopper PW-100.
 - b. Hubbell Building Automation SOM 101.
 - c. Greengate OSW-P-0451-W.

- d. Sensorswitch WSD.
 - e. Philips LRS2210.
 - 2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
 - a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
 - b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
 - c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes. Ambient light sensing shall be adjustable from 20FC to 300FC, with override.
 - d. Ambient Light Sensor: Integral ambient light sensor to switch off lights when sufficient daylight is present.
 - e. Device Body: White, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with “decora” style switch plate.
 - 3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
 - a. Manufacturers:
 - 1) Perfect Sense PWD.
 - 2) Wattstopper PW-200.
 - 3) Hubbell Building Automation SOM-102.
 - 4) Greengate OSW-P-0451-DMV.
 - 5) Sensorswitch WSD-2P.
 - 6) Philips LRS2215.
 - 7) Leviton ODSOD-IDW.
- C. 360° Ceiling Mounted Dual Technology Occupancy Sensor
 - 1. Manufacturers:
 - a. Wattstopper DT 300
 - b. Hubbell Building Automation “OMNI-DT” Series.
 - c. Greengate OMC-DT-2000-R.
 - d. Sensorswitch CM-PDT-R.
 - e. Philips LRM2255.
 - 2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
 - b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
 - d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - e. Manual override function.
- D. 110° Wall Mounted Dual Technology Occupancy Sensor
 - 1. Manufacturers:
 - a. Wattstopper DT-200
 - b. Hubbell Building Automation “LO-DT” Series.
 - c. Sensorswitch WV-PDT-R/WV-BR.
 - d. Philips LRM2265.

2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
 - a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
 - b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
 - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
 - d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
 - e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
 - f. Manual override function.
- E. Occupancy Sensor Control Units:
 1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
 - a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
 - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
 - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
 - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
 - e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
 - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

PART 3 EXECUTION

3.01 OCCUPANCY SENSOR INSTALLATION

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.
- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.02 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. 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.

3.03 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 0999 - ELECTRICAL TESTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."
 - 2. Division 26 Section "Grounding and Bonding."
 - 3. Division 26 Section "Enclosed Switches."
 - 4. Division 26 Section "Fuses."

1.02 SECTION INCLUDES

- A. A recognized corporately independent N.E.T.A. certified testing firm will be contracted separately by the Owner for the purpose of performing inspections and tests as herein specified. The Electrical Contractor shall be familiar with the work required by the testing agency, fully cooperate with implementation of the acceptance testing program, and provide any work in this section specifically required by the Electrical Contractor.
- B. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.
- C. The test and inspections shall determine suitability for energization.
- D. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.03 REFERENCES

- A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.
 - 1. National Electrical Manufacturer's Association - NEMA
 - 2. American Society for Testing and Materials - ASTM
 - 3. Institute of Electrical and Electronic Engineers - IEEE
 - 4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1996
 - 5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications-MTS-1997
 - 6. American National Standards Institute - ANSI C2: National Electrical Safety Code
 - 7. State and Local Codes and Ordinances
 - 8. Insulated Cable Engineers Association - ICEA
 - 9. Association of Edison Illuminating Companies - AEIC
 - 10. Occupational Safety and Health Administration
 - 11. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
 - d. ANSI/NFPA 101: Life Safety Code

1.04 QUALIFICATIONS

- A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.
- D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.
- E. The Contractor shall submit proof of the above qualifications with bid proposal.
- F. The terms used herewithin such as Test Agency, Test Contractor, Testing Laboratory, or Contractor Test Company, shall be construed to mean the testing organization.
- G. Acceptable Testing Firms:
 - 1. Northern Electrical Testing; Phone (248) 689-8980.
 - 2. Utilities Instrumentation Services; Phone (734) 482-1450.
 - 3. Emerson/High Voltage Maintenance Corporation; Phone (248) 305-5596.
 - 4. Powertech Services, Inc.; Phone (810) 720-2280.
 - 5. Magna Electric; Phone (248) 667-9492.
 - 6. Power Plus Engineering, Inc. Phone (248) 344-0200.

1.05 PERFORMANCE REQUIREMENTS

- A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.
- B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.
- D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.
- E. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.
- F. Safety and Precautions
 - 1. Safety practices shall include, but are not limited to, the following requirements:
 - a. Occupational Safety and Health Act.
 - b. Accident Prevention Manual for Industrial Operations, National Safety Council.
 - c. Applicable state and local safety operating procedures.
 - d. NETA Safety/Accident Prevention Program.
 - e. Owner's safety practices.
 - f. National Fire Protection Association - NFPA 70E.
 - g. American National Standards for Personnel Protection.
 - 2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
 - 3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 TEST INSTRUMENT CALIBRATION

- A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
 2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
 3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
 - b. Laboratory instruments: 12 months
 - c. Leased specialty equipment: 12 months
(Where accuracy is guaranteed by Lessor)
 4. Dated calibration labels shall be visible on all test equipment.
 5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
 6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
 7. Calibrating standard shall be of higher accuracy than that of the instrument tested.
- B. Field Test Instrument Standards
1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
 - a. Maintained in good visual and mechanical condition.
 - b. Maintained in safe, operating condition.
- C. Suitability of Test Equipment
1. All test equipment shall be in good mechanical and electrical condition.
 2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
 3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
 4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
 5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.
- 1.07 TEST REPORTS
- A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:
1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
 2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
 3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
 4. Record of infrared scan and photos showing potential problem locations.
 5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.
- B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

3.01 THERMOGRAPHIC SURVEY

- A. Visual and Mechanical Inspection
 - 1. Remove all necessary covers prior to scanning.
 - 2. Inspect for physical, electrical, and mechanical condition.
- B. Equipment to be Scanned
 - 1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.
- C. Provide report indicating the following:
 - 1. Problem area (location of "hot spot").
 - 2. Temperature rise between "hot spot" and normal or reference area.
 - 3. Cause of heat rise.
 - 4. Phase unbalance, if present.
 - 5. Areas scanned.
- D. Test Parameters
 - 1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
 - 2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 - 3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.
- E. Test Results
 - 1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
 - a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
 - b. Temperature gradients of 37°F to 59°F indicate deficiency; repair as time permits.
 - c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles
 - 2. Ground-fault circuit interrupter receptacles
 - 3. Single- and double-pole snap switches and dimmer switches.
 - 4. Device wall plates.
 - 5. Receptacles with integral USB charger.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.04 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes
- D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- E. NEMA WD 1: General Requirements for Wiring Devices.
- F. NEMA WD 6: Wiring Device – Dimensional Requirements.
- G. UL 20: General-Use Snap Switches.
- H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- I. UL 498: Electrical Attachment Plugs and Receptacles.
- J. UL 943: Ground Fault Circuit Interrupters.
- K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.07 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Configuration 5-20R duplex receptacle.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems 5352.
 - b. ArrowHart Wiring Devices 5352.
 - c. Bryant CBR20.
 - d. Pass & Seymour/Legrand; Wiring Devices Division PS5352.
- B. GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems GF5352.
 - b. Cooper Wiring Devices VGF20.
 - c. Pass & Seymour/Legrand; Wiring Devices Division 2084.
- C. Commercial Grade Tamper Resistant Receptacles with integral USB charger:
 - 1. Configuration: 5-20R, 2P, 3W grounding, straight blade, tamper resistant duplex receptacle with two USB charging ports, decorator style.
 - a. 20A circuit feed through.
 - b. Comply with UL 498 and UL 1310.
 - c. Comply with Part 16 of the FCC rules
 - 2. USB Charging 2.1A, 5VDC dual ports.
 - a. Comply with battery charging specification USB BC1.2
 - b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.
 - c. LED USB power light to indicate charging available
 - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wiring Device- USB20X2-x
 - b. Arrow Hart Wiring Devices – TR7746-x.
 - c. Legrand Pass & Seymour TR5362USB-W.

2.02 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector, NEMA WD 6, device configurations as indicated on drawings, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.03 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.04 WALL SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Incorporated; Wiring Device-Kellems 1220 Series.
 2. ArrowHart Wiring Devices AH1220 Series.
 3. Bryant 4900 Series.
 4. Pass & Seymour/Legrand; Wiring Devices Division PS20AC Series.
- B. Device body: Plastic handle.
- C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.
- E. Provide single-pole, two-pole, three-way and four-way switches as indicated.
- F. Provide pilot light where indicated.
- G. Provide key type where indicated. Furnish four keys to Owner.
- H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 1. Switch: 20 A, 120/277-V ac.
 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.05 DIMMER SWITCHES

- A. General:
 1. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 2. Dimmer switches shall provide full-range, variable control of light intensity utilizing a continuous Square Law dimming curve.
 3. Provide protected memory during temporary power failures that restores lights to same level of intensity set prior to power interruption.
 4. Provide dimmer switches UL listed for the type of load being served (incandescent, fluorescent, magnetic low voltage transformer, electronic low voltage transformer). Universal load-type dimmer switches shall not be acceptable.
 5. Provide dimmers that provide no adverse effects on other components of the electrical system being served (low voltage transformers, ballasts, lamps, etc.).

2.06 WALL PLATES

- A. Manufacturers:
 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:
 - a. 0.035-inch- (1-mm-) thick, satin-finished stainless steel
3. Material for Unfinished Spaces:
 - a. Galvanized steel
4. Material for Wet Locations: Gasketed Cast aluminum with spring-loaded cover, and listed and labeled for use in "wet locations."
 - a. Manufacturers:
 - 1) Red Dot Model CKSUV, Thomas & Betts.
 - 2) ArrowHart WIUM-Series.

2.07 FINISHES

- A. Color:
 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.
 2. Wall Switches: As selected by Architect, unless otherwise indicated.
 3. Dimmer Switches: As selected by Architect, unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging according to manufacturer's written instructions.
- E. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- F. Arrangement of Devices:
 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
 3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 4. Install horizontally mounted receptacles with grounding pole on the left.
 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
 6. Install switches with OFF position down.
- G. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- H. Use oversized plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- J. Remove wall plates and protect devices and assemblies during painting.
- K. Coordinate installation of access floor boxes with access floor system provided by Architectural trades.

- L. Install properly oriented access floor boxes into cutouts in access floor tiles and secure to tiles per Manufacturer's instructions.
- M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect each wiring device for defects.
 - 2. Operate each wall switch with circuit energized and verify proper operation.
 - 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 - 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches, controllers, and motor-control centers.

1.03 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.05 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
 1. Motor Branch Circuits: Class RK5, time delay.
 2. Other Branch Circuits: Class RK1, time delay.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.
- B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- C. Install spare-fuse cabinet(s).

3.03 IDENTIFICATION

- A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Fuses".

1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.03 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.04 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

1.05 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.

4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - B. Shop Drawings: Diagram power, signal, and control wiring.
 - C. Qualification Data: For testing agency.
 - D. Field quality-control test reports including the following:
 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.
 - E. Manufacturer's field service report.
 - F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections, include the following:
 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 2. Time-current curves, including selectable ranges for each type of circuit breaker.
- 1.06 QUALITY ASSURANCE
- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NFPA 70.
- 1.07 PROJECT CONDITIONS
- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- 1.08 COORDINATION
- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Industries, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
 - 2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.03 TOGGLE DISCONNECT SWITCH

- A. Manufacturers:
 - 1. Double Pole:
 - a. Hubbell 1372.
 - b. Leviton 6808G-DAC.
 - c. Pass & Seymour 7812.
 - d. Bryant 30102.
 - 2. Three Pole:
 - a. Hubbell 1379.
 - b. Leviton 7810GD.
 - c. Pass & Seymour 7813.
 - d. Bryant 30103.
- B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.04 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Indoor Dry Locations: NEMA 250, Type 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Install switches with off position down.
- D. Install NEMA KS 1 enclosed switch where indicated for motor loads $\frac{1}{2}$ HP and larger and equipment loads greater than 30A.
- E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than $\frac{1}{2}$ HP and equipment loads 30A. and less.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" (1830 mm) whip.
- H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch (25 mm) from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.
- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.04 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
 - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Test all NEMA AB1, molded case circuit breakers with thermal magnetic trip or auxiliary, solid-state trip units 100A and larger. Certify compliance with test parameters.
 - a. Visual and Mechanical Inspection
 - 1) Circuit breaker shall be checked for proper mounting and compare nameplate data to Drawings and Specifications.

- 2) Operate circuit breaker to ensure smooth operation.
 - 3) Inspect case for cracks or other defects.
 - 4) Check internals on unsealed units.
 - b. Electrical Tests
 - 1) Perform a contact resistance test.
 - 2) Perform an insulation resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
 - 3) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time. Make external adjustments as required to meet time current curves.
 - 4) Determine short time pickup and delay by primary current injection.
 - 5) Determine ground fault pickup and time delay by primary current injection.
 - 6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
 - 7) Perform adjustments for final settings in accordance with coordination study.
 - 8) For circuit breakers 800A and larger, verify all functions of trip unit by means of secondary injection in lieu of primary injection.
 - c. Test Values
 - 1) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
 - 2) Insulation resistance shall not be less than 100 megohms.
 - 3) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) All trip times shall fall within N.E.T.A. Acceptance Testing Specifications, Table 10.7 Circuit breakers exceeding specified trip time at three hundred percent (300%) of pickup shall be tagged defective.
 - 5) Instantaneous pickup values shall be within values shown on N.E.T.A. Acceptance Testing Specifications, Table 10.8 or manufacturer's recommendations.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 3.05 ADJUSTING
- A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.
- 3.06 CLEANING
- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
 - B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
 - 1. Across-the-line, manual and magnetic controllers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
 - 2. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.

1.03 SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each enclosed controller.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. UL listing for series rating of overcurrent protective devices in combination controllers.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For manufacturer and testing agency.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - 1. Routine maintenance requirements for enclosed controllers and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.04 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
- C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- F. NECA 402-2000 – Recommended Practice for Installing and Maintaining Motor Control Centers.
- G. NEMA AB 1 - Molded Case Circuit Breakers.
- H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- I. NEMA KS 1 - Enclosed Switches.
- J. ANSI/NFPA 70 - National Electrical Code.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- D. 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.
- E. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.
- B. Deliver products to site under provisions of Section 26 0100. Store and protect products under provisions of Section 26 0100.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.
- E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.07 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0100.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with interruption of electrical service without Owner's written permission.

1.09 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
 - 2. Indicating Lights: Two of each type installed.
 - 3. Keys: Furnish 2 of each to Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electrical Company; GE Industrial Systems.
 - 3. Siemens/Furnas Controls.
 - 4. Square D.

2.02 ACROSS-THE-LINE ENCLOSED CONTROLLERS

- A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."
 - 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

- B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
 - 1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
 - 2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
 - 3. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
- C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
 - 1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
 - 2. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
 - 3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 VARIABLE FREQUENCY CONTROLLERS

- A. Refer to Division 20 "Variable Frequency Controllers."
- B. Equipment furnished by mechanical trades and installed by electrical trades.

