PROJECT MANUAL FOR: CRITICAL CARE ADDITION – NEW CATH LAB

PROJECT NUMBER: CP190671

AT
UNIVERSITY OF MISSOURI
COLUMBIA, MISSOURI

FOR:
THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:
bcDESIGN GROUP
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DATE: SEPTEMBER 18, 2019

I hereby certify that Drawing Sheets Cover, G100, G101, G102, G103, D100, D101, A100, A200, A600, A700 as well as Specification Sections 02 4119, 02 4126 and Specification Divisions 2-13 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: __________________________

I hereby certify that Drawing Sheets S100 have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: __________________________

I hereby certify that Drawing Sheets DM200, DM201, DM203, DM300, DM301, DM301A, DM301B, DM302, DM501, DM502, M100, M101, M200, M201, M201A, M201B, M202, M203, M203A, M203B, M300, M301, M301A, M301B, M302, M401, M501, M502, M503, M504, M505, M801 as well as Specification Divisions 20-23 (excluding Sections 22 0800 and 23 0800) have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: __________________________

I hereby certify that Drawing Sheets E000, E001, E200, E204, E304, E400, E401, E402, E500, ED100 as well as Specification Divisions 26-28 (excluding section 26 0800) have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Drawings and/or Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Signature: __________________________

BID SET
SECTION 01 9113 – GENERAL COMMISSIONING

PART 1 GENERAL

1.01 DESCRIPTION
A. Burns and McDonnell (BMcD) will act as the Commissioning Authority, hired to verify that the systems work as intended. The Commissioning Authority will inform the Owner of the results of the commissioning and provide suggestions, as necessary, to correct deficiencies in observed performance or installation.
B. Commissioning is the process to verify to the Owner that systems, equipment, mechanical, electrical, controls and special systems function together properly to meet performance requirements and design intent, and as described in the Contract Documents. The Sub contractor shall be responsible for participation in the commissioning process as outlined below and in references and attachments throughout the Contract Documents. The Sub contractor shall furnish labor and materials sufficient to meet all requirements of building commissioning under this contract.
C. Various sections in the Division 22, 23 and 26 Specifications outline the specific commissioning responsibilities of each Sub contractor for the division and also obligate the Construction manager (CM) to coordinate and manage the commissioning responsibility of those subcontractors.

1.02 REQUIREMENTS INCLUDED
A. Duties of Construction Manager and Sub Contractor
B. Duties of Commissioning Authority
C. Acceptance Procedures
D. Performance Period
E. Training and Instruction

1.03 RELATED SECTIONS
A. Section 220800 – Commissioning of Plumbing Systems
B. Section 230800 – Commissioning of Mechanical Systems
C. Section 260800 – Commissioning of Electrical Systems

1.04 TERMS
A. Acceptable Performance: A component or system being able to meet specified design parameters under actual load including satisfactory documented completion of all functional performance tests, control system trending and resolution of outstanding issues.
B. Basis of Design: The Basis of Design is the documentation provided by the design engineer documenting design decisions that were made to meet the design intent as defined by Owner. The Basis of Design describes the systems, components, conditions and methods to meet the design intent.
C. Commissioning Plan: The Commissioning Plan is prepared by the Owner’s Commissioning Authority and defines the scope and format of the commissioning process and the responsibilities of all involved parties. The
Commissioning Plan is provided to all commissioning team members to inform them of the intent and scope of the commissioning work to ensure inclusion in the project scope and to expedite the commissioning process.

D. Functional Performance Testing: That full range of checks and tests carried out to determine if all components, sub-systems, systems and interfaces between systems function in accordance with the Contract Documents. In this context, “function” includes all modes and sequences of control operation, all interlocks and conditional control responses and all specified responses to abnormal emergency conditions. The functional performance tests will be prepared by the Commissioning Authority.

E. Commissioning: The process to assure the Owner that building equipment, controls and systems function together properly to meet design intent and performance requirements shown in a composite manner in the Contract Documents.