2.04 ENCLOSURES

- A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
 - 1. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.05 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.
- C. Indicating Lights: Run (Red), off or ready (Green).
- D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.
- E. Selector Switch: NEMA ISC 2, mounted in front cover to read "hand/off/auto," provide auxiliary contact for auto position monitoring.
- F. Control Relays: Auxiliary and adjustable time-delay relays.
- G. Elapsed Time Meters: Heavy duty with digital readout in hours.

2.06 FACTORY FINISHES

- A. Finish: Manufacturer's standard gray paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.

3.03 INSTALLATION

- A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
- D. Install motor control equipment and contactors in accordance with manufacturer's instructions.
- E. Select and install heater elements in motor starters to match installed motor characteristics.
- F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.04 IDENTIFICATION

- A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.05 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.06 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters and Motor Control - Adjustable Speed Drive Systems." 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.

3.07 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Sections.

END OF SECTION

SECTION 26 5100 INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures with lamps and ballasts.
 - 2. Exit signs.
- B. Related Sections include the following:
 - 1. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
 - 2. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.03 DEFINITIONS

- A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.
- B. CRI: Color rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
 - 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- E. RCR: Room cavity ratio.

1.04 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Submit as one package, bound together. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
 - 2. Emergency lighting unit battery and charger.
 - 3. Photometric performance data.
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) 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. Suspended ceiling components.
- D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.
- E. Source quality-control test reports.
- F. Field quality-control test reports.

- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Sections include the following:
 - 1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.
 - H. Warranties: Special warranties specified in this Section.
- 1.05 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. Comply with:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
 - 3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
 - 4. Resource Conservation and Recovery Act (RCRA), May 1994.
 - 5. Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
 - 6. Code of Federal Regulations (47 CFR 37342).
 - C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
- 1.06 COORDINATION
- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- 1.07 WARRANTY
- A. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - B. Manufacturer's Special Warranty for T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: One year from date of Substantial Completion.
- 1.08 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. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Battery and Charger: One for each emergency lighting unit.

PART 2 PRODUCTS

- 2.01 FIXTURES AND COMPONENTS, GENERAL
- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
 - B. Metal Parts: Free of burrs and sharp corners and edges.

- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- F. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- G. General:
 - 1. Install ballasts, and specified accessories at factory.
 - 2. Install lamps on project site after fixture installation.
 - 3. Provide factory installed ballast disconnecting means required by NFPA 70.

2.02 LIGHTING FIXTURES

- A. Provide lighting fixtures as included in specification 26 5100A "Lighting Fixture Product Data." This section contains product data sheets from the basis of design manufacturer with annotations.
- B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.
- C. The lighting fixture schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5100A shall govern.

2.03 FLUORESCENT LAMP BALLASTS

- A. Description: Include the following features, unless otherwise indicated:
 - 1. Designed for type and quantity of lamps indicated at full light output except for emergency lamps powered by in-fixture battery-packs.
 - 2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.
- B. Program rapid start electronic ballasts for linear lamps shall include the following features, unless otherwise indicated:
 - 1. Products:
 - a. Advance/Phillips.
 - b. Sylvania/Motorola.
 - 2. Comply with NEMA C82.11.
 - 3. Ballast Type: Programmed rapid start, unless otherwise indicated.
 - 4. Programmed Start: Ballasts with two-step lamp starting to extend life of frequently started lamps.
 - 5. Sound Rating: A.

6. Total harmonic distortion rating of less than 10 percent according to NEMA C82.11. Input current third harmonic content shall not exceed 10%.
7. Transient Voltage Protection: IEEE C62.41, Category A.
8. Operating Frequency: 25 kHz or higher, and operate without visible flicker.
9. Lamp Current Crest Factor: Less than 1.7.
10. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
11. Power factor shall be 90% minimum.
12. Ballast factor shall be .85 to 1.00.

2.04 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. 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.
- D. Provide edge lit signs with a mirror plaque background.

2.05 FLUORESCENT EMERGENCY LIGHTING FIXTURES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Internal Type:
 - a. Philips Emergency Lighting: Philips Bodine.
 - b. Iota.
 - c. Dual Lite.
 - d. Lithonia.
 2. Description: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.
 3. Emergency Connection: Operate one or two fluorescent lamps continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 - a. For any area where only one luminaire is provided for emergency operation, two lamps shall operate under loss of normal power.
 4. Night Light Connection: Operate one or two fluorescent lamps continuously.
 - a. For any area where a night light also operates as an emergency light and only one luminaire is provided for night light/emergency operation, two lamps shall operate under loss of normal power.
 5. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space. Install remote test switch and plate in adjacent ceiling tile.
 6. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
 7. Charger: Fully automatic, solid-state, constant-current type.

8. Lamp Ratings:

<u>Lamp Type</u>	<u>Minimum Lumen Output (one or two lamps)</u>
F32T8	1350*

* Indicates ratings for minimum output for one and two lamps.

9. Self test electronic circuitry to monitor battery charging current and voltage. Provide audible alarm and L.E.D. to indicate results.

10. Universal transformer to operate at 120 volt or 277 volt.

B. Central Type: Factory installed, full light output, fluorescent emergency ballast to operate lamps indicated from a remote emergency power source.

2.06 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches 1219 mm, 2800 initial lumens (minimum), CRI greater than 80, color temperature of 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- D. Fluorescent Lamp Manufacturers:
 - 1. Osram Sylvania.
 - 2. General Electric.
 - 3. Philips.

2.07 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Electrical Supports" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gauge.
- C. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- D. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- E. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.08 FINISHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Fixtures: Manufacturers' standard, unless otherwise indicated.
 - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
 - 2. Metallic Finish: Corrosion resistant.

2.09 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.
- B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturers instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
- B. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- C. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- D. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Suspended Fixture Support: As follows:
 - 1. Install suspended luminaires and exit signs using pendants supported from swivel hangers except where noted to use chain hangers. Provide pendant length required to suspend luminaire at indicated height.
 - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 3. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 4. Continuous Rows: Suspend from cable.
- I. Adjust aimable fixtures to provide required light intensities.
- J. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- K. Emergency lighting units and fluorescent emergency lighting fixtures with unit battery inverters shall be circuited to unswitched hot leg of adjacent circuit and shall activate on loss of primary power.

3.02 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 and UL 486B.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Examine each luminaire to determine suitability for lamps specified.
- C. Verify normal operation of each fixture after installation.
- D. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- F. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

- G. Check for variance in lamp color temperature throughout project.
- H. Spot check for lamp output level from start up through 10 minute duration and make rotation.

3.04 ADJUSTING

- A. Aim and adjust luminaires as directed by the Architect/Engineer.
- B. Adjust exit sign directional arrows as indicated on Drawings.
- C. Adjust all "low end trim" settings of dimming switches prior to punchlist.
- D. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

3.05 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

END OF SECTION



FEATURES & SPECIFICATIONS

INTENDED USE — For applications that require medium to high light levels such as manufacturing, warehousing, storage, retail or task lighting. Ideal for mounting heights up to 25'.

Attributes: Heavy-duty design for demanding industrial environments. Pressure-lock lampholders enclosed in snap-in turret housing. Available in 4' or 8' lengths. 6" lamp spacing of 2-lamp models, 3" lamp spacing on 3-lamp models. Solid top, 10% or 20% uplight reflectors available, painted after fabrication.

CONSTRUCTION — Die-embossed reflector constructed of heavy gauge cold-rolled steel.

Finish: Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Finish is high-gloss baked white enamel.

ELECTRICAL — Thermally protected, resetting, Class P, HPF, UL listed, CSA Certified ballast is standard. Energy saving and electronic ballasts are sound rated A.

Fixture is suitable for damp locations. AWM, TFN or THHN wire used throughout, rated for required temperatures.

INSTALLATION — For surface or suspended mounting, unit or row installation.

LISTINGS — UL Listed for 25°C ambient temperatures. 120V, 277V and MVOLT are UL Listed and CSA Certified (standard). 347V is CSA Certified (see Options). NOM Certified (see Options).

WARRANTY — 1-year limited warranty. Full warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx.

Ballast warranties provided through the component manufacturers.

Actual performance may differ as a result of end-user environment and application.

Note: Specifications subject to change without notice.

APPROVED ALTERNATE MANUFACTURERS:
1. METALUX "DMF" SERIES
2. DAY-BRITE "1F" SERIES

Heavy-Duty Turret Industrial

AF

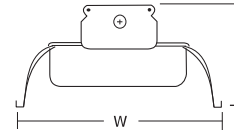
4' or 8' lengths
1, 2, 3 or 4 lamps



Specifications

Length: 49-13/16 (126.5) or
99-5/8 (253.0)
Width: 13-3/8 (34.0)
Height: 6-5/8 (16.8)

All dimensions are inches (centimeters)
unless otherwise indicated.



ORDERING INFORMATION

For shortest lead times, configure product using **bolded options**.

Example: AF 3 32 MVOLT GEB10IS

Series	Number of lamps	Lamp type	Voltage	Options
AFST Solid reflector	1	32 32W T8 (48")	120	Shipped installed in fixture
AF10 10% uplight apertured reflector	2	48 38W T12 slimline (48")	277	GEB Electronic ballast, ≤20% THD ¹
AF 20% uplight apertured reflector	3	96T8 59W T8 slimline (96")	347	GEB10IS T8 electronic ballast, ≤10% THD, instant start
For tandem double-length unit, add prefix T.	4	HQ lamps	MVOLT	GEB10RS T8 electronic ballast, ≤10% THD, rapid start ²
Example: TAF10	Not included	48HO 60W T12 800MA (48")		GEB10PS Electronic ballast, ≤10% THD, programmed start
		48T8HO 60W T8 slimline (48")		EL Emergency battery pack (nominal 300 lumens), see Life Safety Section ³
		96HO 110W T12 800mA (96")		GLR Internal fast-blow fusing (add X for external) ³
		96T8HO 86W T8 300mA (96")		GMF Internal slow-blow fusing (add X for external) ³

PLF_ Plug-in wiring, Specify 1, 2 or 3 branch circuits & hot wires (A = black, B = red, C = blue, AB or AC)
TILW Tandem in-line wiring
CSA CSA Certified (347V only)

Accessories

Order as separate catalog number

ACEP	Full-depth endplates (1 pair)
HRUN	Hooker™ T-bar hanger for 5" channel (flush to ceiling)
HRUN1	Hooker™ T-bar hanger for 5" channel (1-1/2" from ceiling)
SQ_	Swivel stem hanger (specify length in 2" increments)
1B	Ceiling spacer (1-1/2" to 2-1/2" from ceiling).
HC36	Chain hangers (1 pair, 36" long).
THUN	Tong hanger for 5" channel
WGAFPV	Wireguard, 4' white (order 2 for 8' fixtures)
DLAF ME	4' 30° x 30° metal eggcrate louver (order 2 for 8' fixtures)
DLAF A12	4' framed acrylic prismatic lens (order 2 for 8' fixtures)

Notes

- Available for 96 (T12) and 48HO (T12).
- Available for 96HO and 347V.
- Specify voltage.

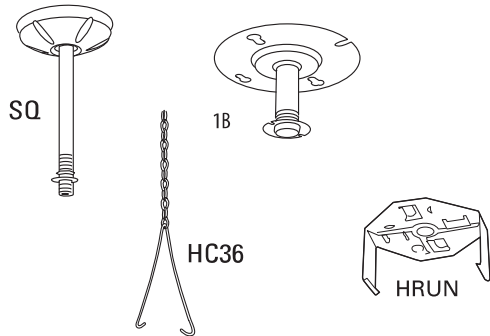
AF

MOUNTING DATA

For unit or row installation. Surface or stem mounting.¹

UNIT INSTALLATION — Minimum of two hangers required.

ROW INSTALLATION — One hanger per fixture plus one per row required.



DIMENSIONS

A = 1/4 x 1/2 (64 x 13) Oval Hole

C = 7/8 (22) Dia. K.O.

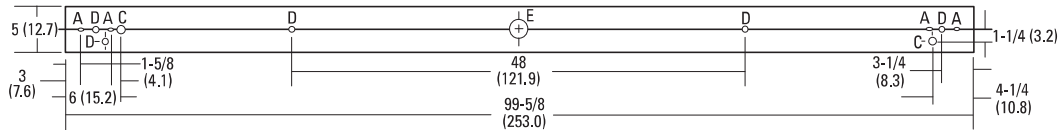
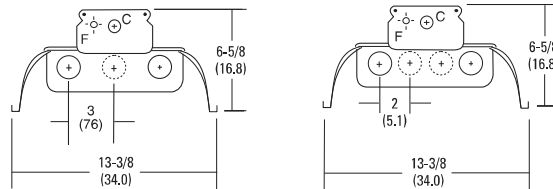
D = 11/16 (17) Dia. K.O.

E = 2 (51) Dia. K.O.

F = 7/16 (11) Dia. K.O.

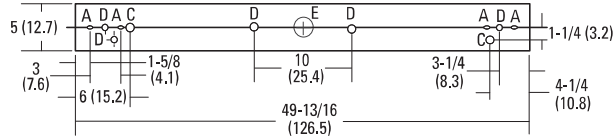
All dimensions are inches (millimeters).

Specifications subject to change without notice.



Energy <small>(Calculated in accordance with NEMA standard LE-5)</small>					
LER.FW	ANNUAL ENERGY COST*	LAMP DESCRIPTION	LAMP LUMENS	BALLST FACTOR	WATTS
74	\$3.24	(2) F32T8	2800	.88	60

*Calculated in accordance with NEMA Standards LE-5.



PHOTOMETRICS

Calculated using the zonal cavity method in accordance with IESNA LM41 procedure. Floor reflectances are 20%. Lamp configurations shown are typical. All data based on 25°C. Full photometric data on these and other configurations available upon request.

AF 2 32

Report ITL 5711

S/MH 1.4

Coefficient of Utilization

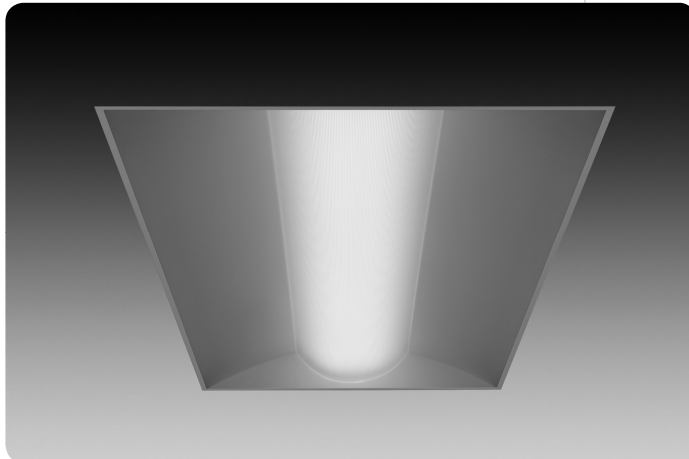
Ceiling	80%			70%			50%		
	70%	50%	30%	70%	50%	30%	50%	30%	10%
1	94	90	86	90	86	83	79	76	74
2	86	79	73	82	75	70	69	65	61
3	78	69	62	74	66	60	61	56	52
4	72	61	54	68	59	52	54	48	44
5	65	54	46	62	52	44	48	41	37
10	43	31	24	41	30	23	28	22	18

Zonal Lumens Summary

Zone	Lumens	%Lamp	%Fixture
0-30	998	17.2	19.0
0-40	1677	28.9	31.9
0-60	3126	53.9	59.6
0-90	4074	70.2	77.6
90-180	1175	20.3	22.4
0-180	5249	90.5	100.0

L1,L1E

amica™ 2x4



features

Architectural recessed LED luminaire.