F. Resolution Log: The purpose of this log is to provide a method for tracking and resolution of deficiencies discovered as a result of the commissioning process. This list also includes the current disposition of issues and the date of final resolution as confirmed by the Commissioning Authority. Deficiencies are defined as those issues where products, execution or performance do not satisfy the Specifications and/or the design intent. The Resolution Log will be created and managed by the Commissioning Authority.

G. Pre-functional Construction Checklists: Checklist is prepared by the Commissioning Authority. Checklist shall be by system or equipment to verify installation and start-up of equipment is complete and ready for functional testing. These documents require signature by the Sub contractor prior to continuing with the commissioning process.

1.05 DUTIES OF CONSTRUCTION MANAGER AND SUB CONTRACTORS

A. Provide copies of all shop drawings, manufacturer’s literature, maintenance information or other information as may be needed for systems to be commissioned to the Commissioning Authority.

B. Collect the information requested by Commissioning Authority for development of a complete Commissioning Plan, (BMcD)’s on-line and cloud based Commissioning application, and functional tests and provide to the Commissioning Authority. The Sub contractor shall review these documents and confirm in writing to the Owner, and Commissioning Authority any known areas of conflict or areas requiring clarifications.

C. Collect all proposed start-up and Pre-functional Construction Checklists documentation

D. To use (BMcD)’s on-line and cloud based Commissioning application to fill out Construction Checklist and to track issues resolutions. Attendance at one BMcD training class is required for all sub-contractors. This training will take place at the construction Cx kick off. The application will need to be loaded on to sub-sub contractors’ tablet/computer and taken into the
field. Checklist must be completed in the field (computer or tablet will need to be supplied by each sub-sub-contractor)

E. Plan for and incorporate commissioning activities into the construction schedule.

F. Provide Commissioning Authority with submittals for all systems to be commissioned including controls system and wiring diagrams and narrative sequences of operation, in time for use in preparing the Functional Test Procedures.

G. Provide a fully operational system per Specifications, started, verified, debugged, calibrated, balanced, tested and under automatic control.

H. Provide at the end of the job the following items for inclusion in the systems manual:
   1. As built, Control drawings, sequences of control/operation
   2. A table of all set points
   3. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown. This needs to be listed in a word or excel formatted document.
   4. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems (including but not limited to Architectural, Mechanical Electrical, Security and Fire protection). This needs to be listed in a word formatted document.

I. Provide qualified personnel to participate in the commissioning tests, including seasonal testing.

J. Cooperate with the Commissioning Authority’s personnel.

K. Provide access to site for the Commissioning Authority for review, verification and testing activities.

L. Provide organized storage space for project drawings, Specifications, equipment and materials submittals, shop drawings and operation and maintenance manuals in the job site trailers or job site office space.

M. Provide updates to all project documentation to reflect all supplemental instructions, addenda or other revisions to the project construction documents. Updates and supplemental instructions must be posted to the master set of documentation for review and reference by all Contractors and for the Commissioning Authority’s use.

N. Provide adequate time and resources to perform functional testing of system to be commissioned in contract.

O. Coordinate participation of the mechanical, electrical, controls and TAB subcontractors in the commissioning process.

P. Participate in any efforts to finalize sequences of operations with Owner, Designers and Commissioning Authority.

Q. Verify that coordination, installation, quality control and final testing have been completed such that installed systems and equipment comply with construction documents.

R. Review the Commissioning Plan, Project Reports and test results and submit comments to the Commissioning Authority.
S. In a timely manner, address issues identified during construction that may affect the commissioning process or final system performance.

T. Perform start-up and testing of mechanical and electrical equipment and systems and document as required with start-up reports and completion of Pre-functional Construction Checklists. These checklists include installation documentation, start-up documentation, controls point-to-point documentation and calibration documentation, verification that controls sequence of operations meets design intent and TAB final documentation. Reports will be stored in the Sub contractor's field trailer. Sub-contractor will coordinate efforts to complete the pre-functional documentation.