Sweeping curves and classic lines
compliment architecture.

Amica's center ribbed diffuser masks
LED brightness and image to create even
illumination.

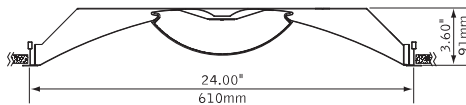
Amica features a shallow 3.6" housing depth
which flies under the radar of most plenum
obstructions.

lens detail



APPROVED ALTERNATE MANUFACTURERS:
1. COOPER "CLASS R2X" SERIES
2. DAY-BRITE "ARIOSO RECESSED LED" SERIES

dimensional data



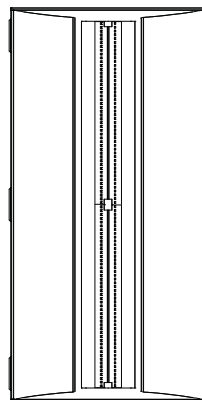
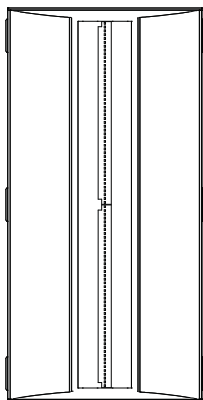
led options



Standard Output (LL1)
Medium Output (LL2)



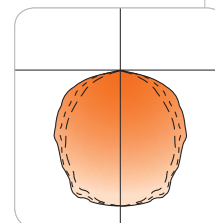
High Output (LL3)



performance

High Output (LL3)
Delivered lumens: 6243lm
Total system watts: 62.9W

Photometric performance is measured
in accordance with IESNA LM-79.



Visit focalpointlights.com for
complete photometric data.

september 2013 A

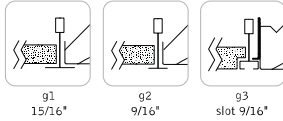
fixture:

project:

mounting information

grid

for lay-in grid, specify G1, G2 or G3.



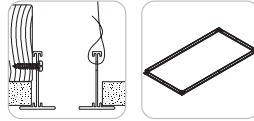
G1
15/16"

G2
9/16"

G3
slot 9/16"

drywall frame kit

specify "DF" Drywall Frame Kit for drywall ceiling conditions.



Use tie-wire or screws to secure frame kit.

cut out dimensions:
2': Min: 24.25"
Max: 24.563"

4': Min: 48.25"
Max: 48.563"

specifications

led system

Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K or 4000K with CRI>80, 0-10V dimming driver standard. LED modules and drivers are replaceable from below.

construction

One piece 20 Ga. steel reflector and housing.
Side access 20 Ga. steel ballast compartment.
Earthquake brackets supplied as standard.

Weight: 25 lbs

optic

20 Ga. steel reflectors finished in matte satin white powder coat.
.095" thick frosted white acrylic lamp diffusers with linear micro-prism pattern.

electrical

Standard 120-277V driver includes 0-10V analog dimming. Power factor > .9.
Optional EcoSystem™ or forward phase dimming drivers from Lutron available.

LED System	Color Temp	Tested System Watts	Delivered Lumens
Standard output	3500K	44.8	4197
Medium output	3500K	66.3	5760
High output	3500K	62.9	6243

* Lumen output may vary +/- 5%. * LL3 output with Lutron drivers reduced by approx. 6%
* Actual wattage may vary +/- 5%

emergency battery

Bodine BSL310-CAN.
Emergency output—10 watts for 90 minutes.

labels

UL and cUL listed.

finish

Polyester powder coat applied over a 5-stage pre-treatment.
Optional Matte Satin White with anti-microbial coating provides 99.99% protection against a broad spectrum of micro-organisms.

Lifetime and warranty

LED system rated for 50,000 hours at 70% lumen output (L70). Rated life and lumen output based on maximum ambient temperature of 25°C. 5 year limited warranty.

ordering

luminaire series FAML

Amica LED FAML

nominal size 24

2' x 4' 24

shielding ACR

Radial Acrylic Diffuser ACR

led system

Standard Output LL1

Medium Output LL2

High Output LL3

color temperature

3000K L30

3500K L35

4000K L40

driver

0-10V Dimming LD1

Lutron® A-Series - EcoSystem™ L3D

Lutron A-Series - Forward Phase LTE
(120 only)

voltage

120 Volt 120

277 Volt 277

mounting

15/16" Grid G1

9/16" Grid G2

9/16" Slot Tee G3

factory options

Air Return AR
(Overall height for luminaire with
Air Return is 4.26")

Chicago Plenum CP

Drywall Frame Kit DF
(Cut out dimensions:
Min: 24.25"/Max: 24.563"
Min: 48.25"/Max: 48.563")

Flex Whip* FW

Emergency Battery Pack
with Integral Test Switch EM

finish

Matte Satin White WH

Matte Satin White
with Anti-Microbial Coating WHA

FOR L1E FIXTURE INDICATED
ON DRAWINGS

* for more information see Reference section.

recessed

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.242.9494 | F: 773.242.9494 | info@focallights.com | www.focallights.com
Focal Point LLC reserves the right to change specifications for product improvement without notification.

Peerless®

L2,L2E



Square LED Indirect/Direct

Type:

Project:

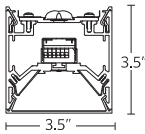
SPECIFICATIONS

Suspended — 3.5" x 3.5"

SQM4

DIMENSIONS

□ SQM4



Lumen Packages:

Specify by Lamp Wattage	LO/LO	HI/LO	LO/HI	HI/HI
Indirect	Low	High	Low	High
Direct	Low	Low	High	High
Total Delivered Lumens*	3500	5150	4850	6500
Distribution Percentage ^{up/down}	50/50	70/30	30/70	50/50
Total Watts*	40	60	60	80

APPROVED ALTERNATE MANUFACTURERS:
1. LUMIUM "HASSIUM 3" SERIES
2. AXIS "BEAM 4" SERIES

Uplight Lumen Packages

Low = 1850 delivered lumens*, 20W
High = 3500 delivered lumens*, 40W

Downlight Lumen Packages

Low = 1650 delivered lumens*, 20W
High = 3000 delivered lumens*, 40W

* nominal per 4'

SPECIFICATIONS

Construction

Extruded aluminum housing is 3.5" square. Extruded aluminum end caps attach mechanically with no exposed fasteners.

Source

Four LED lumen packages (see chart above). Three available color temperature options (3000K, 3500K and 4000K). All within 2.5 MacAdam ellipses.

Optics

Softshine® optical system consists of injection-molded primary optics, co-extruded acrylic lense and metal reflectors. Lenses connect end to end to form a continuous line of light.

Dimming

eldoLED® driver provides smooth, flicker-free dimming down to black (0.1%). Dual circuit (DCT) option for independent indirect and direct dimming.

Finish

Standard finish for housing and end caps is anodized aluminum or gloss white. Consult factory for custom colors.

Controls

Optional nLight-embedded controls allow for constant lumen management (N80) and facilitate simple "plug-and-play" networking and control via CAT-5e cable.

Electrical

eldoLED light engine consists of modular LED boards and 0-10V dimming driver that dims to black rated for 50,000 hours (L80) at 25° C ambient temperature. See chart above for driver input wattage per lumen package.

Specify 120V or 277V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment

Damp location label option. Ambient operating temperature 0° C to 25° C.

Luminaire Length

4' and 8' lengths in a single section for exact suspension spacing of 4' and 8'. For total luminaire length, add 1" for each standard end cap and 2 1/4" for each sculptured end cap. Using internal joiners, 4' and 8' sections can be joined to form longer rows.

Validation

CSA/CUS listed. FCC part 15 certified, LM-79 tested. Lighting Facts partner.

Warranty

Five-year limited warranty coverage includes luminaire construction, LED light engine, driver and nLight control device. Terms and conditions apply.

Packaging

100% post-consumer recycled cardboard box. Biodegradable foam inserts and protective luminaire bag. Recycled kraft paper tape.

CATALOG NUMBER

Example: SQM4 HI/LO 48FT R8 120 EZB SCT LP835 F1/24 C032 PDT1

Fixture	Lamp Wattage	Fixture Row Length	Maximum Section Length	Voltage	Driver Type	# of Emergency Modules	Emergency Type¹
SQM4	LO/LO 1850 nominal delivered-lumens up 1650 nominal delivered-lumens down	X FT (4' increments)	RA 4' section(s) R8 8' section(s)	120 277	EZB eldoLED dims to black	(Blank) None 1SE 1 section 2SE 2 sections XSE X sections	(Blank) None EC Emergency circuit
	LO/HI 1850 nominal delivered-lumens up 3000 nominal delivered-lumens down						
	HI/LO 3500 nominal delivered-lumens up 1650 nominal delivered-lumens down						
	HI/HI 3500 nominal delivered-lumens up 3000 nominal delivered-lumens down						
Switching	LED Color Temperature	Mounting Type	Overall Suspension²	Finish	Options	PROVIDE BATTERY BACKUP FOR L2E LIGHT FIXTURES INDICATED ON DRAWINGS.	
SCT Single circuit DCT Dual circuit (not available with 4 nLight)	LP830 3000K 80+ CRI 17-20+ R9 LP835 3500K 80+ CRI 17-20+ R9 LP840 4000K 80+ CRI 17-20+ R9	F1/ T-bar ceiling (universal mounting bracket) F1A/ T-bar ceiling (UMB with integrated J-box) F2/ Hard ceiling (horizontal J-box)	24 24" 36 36" 48 48" 72 72" XX XX" Overall suspension is measured from ceiling to bottom of fixture	C032 White white (high gloss) C100 Anodized aluminum C099 Custom finish	CFG Configuration, consult factory for drawings CP Chicago plenum (available with F1A only) DL Damp location label GLR Fusing (fast blow) GWF Fusing (slow blow) LW 80% lumen management without networking MCS Matching feed canopy at support N80 nLight nLO with 80% lumen management per row/zone N100 nLight nLO without lumen management per row/zone OJB Offset junction box SCEP Sculptured end cap SLP Sloped ceiling adapter (for 10-45°; must be specified with F2 and OJB options) XXXX Integrated sensor; choose options and obtain code on next page		

Notes:

- Emergency type is installed in last 4' of luminaire sections. Separate feed required
- Adjustable cable gripper comes standard

2246 5th Street, Berkeley, CA 94710 • Tel: 510.845.2760 • Fax: 510.845.2776 • Email: techsupport@peerlesslighting.com • PeerlessLighting.com

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SQM4 Square LED Indirect/Direct 1

Peerless®

Square LED

Indirect/Direct

Type:

Project:

Suspended — 3.5" x 3.5"

SQM4

INTEGRATED nLIGHT MICRO SENSOR

Determine the appropriate sensor type, network type and sensor power source for your application. Enter the code in the Options section of the Catalog Number.

EXAMPLE: PDT1

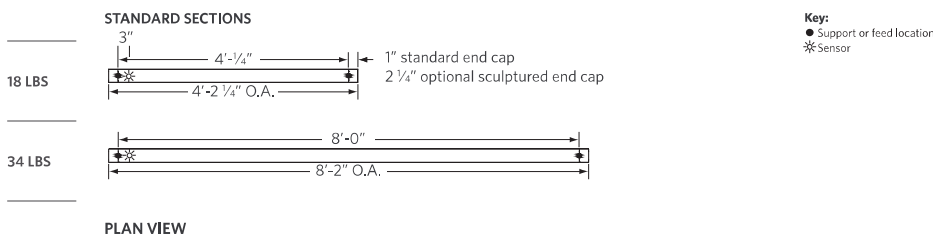
Sensor Type (choose one)		Network Type & Sensor Power Source (choose one)	
ADC nLight model nES ADCX	Daylight Dimming No occupancy sensing	1* nLight-Enabled (Network-Ready) with Luminaire-Integrated Power Pack 10' Cat-5e cable and splitter provided	
PDT nLight model nES PDT7 ADCX	Daylight Dimming and Occupancy Detection	2 Standalone Operation (No Networking) with Luminaire Integrated Power Pack No Cat-5e cable provided	
		3* nLight-Enabled (Network-Ready) with Remote nLight Power Pack or nPanel 10' Cat-5e cable and splitter provided Order required remote nLight Power Pack or nPanel separately through nLight (Acuity Brands Controls)	

For more information about the Integrated nLight Micro Sensor, its capabilities and options, download the PDF guide at: PeerlessLighting.com/nLight-Sensor-Guide

*nLight-Enabled (network-ready) options include one RJ-45 connector on the luminaire, 10 feet of Cat-5e cable to control the entire luminaire row (depending on wattage/voltage limitations), and splitter. The Cat-5e cable drop is located in the same section as the sensor. For multiple zones, please contact techsupport@peerlesslighting.com.

WEIGHTS & SUPPORT SPACING

Suspension spacing equals section length.

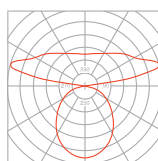


CONFIGURATIONS

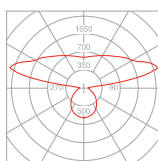
Square can be configured with special mitered sections to provide seamless corner illumination where two luminaires join together. Reference [Pattern Connector Guide](#) for additional details.

PHOTOMETRICS

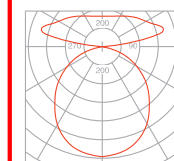
Actual performance may differ as a result of end-user environment and application.



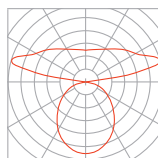
HI/HI LP835
82 lumens per watt
6531 delivered lumens
53% up / 47% down



HI/LO LP835
86 lumens per watt
5272 delivered lumens
68% up / 32% down



LO/HI LP835
83 lumens per watt
4924 delivered lumens
38% up / 62% down



LO/LO LP835
94 lumens per watt
3585 delivered lumens
54% up / 46% down

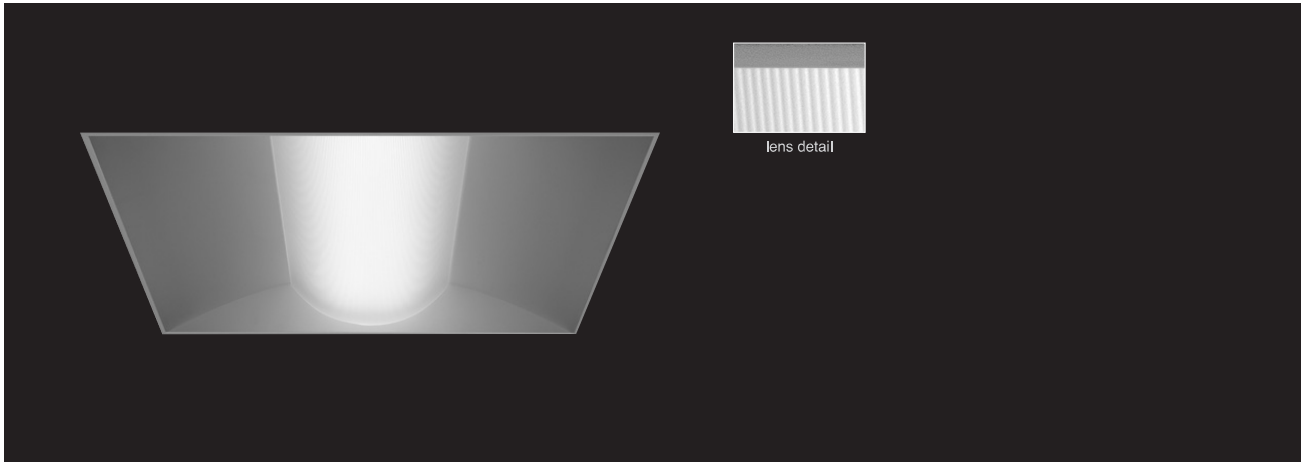
2246 5th Street, Berkeley, CA 94710 • Tel: 510.845.2760 • Fax: 510.845.2776 • Email: techsupport@peerlesslighting.com • PeerlessLighting.com

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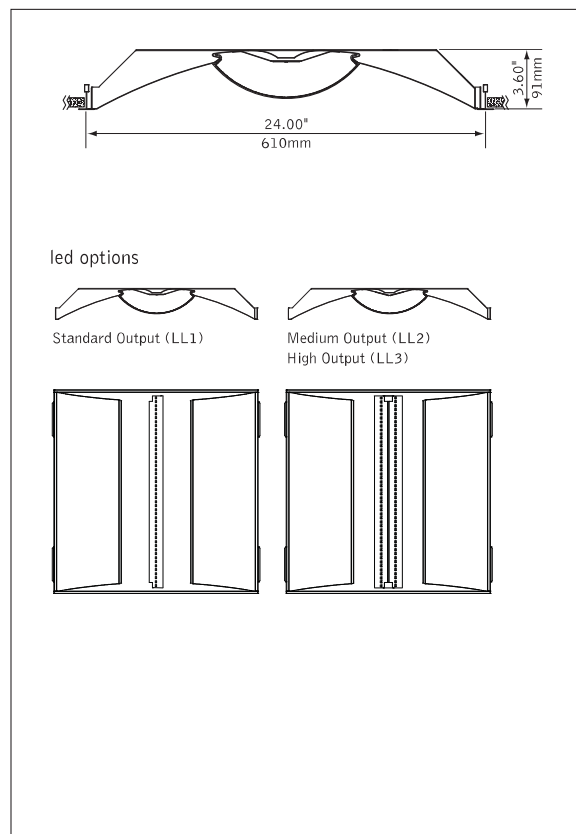
SQM4 Square LED
Indirect/Direct **2**

Amica™ 2x2

LED



DIMENSIONAL DATA



FEATURES

Architectural recessed LED luminaire.

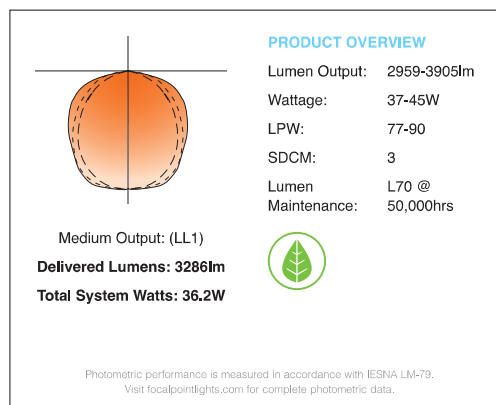
Sweeping curves and classic lines complement architecture.

Amica's center ribbed diffuser masks LED brightness and image to create even illumination.

Amica features a shallow 3.6" housing depth which flies under the radar of most plenum obstructions.

APPROVED ALTERNATE MANUFACTURERS:
1. COOPER "CLASS R2X" SERIES
2. DAY-BRITE "ARIOSO RECESSED LED" SERIES

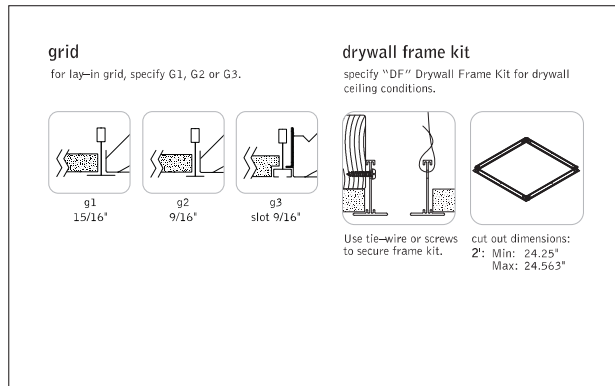
PERFORMANCE



fixture:

project:

MOUNTING INFORMATION



SPECIFICATIONS

LED System

Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K or 4000K with CRI>80, 3 SDCM. 0-10V dimming driver standard. LED modules are replaceable from below.

Construction

One piece 20 Ga. steel reflector and housing. Side access 20 Ga. steel ballast compartment. Earthquake brackets supplied as standard. Unit weight: 17 lbs.

Optic

20 Ga. steel reflectors finished in matte satin white powder coat. .095" thick frosted white acrylic lamp diffusers with linear micro-prism pattern.

Electrical

Standard 120-277V driver includes 0-10V analog dimming. Power factor > .9. Optional EcoSystem™ or forward phase dimming drivers from Lutron available.

Emergency Battery

Bodine BSL310-CAN. Emergency output—10 watts for 90 minutes.

Labels

UL and cUL Listed. Suitable for Dry or Damp Locations, indoor use only.

Finish

Polyester powder coat applied over a 5-stage pre-treatment. Optional Matte Satin White with anti-microbial coating provides 99.99% protection against a broad spectrum of micro-organisms.

Lumen Maintenance

L70 at 50,000 hours.

Warranty

LED system rated for operation in ambient environments up to 25°C. 5 year limited warranty.

PERFORMANCE CHART

LED System	Color Temp	Tested System Watts	Delivered Lumens
Standard output	3500K	38.5	2959
Medium output	3500K	36.2	3286
High output	3500K	44.7	3905

*Lumen output may vary +/- 5%. Actual wattage may vary +/- 5%.

Focal Point LLC reserves the right to change specifications for product improvement without notification.

ORDERING

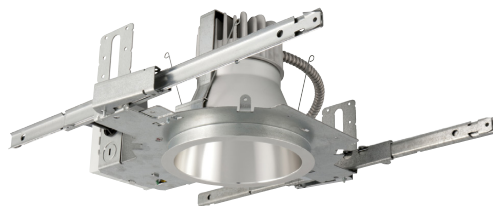
Luminaire Series	FAML
Amica LED	FAML
Nominal Size	22
2' x 2'	22
Shielding	ACR
Radial Acrylic Diffuser	ACR
LED System	
Standard Output	LL1
Medium Output	LL2
High Output	LL3
Color Temperature	
3000K	30K
3500K	35K
4000K	40K
Circuit	1C
Single Circuit	1C
Voltage	
120 Volt	120
277 Volt	277
UNV Volt	UNV
(Cannot be specified with EM option)	
Driver	
0-10V Dimming	LD1
Lutron® A-Series - EcoSystem®	L3D
(2) drivers supplied with LL3, (2) EcoSystem addresses consumed	
Lutron A-Series - Forward Phase	LTE
(120 only) (2) drivers supplied with LL3, (2) loads consumed	
Mounting	
15/16" Grid	G1
9/16" Grid	G2
9/16" Slot Tee	G3
Factory Options	
Air Return	AR
(Overall height for luminaire with Air Return is 4.25")	
Chicago Plenum	CP
Drywall Frame Kit	DF
(Cut out dimensions: Min: 24.25" Max: 24.563")	
Emergency Battery Pack with Integral Test Switch	EM
Flex Whip*	FW
Finish	
Matte Satin White	WH
Matte Satin White with Anti-Microbial Coating	WHA



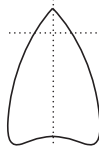
FOR L3E FIXTURE INDICATED ON DRAWINGS

*For more information visit focalpointlights.com/reference or consult factory. Quickship is a limited offering, visit focalpointlights.com/quickship for specifics.

L4,L4E



Luminaire Type:
Catalog Number
(autopopulated):



Gotham Architectural Downlighting
LED Downlights

6" Evo®
Open Reflector

Solid-State Lighting



APPROVED ALTERNATE MANUFACTURERS:
1. PORTFOLIO "LD6A20" SERIES
2. CALCULITE "C6L" SERIES

FEATURES

OPTICAL SYSTEM

- Self-flanged semi-specular, matte-diffuse or specular lower reflector
- Patented Bounding Ray™ optical design (U.S. Patent No. 5,800,050)
- 45° cutoff to source and source image
- Top-down flash characteristic

MECHANICAL SYSTEM

- 16-gauge galvanized steel construction; maximum 1-1/2" ceiling thickness
- Telescopic mounting bars maximum of 32" and minimum of 15", preinstalled, 4" vertical adjustment
- Toolless adjustments post installation
- Junction box capacity: 8 (4 in, 4 out) 12AWG rated for 90°C
- Light engine and driver accessible through aperture

ELECTRICAL SYSTEM

- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours based on IESNA LM-79-2008
- 120-277VAC, 50/60Hz power supply with 0-10V dimming (1.0-100%)
- Overload and short circuit protected
- LEDs tested under LM80

LISTINGS

- Fixtures are CSA certified to meet US and Canadian standards; wet location, covered ceiling

WARRANTY

- 5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

ORDERING INFORMATION

EXAMPLE: EVO 35/10 6AR 120

Series	Color temperature	Nominal lumen values	Aperture/Trim color	Distribution	Finish	Voltage
EVO	27/ 2700 K	10 1000 lumens	6AR Clear	(blank) 1.0 s/mh	(blank) Semi-specular	MVOLT
	30/ 3000 K	14 1400 lumens	6PR Pewter	VND Very narrow (0.5 s/mh)	LD Matte diffuse	120
	35/ 3500 K	18 1800 lumens	6WTR Wheat	ND Narrow (0.6 s/mh)	LS Specular	277
	41/ 4100 K	22 2200 lumens	6GR Gold	MD Medium (0.8 s/mh)		347 ²
			6WR White	WD Wide (1.2 s/mh)		

Driver	Options
(blank) ³ 0-10V dimming driver. Minimum dimming level 10%	SF Single fuse
ECOS2 ^{4,5} Lutron® Hi-Lume® 2-wire forward-phase dimming driver. Minimum dimming level 1%	RRL RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature.
ECOS3 ^{4,4} Lutron® Hi-Lume® 3-wire or EcoSystem® dimming driver. Minimum dimming level 1%	NEPP ⁶ Interface for Sensor Switch® nLight® network provided with integral power supply. Refer to TN-623-01.
	NSD ⁶ Sensor Switch® nLight® one 5A relay with one 0-10 VDC dimming output; requires bus power, such as nPP16 power pack. Refer to nSP5-D.
	TRW ⁷ White painted flange
	TRBL Black painted flange
	EL ^{8,9} Emergency battery pack with integral test switch
	ELR ^{8,9} Emergency battery pack with remote test switch
	CP ¹⁰ Chicago plenum
	BGTD Bodine generator transfer device

ACCESSORIES order as separate catalog numbers (shipped separately)

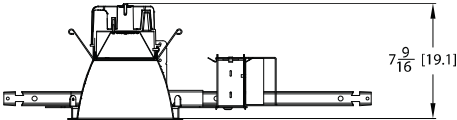
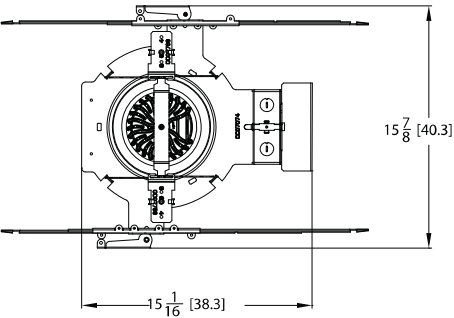
SCA6	Sloped ceiling adapter. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Ex: SCA6 10D. Refer to TECH-190.
CTA4-8 YK	Ceiling thickness adapter (extends mounting frame to accommodate ceiling thickness up to 2").
GVRT	Vandal-resistant trim accessory. Refer to TECH-200.
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.
NSP5 D ER KIT	Sensor Switch nLight secondary relay and dimming pack device used to switch and dim luminaires powered via an emergency circuit. Refer to NSP5 D ER KIT.

6" EVO
Open Reflector
Solid-State Lighting



DIMENSIONAL DATA

All dimensions are inches (centimeters) unless otherwise noted.



Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap Trim: 7-1/2 (19.1)

ELECTRICAL

WATTAGE CONSUMPTION MATRIX		
LUMENS	WATTAGE	LUMENS per WATT
2200	32	67
1800	28	66
1400	25	63
1000	18	61

NOTES

ORDERING NOTES	
1. Not available with finishes.	7. Not available with white reflector.
2. Not valid with emergency options, i.e., EL and ELR.	8. For dimensional changes, refer to TECH-140 . Not available with CP option. Not available with 347V.
3. Refer to TECH-240 for compatible dimmers.	9. Must specify 120 or 277V.
4. Not available with NEPP option.	10. Not available with EL or ELR options.
5. 120V only.	
6. For Emergency generator/inverter applications order non-nLight-enabled fixture and NSP5 D ER KIT as an accessory. Refer to NSP5 D ER KIT .	





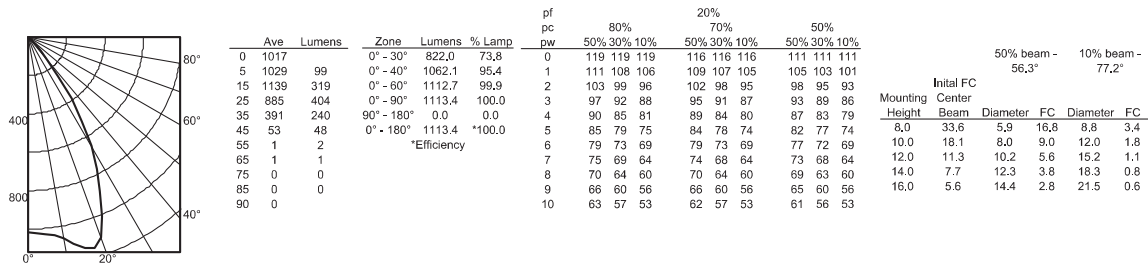
6" EVO
Open Reflector
Solid-State Lighting

PHOTOMETRY

Distribution Curve Distribution Data Output Data Coefficient of Utilization Illuminance: Single Luminaire 30" Above Floor

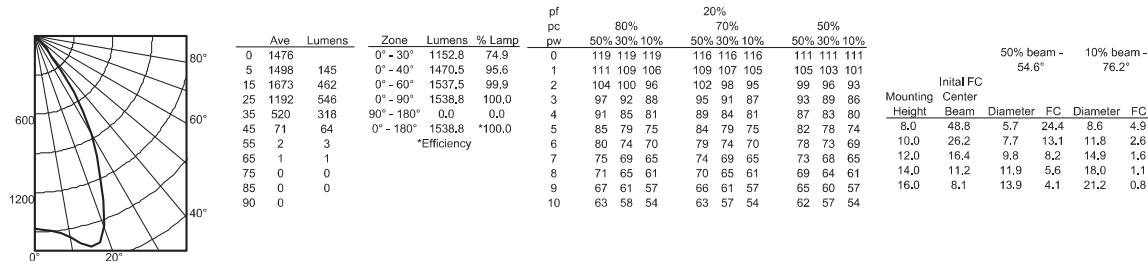
EVO 35/10 6AR LS

INPUT WATTS: 18.4, DELIVERED LUMENS: 1113.4, LM/W=60.5, 1.1 S/MH, TEST NO. LTL21133



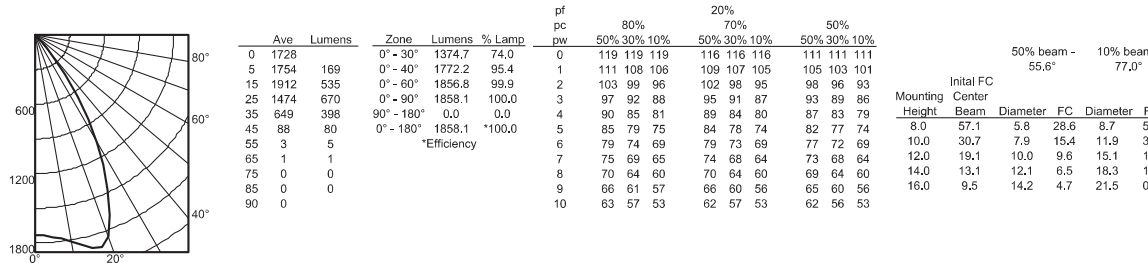
EVO 35/14 6AR LS

INPUT WATTS: 24.6, DELIVERED LUMENS: 1538.8, LM/W=62.6, 1.0 S/MH, TEST NO. LTL21127



EVO 35/18 6AR LS

INPUT WATTS: 28.1, DELIVERED LUMENS: 1858.1, LM/W=66.1, 1.1 S/MH, TEST NO. LTL20947



PHOTOMETRY NOTES

- Tested in accordance with IESNA LM-79-08.
- Tested to current IES and NEMA standards under stabilized laboratory conditions.
- Actual performance may differ as a result of end-user environment and application.
- Actual wattage may differ by +/- 10% when operating between 120-277V +/- 10%.
- CRI: 83 typical.
- Consult factory or IES file for microgroove baffle, black cone or other photometric reports.

DESCRIPTION

Driven by performance and a clean aesthetic, the Straight and Narrow Series in LED represents the ultimate in simplicity; a narrow, uniform line of light. Constructed with premium materials with industry leading technology, the Straight and Narrow family is available in configurable runs and individual lengths of 2', 3', 4', 6' and 8'. Fully compatible with Cooper Controls FifthLight DALI and shipped standard with 0-10V dimming, the Straight and Narrow family integrates seamlessly with today's modern building management systems. With virtually unlimited applications, the Straight and Narrow family allows architects and designers the freedom to experiment with their designs without exceeding ever decreasing energy budgets.

Catalog #		Type
Project		L5,L5E
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction

Housing extruded from premium 6063 aluminum. Nominal 2', 3', 4', 6' or 8' illuminated sections. Used in run configuration and/or individual fixtures. All components are RoHS compliant.

Lens

Available in snap-in or lay-in profiles, two diffusion options are available. Satin white provides the highest aesthetic uniformity while the high transmission lens provides the most superior efficacy.

Finish

Fixture housings are high reflectance white using electrostatically applied polyester powder coat paint.

Electrical

Long-life LED system coupled with electrical driver to deliver optimal performance. LED's are available in 3000K, 3500K or 4000K with a typical CRI ≤ 85 . Projected life is 50,000 hours at 70% lumen output. Electronic drivers are available for 120-277V applications

Controls

Equipped standard with a 0-10V continuous dimming driver compatible with most standard dimming devices (refer to website for specific compatibility reference). Combine with FifthLight DALI and other energy saving products like sensors, daylighting controls and building management systems to maximize energy savings.

Mounting

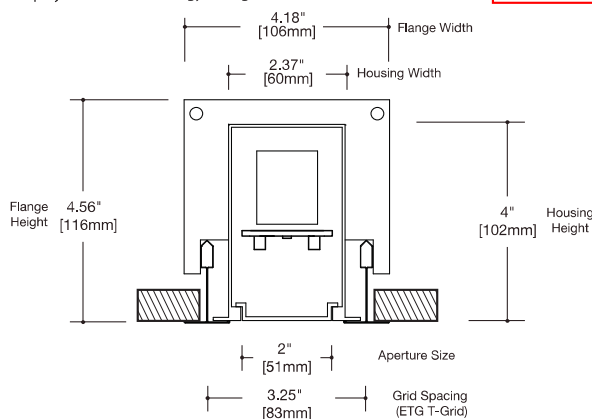
Recessed.
Vertical in wall, Horizontal in wall
and standard ceiling recessed mounting
is available. Please specify mounting grid
or substrate:

(ETG) = 15/16" Exposed T-grid
(FTG) = 9/16" Exposed T-grid
(STG) = 9/16" Screw Slot Grid
(SR) = Sheet Rock (Flanged)
(FSR) = Flangeless Sheet Rock

Warranty

Five year warranty.

APPROVED ALTERNATE MANUFACTURERS:
1. FOCAL POINT "SEEM 2" SERIES
2. AXIS "BEAM 2" SERIES



22-DR
Straight &
Narrow
LED
Recessed
Direct

powered by
fifthlight
technology

ORDERING INFORMATION

Sample Number: S22-DR-2L35-ETG-4-U-DD-S1-S92-W

S22	D	R								
Series S22 = Series 22	Mounting R = Recessed	LED Color Temp L30 = LED, 3000K L35 = LED, 3500K L40 = LED, 4000K	Mounting Type ETG = 15/16" Exposed T-grid FTG = 9/16" Exposed T-grid STG = 9/16" Screw Slot Grid SR = Sheet Rock (Flanged) FSR = Flangeless Sheet Rock	Length 2 = 2 foot Individual 3 = 3 foot Individual 4 = 4 foot Individual 6 = 6 foot Individual 8 = 8 foot Individual xx = Configurable Run (Specify length in 1ft increments)	Driver Options DD = 0-10V Dimming SL1 = FifthLight DALI LUT = Lutron DALI	Emergency Options EM = Battery Pack ² EC = Emergency Circuit	Lens Options S92 = Satin Lay-in Lens S92S = Satin Snap-in Lens ³ S92HT = High Transmission Lay-in Lens S92HTS = High Transmission Snap-in Lens ³	Circuiting Options SI = Single Circuit DU = Dual Circuit	Voltage 1 = 120V 2 = 277V 3 = 347V(remote transformer) U = Universal Voltage	Color Options W = Matte White S = Silver XX = Custom Color
Light Output D = Direct	Light Level LED (3500K) per foot 1 = Light Level 1 ¹ 440 Lumens, 7 Watts, 62 LPW 2 = Light Level 2 ¹ 560 Lumens, 9.25 Watts, 60 LPW									

NOTES:
Not all options available. Please consult your local Cooper Lighting Representative for availability.
Specifications and dimensions subject to change without notice.
1. Light Level measured at 3500K; add 10% lumen output for 4000K or subtract 10% lumen output for 3000K.
2. Battery packs must be remote mounted.
3. Eat, vertical and horizontal in-wall mounting use snap-in lens.

NOTES:

Not all options available. Please consult your local Cooper Lighting Representative for availability.
Specifications and dimensions subject to change without notice.

1. Light Level measured at 3500K; add 10% lumen output for 4000K or subtract 10% lumen output for 3000K.
2. Battery packs must be remote mounted
3. For vertical and horizontal in-wall mounting use snap-in lens

Cooper Lighting
by **E.T.N.**

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Lighting Business
1121 Highway 74 South
Peachtree City, GA 30269
P: 770-486-4800
www.cooperlighting.com

Specifications and dimensions subject to change without notice.

ADN101862
4/15 /2014



FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for applications requiring attractive, thin-profile, die-cast aluminum signage.

CONSTRUCTION — Die-cast aluminum housing, thin profile. Clear lacquer, brushed aluminum inhibits fingerprints and other surface contaminants. Also available with white finish.

Universal directional chevron knockouts are completely concealed and easily removed.

Letters are 6" high with 3/4" stroke, with 100 ft. viewing distance rating, based upon UL924 standards.

OPTICS — The typical life of the exit LED lamp is 10 years.

Low energy consumption: one watt (120/277V).

ELECTRICAL — Dual-voltage input capability 120 or 277 VAC. Emergency models are provided with test switch, status indicator and a battery that automatically recharges when normal power is restored.

Battery: Emergency model provided with sealed, maintenance-free, nickel-cadmium battery that delivers 90 minutes of emergency power.

INSTALLATION — Universal mounting (top, end or back). Mounting knockouts and hole plugs are easily removed. Die-cast aluminum canopy is provided.

LISTINGS — UL Listed standard. Damp location listing 32°F to 122°F (0°C to 50°C) standard. Meets UL 924, NFPA 101 (current Life Safety Code), NFPA 70-NEC and OSHA illumination standards.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Actual performance may differ as a result of end-user environment and application.

Note: Specifications subject to change without notice.

Catalog Number
Notes
Type X

Signature

Thin Die-Cast Aluminum Exit



TLE

LED Lamps



APPROVED ALTERNATE MANUFACTURERS:
1. CHLORIDE "SSL" SERIES
2. ISOLITE "TL" SERIES

ORDERING INFORMATION

All configurations of this product are considered "standard" and have short lead times.

Example: TLE 1 R EL N

TLE				
Family	Housing color	Number of faces	Letter color	Options
TLE	(blank) Brushed aluminum W White	1 Single face 2 Double face	R Red G Green	(blank) AC only; 120/277V EL N 120/277 VAC input with nickel-cadmium battery back-up

Accessories: Order as separate catalog number.	
ELA WG1	Back-mount wireguard ¹
ELA WGEXT	Top-mount wireguard ¹
ELA WGEXE	End-mount wireguard ¹

Notes
1 See spec sheet [ELA-WG](#).

EMERGENCY

TLE

TLE Thin Die-Cast Aluminum Exit

SPECIFICATIONS

ELECTRICAL

Primary Circuit				
Type	Typical LED Life	Supply voltage	Input watts	Max. amps
Red LED, AC only	10 years	120	1	0.1
		277	1	0.1
Green LED, AC only	10 years	120	1	0.1
		277	1	0.1
Red LED, emergency	10 years	120	1	0.1
		277	1	0.1
Green LED, emergency	10 years	120	1	0.1
		277	1	0.1

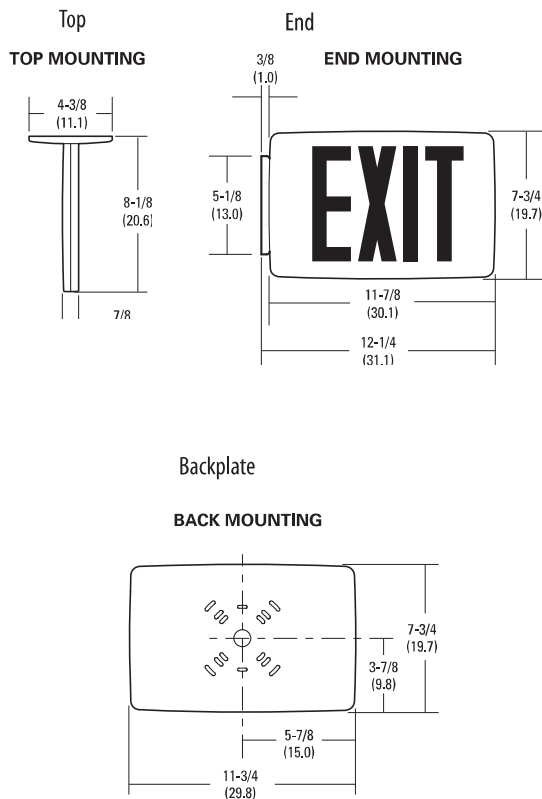
BATTERY (included with EL N option)		
Sealed Nickel-Cadmium		
Shelf life ²	Maintenance ³	Optimum temperature ⁴
3 years	None	32° - 122°F (0° - 50°C)

Notes

- Based on continuous operation. The typical life of the exit LED lamp is 10 years.
- At 77°F (25°C).
- All life safety equipment, including emergency lighting path of egress, must be maintained, serviced and tested in accordance with all National Fire Protection Association and local codes. Failure to perform the required maintenance, service or testing could jeopardize the safety of occupants and will void all warranties.
- Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity. Consult factory for detailed information.

MOUNTING

All dimensions are inches (centimeters).
Shipping weight: 3 lbs. (1.3 kgs.).



SECTION 270500 – TELECOMMUNICATIONS GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.02 SUMMARY

- A. This Section includes telecommunications general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate the installation of the telecommunications wiring devices, equipment, supports, pathways etc., with all other trades prior to installation. Verify and coordinate routing of cable trays, conduits, wireways, etc., intended to support routings of telecommunications cabling.

1.04 DRAWINGS

- A. The Drawings must show the location of equipment racks & elevations, Ladder rack on 3 walls, power outlet locations, general arrangement of equipment, electrical systems and related items. The installation will follow as closely as elements of the construction will permit.
- B. The Drawings must show a conduit & cabling riser diagram from MDF and related IDFs. Copper pair and fiber strand counts will be detailed showing the distribution of riser cabling between the MDF and related IDFs.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer and WSU C&IT.
- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect and WSU C&IT for resolution.

1.05 INSPECTION OF SITE

- A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.
- B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.

1.06 CONTRACT BREAKDOWN

- A. WSU Facilities Department retains the installation and coordination for all projects initiated by that department, WSU C&IT retains the design review, installation and coordination for all other voice, data & video projects not initiated by WSU Facilities.
- B. Within two (2) weeks following award of contract, submit to the Architect/Engineer for approval a contract amount breakdown. Breakdown shall be submitted on a form similar to the form

available at the Architect's/Engineer's office. All requests for payment shall be based on the approved breakdown.

1.07 TEMPORARY FACILITIES

- A. Provide and remove upon completion of the project, in accordance with the general conditions, a complete temporary telephone service during construction, as required.

1.08 ALTERNATES

- A. See Alternate Section and other applicable parts of the specifications.

1.09 GUARANTEE

- A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, provided that such failure is due to defects in the equipment, material or installation or to follow the specifications and drawings. File with the Owner any and all guarantees from the equipment manufacturers.

1.10 CODES, PERMITS AND FEES

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for telecommunications work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local service providers shall be complied with. Check with the local exchange carrier supplying service to the installation and determine all raceways and devices required including, but not limited to, all terminal cabinets, backboards, space requirements, etc.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

1.11 STANDARDS OF MATERIAL AND WORKMANSHIP:

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
 - A.N.S.I. American National Standards Institute
 - A.S.T.M. American Society for Testing Materials
 - BICSI Building Industry Consulting Services International
 - I.C.E.A. Insulated Cable Engineer's Association
 - I.E.E.E. Institute of Electrical and Electronics Engineers
 - N.E.C. National Electrical Code
 - N.E.M.A. National Electrical Manufacturer's Association
 - NFPA National Fire Protection Agency
 - TIA Telecommunications Industry Association
 - U.L. Underwriters Laboratories, Inc.
- B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.
- C. All equipment of the same or similar systems shall be by the same manufacturer.

1.12 RECORD DRAWINGS

- A. Provide complete operating and maintenance instruction manuals covering all telecommunications equipment herein specified, together with parts lists. All literature shall be furnished in triplicate for Owner and shall be bound in book or ring binder form as directed by Architect/Engineer.
- B. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
 - 1. Routine maintenance procedures.
 - 2. Trouble-shooting procedures.
 - 3. Contractor's telephone numbers for warranty repair service.
 - 4. Shop drawings.
 - 5. Recommended spare parts lists.
 - 6. Names and telephone numbers of major material suppliers.
- C. Provide revised telecommunications working Drawings indicating "as-built" conditions. Drawings shall indicate all changes that have occurred during construction. Properly and identify backbone and horizontal wiring pathways. Locate all network and workstation devices. Identify all devices on plan with proper labeling. Identify outside plant backbone conduits, man holes & fiber cables installed on a site plan. "as-Built" Drawings shall be submitted on AutoCAD 2000 or newer electronic DWG file format. Provide (1) copy paper and (1) copy electronic DWG file.
- D. Provide certified test records for all installed cable showing compliance with specifications. Provide in single bound volume arranged by function and geographic location.

1.13 MATERIAL AND EQUIPMENT MANUFACTURERS

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of telecommunications equipment and shall be of the manufacturer's latest design.
- B. No substitutions will be allowed without WSU C&IT approval.

1.14 SHOP DRAWINGS/SUBMITTALS

- A. All shop drawings shall be submitted in groupings of similar and/or related items (cable and connectors, equipment cabinets and racks, etc.). Incomplete submittal groupings will be returned unchecked.
- B. Provide detailed layout shop drawings of backbone and horizontal cabling distribution, pathways, equipment room layouts, details and related information necessary of installation and maintenance. After review by the Engineer, a copy of drawings will be stamped and returned to the contractor.
- C. Submit for approval two (2) copies of shop drawings for all telecommunications systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation. Refer to other sections of the Specifications for additional requirements.
 - 1. Structured cabling system components.
 - 2. Structured cable system raceways and supports.
 - 3. Outside plant cabling and components.
 - 4. Outside plant ducts manholes, hand holes & conduit systems on a site plan with elevations.
 - 5. Equipment racks and cabinets including management components.

6. Labeling equipment.
 7. Telecommunications grounding components.
 8. Conduit, inner duct, junction and pullboxes.
 9. Surface raceway components.
 10. Manholes, hand holes and all accessories.
 11. Telephone system components.
 12. Data network system components.
 13. Audio/video system components.
 14. Access control system components.
 15. Security Camera system components.
- 1.15 USE OF EQUIPMENT
- A. The use of any equipment or any part thereof for purposes other than testing even with the Owner's consent shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- 1.16 WORK SPECIFIED UNDER OTHER DIVISIONS
- A. The following items are an integral part of the telecommunications system and will be provided by the Electrical Contractor & or Telecommunications Contractor.
1. Raceways
 2. Boxes, cabinets and enclosures.
 3. Grounding and Bonding
 4. Underground Utilities
- 1.17 WORK PROVIDED BY OTHERS
- A. Conduit, cabletrays, sleeves, boxes, floor boxes, surface raceways and grounding shall be provided by the Electrical Contractor under Division 26.
- B. Coordinate installation of telecommunications work with work provided by Electrical Contractor in paragraph A above.
- C. The Owner will provide network electronics equipment in all Communication Rooms as required.
- 1.18 CONTRACTOR QUALIFICATIONS
- A. The Installing Contractor for each communications system shall have a minimum of 5 years of experience with the types of systems specified. They must be certified to install, test & warranty the product specified prior to a bid submittal. **No exception to this will be allowed.**
- B. The Installing Contractor shall submit a reference list consisting of a minimum of 3 installations of equivalent size and complexity of this contract. The reference list shall contain the following information for each installation:
1. Name of project, square footage, location and brief description of systems.
 2. Date of completed installation.
 3. Contact name and phone number of facility representative.
 4. Total bid amount of each system installed.
 5. Final contract amount of each system installed, including all change orders and bulletins.
- C. The Installing Contractor shall submit with the bid the names and registration numbers of members of the firm that have a valid membership and are certified with BICSI as registered

Communications Distribution Designers (RCDD). This contractor shall identify at least one RCDD assigned to this project in the bid.

- D. The bidding, shop drawing submittal, procurement of materials, the installation as-builts and record documents shall be reviewed and overseen by the RCDD(s) assigned to the project.
- E. The contractor's bid, shop drawing submittals, as-builts and record documents shall bear the valid seal of the RCDD(s) assigned to this project.
- F. The Installing Contractor of the video system shall submit with the bid names and license numbers of all members of the firm that hold a valid commercial general class license with the FCC. The Contractor shall identify at least one FCC licensed technician/engineer assigned to this project with the bid.
- G. All calculations, shop drawings, testing, certification and as-built documents shall be directly supervised by the licensed technician/engineer assigned to the project.
- H. The contractor must provide a copy of the manufacturer's certification that the contractor is currently certified to install, test & warranty the proposed system prior to a bid submittal. See Section 17110, 7.5A and section 17010, 1.16A. No exception to this will be allowed.

PART 2 PRODUCTS

Not applicable.

PART 3 EXECUTION

3.01 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all installation specifications set by the equipment manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer and WSU C&IT for resolution.

3.02 WORK PERFORMED BY OTHERS

- A. Electrical Contractor shall install 4" sq. sheet steel wall boxes, minimum 1" trade size conduit (or as indicated on drawings) stubbed 12" above ceiling with 6" radius (or as required by TIA/EIA-569), with a 90 degree bend at top in the direction towards route destination, and plastic bushing for recessed locations.
- B. Electrical Contractor shall install 4" sq. cast boxes. Minimum 1" trade size conduit (or as indicated on Drawings) stubbed up to 10' AFF (or as indicated on Drawings), with 6" radius (or as required by TIA/EIA-569) for surface mounted locations.
- C. The Owner will provide access point & network electronics equipment in all Communications Rooms as required.
- D. The Owner will provide all voice & data cross-connect jumpers.

3.03 DEMOLITION WORK

- A. All demolition of existing telecommunications Cable, equipment and materials shall be specified by C&IT and done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, cable, patch panels, devices, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to meet NFPA requirements.
- B. In general, demolition of old low voltage communications cabling work is indicated on the drawings, however, the contractor shall visit the job site to determine the full extent and character of this work. All existing voice & data jacks demolished need to be documented. A room number, Jack number (if still there), approximate location in the room & the

communication room where it terminated need to be identified. This information must be returned to C&IT IT Customer Services Telecommunications department.

- C. None of the recovered material shall be reused in the new work.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present systems to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute cable as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining outlet boxes or at the panels.
- F. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining outlet boxes or at the panels.
- G. Where new walls and/or floors are installed which interfere with existing telecommunications outlets, devices, etc., this contractor shall adjust, extend and reconnect such items as required to maintain continuity of same.
- H. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface metal raceway or exposed conduits will be permitted only where approved by the Architect/Engineer and as specifically indicated on the drawings.

3.04 WORK IN EXISTING BUILDINGS

- A. The Owner will provide access to existing buildings as required. However, this contractor, once work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed work. Promptly repair any damage to same at this contractor's expense.
- C. Consult with the Owner's representative as to the methods of carrying on the work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all telecommunications services shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's representative.

3.05 COORDINATION

- A. Install work to avoid interference with work of other trades including, but not limited to, architectural, mechanical and electrical trades. Remove and relocate any work that causes interference at this contractor's expense. Disputes regarding the cause of interference will be resolved by the Owner's representative or Architect/Engineer.
- B. If there is a general contractor, the general contractor is responsible for the construction schedule. All work activities are to be coordinated with the general contractor.

3.06 CHASES AND RECESSES

- A. Chases and recesses shall be provided by the Architectural Trades, but this contractor shall be responsible for coordinating their accurate location and size.

3.07 SLEEVES

- A. Provide and install Hilti Speed Sleeve model CP-630 or EZ path fire stop system wherever conduits or cabling pass through fire rated walls, floors or cables pass through openings in walls.
- B. All sleeves through the floor are to extend 2 inches above floor, unless otherwise noted. Provide escutcheons at each sleeve in finished areas and adequate spacing between sleeves to accommodate escutcheons.

3.08 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be done by the Contractor.

3.09 EXCAVATION AND BACKFILLING

- A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the telecommunications work. Coordinate the work with other excavating and backfilling in the same area.
- B. Refer to electrical Drawings and the architectural Specifications for excavating and backfilling methods and materials.

3.10 ACCESS DOORS

- A. Provide access doors for installation by architectural trades. In the walls, provide Milcor No. "DW" or "M" as required to make all controls, electrical boxes and other equipment installed by the contractor accessible. Minimum size 12 inches x 12 inches. In the ceiling, provide Milcor No. 3210, 3105 or 3206 for accessibility as mentioned above, 24 inches x 24 inches minimum size. The plaster or acoustical tile insert shall be by the architectural trades. Areas with accessible ceilings (ceilings where tiles are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors.
- B. When access doors are in fire resistant wall or ceilings, they must bear the Underwriters Laboratories, Inc., Label, with time design rating equal to or exceeding that of the wall or ceiling unless they were a part of the tested assembly.

3.11 CLEANING

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, cleaning all telecommunications equipment spaces, devices, cover plates, and removing all scrap cable and debris from pathways.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be protected from theft, injury or damage.
- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect. Equipment set in place in unprotected areas must be provided with temporary protection.

3.13 EXTRA WORK

- A. For any extra telecommunications work that may be proposed, this contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. This contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

3.14 DRAWINGS AND MEASUREMENTS

- A. These Specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor will understand that the work herein described shall be complete in every detail.
- B. The drawings are not intended to be scaled for rough-in measurements or to serve as Shop Drawings. Field measurements, necessary for ordering materials and fitting the installation to the building construction and arrangement, shall be taken by this contractor.

3.15 AUTOMATION SYSTEM PROGRAM CODE

- A. All automation system uncompiled and compiled program codes, source codes, custom modules, graphical user interface screen shots and any other automation system programming data and material (Program Code) shall be provided to the UNIVERSITY in hard copy and on CD Rom in an unencrypted format acceptable to the UNIVERSITY.
- B. Copyright for the Program Code shall be assigned to the UNIVERSITY for purposes of system maintenance.
- C. Provision of and Copyright assignment of the Program Code to the UNIVERSITY by the Vendor shall be conditions of the Purchase Order and contract acceptance by the Vendor.
- D. Provision of and Copyright assignment of the Program Code to the UNIVERSITY by the Vendor shall be conditions of final System acceptance by the UNIVERSITY.

END OF SECTION

SECTION 271200 - TELECOMMUNICATIONS INTERIOR PATHWAYS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Related Sections include the following:
 - 1. Division 17 Section "Telecommunications General Requirements."

1.02 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. NFPA-297 - Guide on Principles and Practices for Communication Systems.
- C. ANSI/TIA/EIA 568-A - Commercial Building Telecommunications Cabling Standard.
- D. ANSI/TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces.
- E. ANSI/TIA/EIA 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications.
- F. ANSI/IEEE-110-1992 - Powering and Grounding Sensitive Electronic Equipment.
- G. BICSI – Building Industry Consulting Services International.

1.03 SUBMITTALS

- A. Submit all structured cabling system raceways and supports identified in this section under provisions of Section 270010.
- B. Product Data: Provide for products specified and required.
- C. Shop Drawings: Indicate project specific part numbers, dimensions, support points, fittings and finishes.

1.04 PROJECT RECORD DOCUMENTS

- A. Submit all structured cabling system raceways and supports identified in this section under provisions of Section 270010.
- B. Accurately record equipment layout and cable layouts in all telecommunication spaces.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 270010.
- B. Protect products from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduits, and cable pathways prior to rough-in.

1.07 DESCRIPTION OF SYSTEMS

- A. Communications cabling systems pathways shall be installed in accordance with ANSI/TIA/EIA 569-A.
- B. Intra-building backbone cabling shall be installed in conduit, cable tray or J-hook support system.
- C. Horizontal cabling (cabling from the telecommunications room to the work area outlet) pathways shall consist of conduit J-hooks accessible ceiling space as indicated on Drawings and as required.

- D. Where the accessible ceiling systems are used as the primary pathway, cabling shall be installed as indicated on the Drawings, with individual work area cables routed exposed and supported as specified herein.

PART 2 PRODUCTS

2.01 J-HOOKS

- A. Manufacturers:
 - 1. Erico-Caddy.
 - 2. B-Line.
- B. Horizontal cable routed exposed through ceiling space shall be supported from J-hooks.
- C. J-hooks shall be a minimum of 5/8" wide and shall have a bearing surface that complies with required bend radii of the specified cables to be supported.
- D. J-hooks shall have flared or folded edges to prevent damage when installing cables.

2.02 INNERDUCT

- A. Manufacturers:
 - 1. Carlon.
 - 2. Endot.
- B. Install inner duct through conduits and sleeves for optical fiber cabling installations.
- C. Description: UL listed, non-metallic, corrugated flexible conduit for use in plenum or riser installations as applicable. Provide each inner duct with one 1/4" W pull tape with a tensile rating of 900 lbs.

PART 3 EXECUTION

3.01 GENERAL

- A. Where cables pass through fire rated walls, the Contractor shall provide and install Hilti Speed Sleeve model CP-630 or EZ path fire stop system. This penetration sleeve must match the fire rating of the wall. The penetration shall be sized per ANSI/TIA/EIA-569.
- B. Any other wall or floor penetrations that aren't fire rated, the Contractor shall fire-stop the penetrations, after final cable installation, using Engineer-approved materials. Fire-stopping materials shall be installed per manufacturer's recommendations and shall maintain partition rating and integrity. All fireproofing shall be applied in a neat manner with all excess material cleaned from all walls and surfaces. Contractor shall replace and re-install all fireproofing materials removed during cable installation.
- C. Contractor shall patch and repair any holes or other damage to walls or partitions and paint to match original, as applicable.
- D. The Communication Cabling Contractor shall provide plastic and/or grounding bushings, as applicable, on all conduit sleeves, stubs and conduit terminations that may have been missed by the Electrical Contractor.
- E. All cutting, patching and restoration to the original condition of walls, ceilings, floors, etc., shall be the responsibility of the Contractor.
- F. All ceiling removal and restoration required for the execution of this work shall be the responsibility of the Contractor.
- G. Any additional existing voice & data jacks demolished need to be documented. A room number, Jack number (if still there), approximate location in the room & the communication room where it terminated need to be identified. This information must be returned to C&IT IT Customer Services Telecommunications department.

- H. All cabling installed exposed in accessible ceiling systems shall be supported by cable tray or J-hooks.
- I. All J-hooks shall be supported directly from the structure above or wall mounted, as applicable, independent of ceiling framing, electrical conduit, mechanical piping and ductwork. Provide all-thread rod with 1/4" diameter or equivalent supporting means with suitable fasteners when attaching to structure or structural members. Increase size of support as required when multiple J-hooks (stacked or tree configuration) are attached to single support based on maximum loading capacity of J-hooks.
- J. J-Hooks shall be spaced 48" Minimum or 60" maximum on center.
- K. Telecommunications cabling shall be routed in continuous conduit above hard ceilings or between floors in any kind of offset condition.
- L. Communications cable pathway routing shall be coordinated with above ceiling work of other Contractors to avoid conflicts and potential sources of EMI.
- M. Do not route exposed communications pathway within 12" of lighting fixtures and electrical power feeders.
- N. Route inner duct for all fiber optic backbone cabling, in cable tray, conduit, and sleeves. Coordinate routings and quantities with Drawings.

END OF SECTION

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pathways.
 - 2. UTP cabling.
 - 3. 62.5/125-micrometer, optical fiber cabling.
 - 4. Coaxial cable.
 - 5. Multiuser telecommunications outlet assemblies.
 - 6. Cable connecting hardware, patch panels, and cross-connects.
 - 7. Telecommunications outlet/connectors.
 - 8. Cabling system identification products.
 - 9. Cable management system.
- B. Related Sections:
 - 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

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.
- 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. LAN: Local area network.
- I. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- J. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- K. RCDD: Registered Communications Distribution Designer.
- L. UTP: Unshielded twisted pair.

1.4 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/EIA-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., 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. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.
- 1.5 PERFORMANCE REQUIREMENTS
- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-C.1, when tested according to test procedures of this standard.
- 1.6 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. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration drawings and printouts.
 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 6. 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.
 - G. 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.

1.7 WARRANTY

A. General

1. The cabling system shall be warranted by the manufacturer(s) of the components for a period of not less than 15 years from the time the installation is deemed complete.
2. It shall be the sole responsibility of the Contractor to register the project with the manufacturer(s) and meet all manufacturers' warranty requirements.
3. Contractor shall provide Owner with all manufacturers' warranty certificates with Record Documents.

B. Warranty Coverage

1. Product - all passive components of the cabling system shall be warranted to be free from defects in material and workmanship.
2. Performance - all passive components, as installed, shall be warranted to exceed TIA and ISO performance specifications for Permanent Link and Channel, as required, at all frequencies specified and shall meet or exceed all manufacturer's published performance data.
3. Applications - the installed Permanent Link and Channel shall be warranted to support all current applications, as well as those introduced in the future, that require the specified cabling system per TIA and ISO specifications.

C. Warranty Requirements

1. Provide a Channel Permanent Link warranty for all data drops.
2. Warranty shall cover repair or replacement of all defective components free of charge, including all labor performed by a manufacturer-certified installer. All replacements components shall be furnished new. No used, reconditioned, or refurbished components shall be allowed.
3. The installing contractor shall be certified by the cabling and connector manufacturers as an approved and trained installer of their equipment. Submit letter of certification from the manufacturer to the engineer at time of submittal. No exception to this will be allowed

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. 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.

D. 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.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. 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.
3. Test each pair of UTP cable for open and short circuits.

1.10 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.

1.11 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.

1.12 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. Patch-Panel Units: One of each type.
 2. Connecting Blocks: One of each type.
 3. Device Plates: One of each type.
 4. Multiuser Telecommunications Outlet Assemblies: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: 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.
- C. Cable Tray Requirements
1. Refer to Division 26 section "Cable Trays" for cable tray intended to support backbone cabling.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways and Boxes."
- Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.
- E. Innerduct:
1. Manufacturers:

- a. Carlon.
 - b. Endot.
2. Install innerduct through conduits and sleeves for optical fiber cabling installations.
3. Description: UL listed, non-metallic, corrugated flexible conduit for use in plenum or outdoor installations as applicable. Provide each innerduct with one 1/4" W. pulltape with a tensile rating of 900 lbs.

2.2 UTP CABLING SYSTEM WARRANTY

A. General

1. The UTP voice and data cabling system shall be warranted by the manufacturer(s) of the components for a period of not less than 20 years from the time the installation is deemed complete.
2. It shall be the sole responsibility of the low voltage cabling Contractor to register the project with the manufacturer(s) and meet all manufacturers' warranty requirements.
3. It shall be the sole responsibility of the low voltage cabling Contractor shall provide Owner with test results, all manufacturers' warranty certificates with Record Documents including a site plan elevation with outside plant man holes, hand holes & conduit.

2.3 COPPER HORIZONTAL CABLING

A. Manufacturers:

1. CommScope
2. BerkTek-Ortronics
3. Superior-Essex
4. Hubbell
5. Beldon

B. Description:

1. Horizontal cable shall be furnished with performance requirements for the system served (voice, video or data) as indicated on the drawings riser diagram.
2. Category 6 enhanced: 23 AWG, 4-pair, 100 ohm, UTP,, with green jacket for data & wireless access points, yellow jacket for voice cabling, purple jacket for security camera cabling. See exact products in section 10.4 C above.
3. Voice jacks will terminate on wall mount 110 type termination blocks. Workstation, server, printer etc. data jacks will terminate in their own group of patch panels installed in equipment racks. Wireless access point & security camera data jacks will terminate in their own separate group of patch panels installed in the equipment racks.

2.4 UTP JACKS AND CONNECTORS

A. Manufacturers:

1. CommScope UNJ600.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. Modular jacks for UTP cables:

1. 8 position, 8 conductor, non-keyed, universal modular jack, snap-in type, terminated with a 110 style pc board connector, color coded for T568A &T568B wiring.
2. Designed to terminate 22-26 AWG solid on insulation-displacement 110-style connectors.
3. Contacts shall be minimum 50 micron gold-plated in the contact area.

4. Rated to match the performance of the cabling system they are installed on.
5. Color coded for system served as indicated on the Drawings.
6. Furnish keystones (icons) for jack identification. Keystones for voice jacks shall be White and keystones for data, wireless access points & security cameras jacks shall be orange.

2.5 UTP PATCH PANELS

A. Manufacturers:

1. CommScope UMP610-24P or UMP610-48P.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. UTP Patch Panel:

6. Patch panel shall serve as data jack, security camera and wireless access point system horizontal cross connect.
7. Wireless access point & security camera data jacks will be terminated on their own patch panel separate from the workstation data jack patch panels.
8. Patch panel shall be configured for standard 19" rack mounting.
9. High density type with 24 modular jack ports for every standard rack mount unit (1.75" high).
10. Maximum 6 port groupings of replaceable modules.
11. Terminations for the "building side" cabling on 110-style insulation pc board connectors color-coded for T568B terminations.
12. Horizontal and vertical cable management hardware front and rear.
13. Performance shall meet the performance of the cabling system they are installed on.
14. Constructed of black anodized aluminum with adequate structural integrity so that panel will not deflect when center of panel is pushed with the hand.
15. Provisions for icons and labeling to comply with the labeling requirements in specification 17170, "Cable Plant Administration and Testing".

2.6 CROSS-CONNECT BLOCKS

A. Manufacturers:

1. CommScope.
2. Ortronics
3. Leviton
4. Hubbell
5. Beldon

B. Cross-connect blocks

1. Cross connect blocks shall be used for voice connectivity backbone to horizontal cross connects:
2. Wall mount 110 type wiring blocks mounted in a modular frame design that includes the frame, blocks, vertical and horizontal wiring troughs, and designation strips.
3. Provide wire management frames between adjacent vertical sections to allow management of cross connect wiring.
4. The frames and horizontal wiring troughs shall be constructed of steel (painted white or ivory in color), the wiring blocks, connecting blocks and vertical frames shall be constructed of molded polycarbonate.
5. Blocks shall be marked black every fifth pair.

6. Locate backbone frames on the right and horizontal frames on the left.

2.7 FACE PLATES

- A. Manufacturers: Same as jacks and connectors, unless otherwise noted. In almost all cases in labs, stainless steel plates will be called out in lieu of plastic. Reference construction drawings.
- B. Face plates for wall mounted workstation outlets shall allow a minimum 2 and maximum of 6 positions and accept snap-in jacks, as specified.
- C. Face plates for recessed outlet boxes shall be high-strength nylon, white color, single-or double-gang as required and as applicable. Face plates shall be equipped with label slots, top and bottom, and clear polycarbonate covers for each label.
- D. Provide duplex mounting frames, as required, to mate and match jacks to face plates.
- E. Provide stainless steel faceplates with attachment hooks for hanging telephone device for outlets indicated as wall phone outlets.

2.8 UTP PATCH CORDS

- A. Manufacturers:
 1. Shall be the same manufacturer & type as the cable, jacks & patch panels installed in the building.
- B. Description:
 1. Provide two (2) patch cords, one of each length specified, for each data port in patch panel outlet and one (1) patch cord for each data port for the workstation, length as specified above.
 2. For the communication room side provide 24 AWG, 4-pair, 100 Ohm, solid, UTP patch cords of similar construction, impedance-matched, having compatible performance as copper UTP horizontal and fully warranted, as required.
 3. For the workstation room side provide cords with stranded conductors and jacketing for greater flexibility, having compatible performance as copper UTP horizontal and fully warranted, as required.
 4. Patch cords shall be 10'-15' in length, gray color for the workstation, 3'-7' in length, gray color for the communication room, 1' in length, green color for the access point & 3' in length, purple color for the security cameras. Coordinate possible different lengths with Owner.

2.9 FIBER OPTIC CONNECTORS FOR BOTH INTER – BUILDING & INTRA – BUILDING CABLES

- A. Manufacturers:
 1. Corning Cable Systems.
- B. Multimode fiber optic connectors shall be:
 1. Field installed SC type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide black color connector.
 2. Field installed SC type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide blue color connector.
- C. Singlemode fiber optic connectors shall be:
 1. Field installed SC type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide black color connector.
 2. Field installed SC type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide black color connector.
- D. Singlemode fiber optic connectors for video shall be:

1. Field installed SC/APC type in 12/24 port panels for INTRA – BUILDING riser tie cabling between communication rooms. Provide green color connector.
 2. Field installed SC type in 12/24 port panels for INTER – BUILDING tie cabling between buildings. Provide green color connector.
 3. Connectors shall be epoxy polish SC/APC type with ceramic ferrule with tool kit.
 4. Connectors shall be fusion type. Compression type connectors shall not be allowed.
 5. All SC/APC connectors and ferrules shall be green in color.
 6. Field Install A Minimum of 2 strands or Coordinated exact quantities and requirements for SC/APC terminated fiber optic strands with C&IT-IT Customer Services- Telecommunications department prior to installation.
- 2.10 FIBER OPTIC PATCH PANELS
- A. Manufacturers
 1. CommScope.
 2. Corning
 3. BerkTek-Ortronics
 - B. Description:
 1. Rack-mounted, minimum 24-port patch panel with modules or panels as indicated suitable for mounting connector types as specified and as required, complete with slide-out fiber management tray and management rings and clips to maintain minimum bend radius of fibers, and lockable front and rear doors, clear, tinted-polycarbonate front door (03U and 04U panels only).
 2. Provisions for icons and labeling to comply with the labeling requirements in specification 17170, "Cable Plant Administration and Testing".
- 2.11 COPPER SPLICING PRODUCTS
- A. Manufacturers:
 1. 3M – Series 2-Type FR 510 Closure.
 - B. Description: Copper splice case, indoor, re-openable, sized for pair counts indicated on Drawings. Provide all hardware and accessories required to make the quantity and type of splices as indicated on the Drawings.
- 2.12 FIBER OPTIC SPLICE PANELS
- A. Manufacturers:
 1. CommScope.
 2. Corning
 3. BerkTek-Ortronics
 - B. Description: Rack-mounted splice enclosure with splice trays, cable strain relief hardware, sliding shelf, locking front and rear doors, grommated entry points, and open-side design for easy fiber egress.
 - C. Splice trays shall be for heat-shrink fusion splices and compatible with splice panel.
- 2.13 GROUNDING
- A. Comply with requirements in Division 26 Section "Grounding and Bonding" for grounding conductors and connectors.
 - B. Comply with ANSI-J-STD-607-A.

2.14 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A 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 "Electrical Identification."

2.15 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-C.1.
- C. Factory test UTP cables according to TIA/EIA-568-C.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C.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 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, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways and Boxes."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. 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/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceways and Boxes" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. 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 above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch 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/EIA-568-C.1.
 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. MUTOA shall not be used as a cross-connect point.
 5. 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 from communications equipment room.
 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. 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.
 10. 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.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 13. At the work area outlet, provide a 12-inch slack loop in each cable.
 14. 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 from the point of termination to maintain cable geometry.
- D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A 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.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
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.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
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.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

- A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 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 equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."
 1. Administration Class: 1.
 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric

designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

- C. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
- E. 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.
- F. 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.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. 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.
- H. 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/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.8 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 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/EIA-568-B.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. Test UTP backbone copper 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.
5. 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) Horizontal and multimode backbone 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 backbone 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.
6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.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.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
8. Coaxial Cable Tests: Conduct tests according to Division 27 Section "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface

device at the demarcation point. Log onto the network to ensure proper connection to the network.

- D. 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.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.9 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. Include training in cabling administration software.

END OF SECTION

SECTION 27 5313.50 – WIRELESS CLOCK AND PROGRAM SYSTEM

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. Provide synchronized wireless master-satellite time system, complete, including the following components:
 - 1. GPS Receiver.
 - 2. Master Transmitter.
 - 3. Indicating clocks.
 - 4. System wire and cable.
- B. Related Sections include the following:
 - 1. Division 26 Section “Electrical General Requirements”.
 - 2. Division 26 Section “Electrical Identification”.
- C. Related Work Specified Elsewhere:
 - 1. 120 volt grounded electrical outlet at transmitter locations.

1.3 DEFINITIONS

- A. GPS: Global Positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time, the most accurate and reliable time.

1.4 REFERENCES

- A. FCC Part 90: Private Land Mobile Radio Services.
- B. FCC Part 90.35: Industrial/Business Pool.
- C. FCC Part 90.257 (b): Assignment and Use of Frequencies in the Band 72-76 MHz.
- D. NFPA 70: National Electrical Code.

1.5 SYSTEM DESCRIPTION

- A. Time system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
- B. Time system shall be a synchronized master-satellite time system. The system shall synchronize all clocks to each other. The system shall utilize GPS technology to provide atomic time. Clocks shall automatically adjust for daylight savings time.
- C. The system shall not require hard wiring. Systems requiring wiring and/or conduit between transmitters and clocks excluding power supply wiring for digital clocks, will not be acceptable.
- D. Analog clocks shall be synchronized to within 10 milliseconds 6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- E. The system shall include internal clock so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
- F. The system shall incorporate fail-safe design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
- G. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.

1.6 REGULATORY REQUIREMENTS

- A. Transmitter and receiver shall comply with Part 90 of FCC rules as follows:
 - 1. The equipment shall not cause harmful interference.
 - 2. The equipment shall accept interference that will cause adverse on equipment operation.
 - 3. Transmitter frequency shall be governed by FCC Part 90.35.
 - 4. Transmitter output power shall be governed by FCC Part 90.257 (b).

1.7 SUBMITTALS

- A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure or color card showing available colors and finishes of clocks.
- B. Operating License: Submit evidence of application for operating license prior to installing equipment. Furnish the license, or if the license has not been received, a copy of the application for the license, to the Owner prior to operating the equipment. When license is received, deliver original license to Owner.
- C. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.
- D. Operation and Maintenance Data: Submit complete installation, set-up and maintenance instructions.
- E. Qualification Data: For Installer and manufacturer.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Analog Clocks: Three of each type installed.

1.9 QUALITY ASSURANCE

- A. Permits: Obtain operating license for the transmitter from the FCC.
- B. Manufacturer Qualifications: A qualified manufacturer specializing in manufacturing commercial time systems with a minimum of 10 continuous years of documented experience.
- C. Installer Qualifications: Time system manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
- D. Source Limitations: Obtain time system components through one source from a single manufacturer. Equipment and components furnished shall be of manufacturers latest model.
- 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.
- F. Comply with NFPA 70 for components and installation.
- G. System shall be installed in compliance with local and state authorities having jurisdiction.

1.10 PROJECT SITE CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.
- B. Coordinate installation of GPS receiver with work on the roof or exterior side wall so that the bracket and related fasteners are watertight.

PART 2 - PRODUCTS

2.1 MANUFACTURER:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Primex Wireless, N3211 County Road H, Lake Geneva WI 53147 (800) 537-0464 FAX (262) 248-0061 www.primexwireless.com
 - 2. Visiplex by Simplex Grinnell, 24755 Halsted Road, Farmington Hills, MI 48335 (248) 427-5050.

2.2 SEQUENCE OF OPERATION

- A. Transmitter Operation:

1. When power is first applied to the transmitter, it checks for and displays the software version, then it checks the position of the switches and stores their position in memory.
2. The transmitter then looks for the GPS time signal.
3. Once the transmitter has received the GPS time, it sets its internal clock to that time.
4. The transmitter then starts to transmit its internal time once every second.
5. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Analog Clock Operation:

1. When the batteries are inserted into the clock:
 - a. Press the red button when the red second hand is at the 12:00 position. At this time the microprocessor will lock in the location of the second hand.
 - b. After the red second hand has passed over the minute hand (first second hash mark after minute hand), press and release the red button. At this time the microprocessor will lock in the location of the minute hand. The microprocessor then assumes the location of the hour hand.
2. After the red button has been pressed twice, the micro processor will start searching the channels. It will start at channel No. 1 and proceed one by one until it either decodes a valid signal or reaches channel No. 16. If no signal is detected the receiver will be shut off and try again later. If a signal is received, the micro processor will store the channel number, set the clock to the receive time, then for the next minute the clock will beep every time that it receives a valid time signal. If the clock is in a good signal area it will beep once a second. If the clock beeps every few seconds, the clock is in a marginal signal area. Clocks should operate in marginal signal areas, but battery life will be about 25 percent shorter.
3. After initial set, the clock will shut off the receiver. On a pre-scheduled basis, the microprocessor will turn the receiver back on and starting with the stored channel, it will again look for a valid time signal. However, the beeper will not operate.
4. If the clock has not decoded a valid time signal for seven days, then it will go back to a double step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.

2.3 EQUIPMENT

A. General: The time system shall include the following components:

1. GPS receiver.
2. Master Transmitter.
3. Indicating clocks.
4. All accessories for complete operation.

B. Master Transmitter:

1. Manufacturer: Model 14000, consisting of wireless transmitter with GPS receiver.
2. General:
 - a. Unit shall obtain current atomic time from satellite.
 - b. The time system shall transmit time continuously to all clocks in the system.
3. GPS Receiver:

- a. Provide roof mounted GPS, with cable length as required.
 - b. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, 3-7/8 inches wide by 4-3/16 inches long by 2 inches deep, designed for roof or outdoor mounting.
 - c. Provide mounting bracket for attachment to roof structure, window or pole installation as required.
4. Transmission:
 - a. Frequency Range: One watt at frequency of 72.100 to 72.400 MHz.
 - b. Transmission Range: One mile, open field.
 - c. Radio technology: Narrowband FM
 - d. Number of channels: 16
 - e. Channel bandwidth: 20 kHz maximum
 - f. Transition mode: one-way communication
 - g. Data rate: 2 KBps
 - h. Operating range: 32 degrees F to 158 degrees F.
5. Transmitter:
 - a. Transmitter output power: +26 to +30 dBm
 - b. Frequency deviation +/- 4 kHz
 - c. Transmitter power requirements: 120 VAC 60 Hz
 - d. Internal power requirements: 5 volts DC
 - e. Carrier frequency stability +/- 20 ppm
6. Transmitter shall have 16 selectable channels to assure interference-free reception.
7. Transmitter shall have the following switches:
 - a. Time zone adjust switches for all time zones in the world. Includes all US time zones: Eastern, Central, Mountain, Pacific, Alaska and Hawaii.
 - b. Daylight Saving Time bypass switch.
 - c. 12-hour or 24-hour display.
8. Transmitter housing shall be black metal case, 16-3/4 inches by 12 inches by 1-7/8 inches in size.
9. Transmitter housing shall incorporate a display which shall include the following:
 - a. Time readout
 - b. AM and PM indicator if 12 hour time display is set
 - c. Day and date readout
 - d. Indicator for daylight savings or standard time
 - e. LED which shall flash red in event of reception problem
 - f. GPS reception indicator
10. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
11. Antenna shall be 46 inches high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be > 110 dBm. Antenna polarization shall be data logic, zero to 5 volts.
12. Power supply:
 - a. Input: 120 volt AC 50/60 Hz, 0.4 amp.
 - b. Output: 9 volt DC, 1.5 amp.
 - c. Cord Length: 72 inches.

C. Indicating Clocks: Analog

1. Manufacturer: Primex Wireless.
 - a. 12-1/2 inch diameter: Model 14150 Series.
2. Size: 12-1/2 inch diameter, or 16 inch diameter as indicated.
3. Color:
 - a. Color and finish as selected from manufacturer's standard colors and finishes.
 - b. Face shall be white.
 - c. Hour and minute hands shall be black.
 - d. Clocks shall be provided with red sweep second hand.
4. Frame: Polycarbonate.
5. Lens: Polycarbonate.
6. Power Supply: Battery operated, minimum 5 year battery life.
7. Mounting: wall mounted. Provide mounting bracket.
8. Accessories:
 - a. Clock lock: Tamper-proof/theft resistant hangers and slots in the backs of the clocks.
 - b. Provide 2 alkaline D cell batteries with each clock.
9. Clocks shall be capable of automatically adjusting for daylight saving time. An on-off switch located on the transmitter shall disable this function if desired.
10. Time shall be automatically updated from the transmitter 6 times per day.
11. Clocks shall remember the time during changing of batteries.
12. Provide double and single face as indicated.
13. Clock receivers shall be as follows:
 - a. Decode sensitivity: >-110 dBm
 - b. Receiver power: Two alkaline "D" cells
 - c. Antenna type: internal
 - d. Antenna gain: -7 dBd
14. If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded.

D. Transmitter Mounting Rack: Provide one for each transmitter as follows:

1. Manufacturer: Model No. 14005
2. Housing: 18 gauge steel, epoxy coated.
3. Size: 18 inches long, 3 inches wide, 15 inches deep.

E. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- B. Verify that 120 volt electrical outlet is located within 6 feet of location of Master Transmitter and that outlet is operational and properly grounded.

3.2 INSTALLATION

- A. GPS Unit:
 - 1. Install on roof in location indicated, in clear view of the sky.
 - 2. Install unit in location free from standing water, and above accumulations of leaves or debris.
 - 3. Seal cable connection to GPS with cable connection sealant. Any added cable lengths must be protected from outside elements.
- B. Master Transmitter and Wireless Satellite Transmitter and Receiver Switch:
 - 1. Locate transmitter where indicated, a minimum of 24 to 36 inches above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.
 - 2. Install mounting rack where required.
 - 3. Attach receiver to transmitter using cable.
 - 4. Connect antenna to transmitter, using care not to strip threads.
 - 5. Connect power supply to the transmitter.
 - 6. Set the channel number on the display to correspond to the FCC license.
 - 7. Plug power supply into electrical outlet.
- C. Analog Clocks: Perform the following operations with each clock:
 - 1. Install D cell batteries.
 - 2. Set clock to correct time in accordance with manufacturer's instructions.
 - 3. Observe clock until valid signals are received and clock adjusts itself to correct time.
 - 4. Install the clock on the wall in the indicated location, plumb, level and tight against wall. Attach using Clock-Lock hanging method and suitable fasteners as approved by clock manufacturer.
- D. Wire Guards: Secure to wall, using approved theft-resistant fasteners.

3.3 SYSTEM STARTUP

- A. At completion of installation and prior to final acceptance, start up the equipment, assure that all equipment is operating properly, and that all clocks are functioning.
- B. Inspect each clock, adjust as required.
- C. Replace parts which are found defective.
- D. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer.

- E. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.4 DEMONSTRATION

- A. Provide training to Owner's representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.5 PROTECTION

- A. Protect finished installation until final acceptance of the project.

END OF SECTION

SECTION 28 3100 - FIRE ALARM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 26 Section "Electrical General Requirements."

1.02 SUMMARY

- A. This Section includes design and installation of new devices onto an existing new fire alarm system.

1.03 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

- A. Fire alarm system shall consist of the following:
 - 1. All new fire alarm devices, and wiring as applicable connected to existing fire alarm system.
 - 2. System smoke detection above all control panels and notification appliance power supply panels.
 - 3. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
 - 4. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
 - 5. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
 - 6. Audible and visual notification appliances in all public and common areas of the building
 - 7. Fire pump monitoring.

1.05 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.
- C. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.
- D. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.
- E. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.
- F. Premises protection includes Business Group.

1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.
- G. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire alarm system design.
 - b. Fire alarm certified by NICET, minimum Level III.
 2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 3. Device Address List: Include address descriptions that will appear on the FACP display.
 4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
 5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
 6. Batteries: Provide battery sizing calculations. Battery size shall be a minimum of 125% of the calculated requirement.
 7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 8. Voice/Alarm Signaling Service: Equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 9. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show device layout, size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
 1. Contractor to be responsible for all applications and fees associated with required plan review and permits.
- G. Documentation:
 1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.
 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
 - a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.
 - b. Electronic media may be provided to Architect.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 - 1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire alarm service.
 - 2. Do not proceed with interruption of fire alarm service without Architect, Construction Manager and Owner written permission.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. FACP and Equipment:
 - a. National Time and Signal.

2.02 FACP

- A. General Description:
 - 1. Modular, power-limited design with electronic modules, UL 864, 9th edition, listed.
 - 2. Addressable initiation devices that communicate device identity and status.
 - 3. Addressable control circuits for operation of mechanical equipment.
 - 4. Mounting: Surface.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP 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; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 - 1. Signaling Line Circuits between control panels: NFPA 72, Class A, Style 7
 - 2. Signaling Line Circuits from control panel to devices: NFPA 72, Class B, Style 4.
 - a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
 - 3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
 - 4. Actuation of alarm notification appliances, emergency voice communications, annunciation, shall occur within 10 seconds after the activation of an initiating device.
 - 5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

- D. Smoke-Alarm Verification:
 - 1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
 - 2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
 - 3. Sound general alarm if the alarm is verified.
 - 4. Cancel FACP indication and system reset if the alarm is not verified.
- E. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.
- F. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP after initiating devices are restored to normal.
 - 1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 - 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 - 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- G. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- H. Transmission to WSU Department of Public Safety Station: Automatically transmit alarm and trouble signals to WSU Department of Public Safety station through a security control panel. Provide (2) two normally closed contacts in the FACP.
- I. Voice/Alarm Signaling Service: A central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as part of the remote annunciator panel.
 - 1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
 - d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.
 - 2. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

2.03 SYSTEM SMOKE DETECTORS

- A. General Description:
 - 1. UL 268 listed, operating at 24-V dc, nominal.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - 3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.

4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
 - B. Photoelectric Smoke Detectors:
 1. Sensor: LED or infrared light source with matching silicon-cell receiver.
 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
 - C. Duct Smoke Detectors:
 1. Photoelectric Smoke Detectors:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
 2. UL 268A listed, operating at 24-V dc, nominal.
 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
 5. Self-Restoring: Detectors shall 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. Provide remote status and alarm indicator and test station where required.
 7. Each sensor shall have multiple levels of detection sensitivity.
 8. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
 9. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.
- 2.04 HEAT DETECTORS
- A. General: UL 521 listed.
 - B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.
 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- 2.05 NOTIFICATION APPLIANCES
- A. Description: 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.
 - B. Voice/Tone Speakers:
 1. UL 1480 listed.
 2. High-Range Units: Rated 2 to 15 W.
 3. Low-Range Units: Rated 1 to 2 W.

4. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
 - C. Visible Alarm Devices: Xenon strobe lights listed under 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: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.
 2. Strobe Leads: Factory connected to screw terminals.
- 2.06 REMOTE STATUS AND ALARM INDICATORS
- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.
- 2.07 ADDRESSABLE CONTROL MODULE
- A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:
 1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
 2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.
- 2.08 WIRE AND CABLE
- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
 - B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.
 - C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):
 1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
 2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
 - D. Non-Power-Limited Fire Alarm Circuits (NPLFA):
 1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - a. Low-Voltage Circuits: No. 16 AWG, minimum.
 - b. Line-Voltage Circuits: No. 12 AWG, minimum.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
 1. Connect new equipment to the existing control panel in the existing part of the building.
 2. Connect new equipment to the existing monitoring equipment at the Supervising Station.
 3. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

- B. Smoke or Heat Detector Spacing:
 - 1. Smooth ceiling spacing shall not exceed 30 feet
- C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- D. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.
- E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector and each sprinkler water-flow switch and valve-tamper switch that is above 10'-0" aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.
- F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.
- G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96" AFF or 6 inches below the ceiling, whichever is less.
- H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.
- I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- K. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.
 - 1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10', wall mount a smoke detector listed for releasing service 10' AFF or 1' below finished ceiling (whichever is lower).

3.02 WIRING INSTALLATION

- A. Install wiring according to the following:
 - 1. NECA 1.
 - 2. TIA/EIA 568-A.
- B. Wiring Method:
 - 1. Fire alarm circuits shall consist of plenum rated multi-conductor cables installed in accessible ceiling spaces.
 - 2. Drops to surface mounted devices shall be installed in conduit. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
 - 3. Drops to devices recessed in partition walls shall be installed in conduit.
 - 4. 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.
 - 5. Fire alarm circuit cables shall be in conduit in exposed areas or below ceilings.
- C. 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.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code 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.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - a. Include the existing system in tests and inspections.
 - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
 - a. Detectors that are outside their marked sensitivity range shall be replaced.
 - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 PROGRAMMING

- A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

3.08 WARRANTY

- A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