U. Lead verification testing of fire/smoke dampers and direct the resolution of deficiencies. Each damper and all functions of shall be tracked in a matrix spreadsheet.

V. Provide preliminary TAB report, indicating all actual field values recorded to the Commissioning Authority, prior to initiation of functional testing. Let the Commissioning Authority know when the TAB will be ready for the verification of 25% of the systems. Issue a written Notice of Readiness for each system to Commissioning Authority upon completion of all systems work, start-up and Pre-functional Construction Checklists requirements by trade sub-contractors.

W. Provide a detailed start up plan for CxA's review, comment and recommendation.

X. Operate equipment and systems as required for functional performance testing. This includes, but is not limited to, manipulating the appropriate controls systems to execute the Functional Test Procedures.

Y. Participate in the fine-tuning or troubleshooting of system performance, if either of these measures becomes necessary.

Z. Compensate owner for retesting and/or troubleshooting time required by the Commissioning Authority because Sub contractor's systems do not meet specified performance. Back-charge Sub contractors as necessary to collect reimbursement for Commissioning Authority compensation.

AA. Review operating and maintenance data for verification, organization, distribution and conformance to requirement of the Contract Documents.

BB. Submit complete operation and maintenance information and as-built drawings to the Commissioning Authority for compliance review of the requirement of the Contract Documents.

CC. Provide documentation of training for the systems listed to be commissioned.

DD. Provide proprietary test equipment required to test all the systems and equipment in this project.

1.06 DUTIES OF COMMISSIONING AUTHORITY

A. Develop the Commissioning Plan.
B. Develop Functional Test Procedures from Contract Documents and final equipment submittals including narrative sequences of operation, control diagrams and software code for execution with the assistance of Contractor staff as required.

C. Review the Sub contractor’s submittals relative to the systems to be commissioned.

D. Perform site observations to follow installation progress and to verify system installation quality and readiness for testing.

E. Observe or review documentation of validation activities including: Proper test and balance activities, rotating equipment drive alignment, vibration testing, acoustical testing, electrical testing and functional tests for normal and off-normal operating sequences.

F. Review submittal of all required pre-functional and start-up documentation provided by Sub contractor for completeness and reasonableness. This includes installation documentation, start-up documentation, point-to-point checklists and preliminary TAB report, prior to initiation of functional testing.

G. Witness a random selection of TAB readings performed by the TAB sub-contractor.

H. Schedule, direct and witness complete functional testing as defined in the Commissioning Plan and Functional Test Procedures. All testing shall be performed by the Sub contractors and documented by the Commissioning Authority.

I. Witness and verify satisfactory completion of equipment and system tests and inter-systems functional performance tests.

J. Conduct commissioning meetings.

K. Provide site observation, functional tests or other project reports in a timely manner.

L. Document inconsistencies or deficiencies in system operations and system compliance. System deficiencies shall be forwarded to the Owner’s Representative and documented in a Resolution Log.

M. Coordinate via the Construction manager participation of Owner’s personnel with equipment, component and systems performance verification and participation in required training.

N. When commissioning has been successfully completed, recommend acceptance to the Owner.

O. Once all functional tests have been successfully completed and all outstanding issues resolved, the Commissioning Authority will provide the Owner with a Final Commissioning Report of all commissioning activities that occurred during the project.

P. Provide technically qualified personnel when scheduled.

Q. Verify that the specified training schedule of Owner’s personnel is provided.

R. Provide the Owner with a systems manual that contains the information required for re-commissioning the building.
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S. Near the end of the warrant period, the Commissioning Authority will review building operation with the operation and maintenance staff and provide a plan for correction of any outstanding issues.

T. The Commissioning Authority will formally communicate with the Sub contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the subcontractors; records of all contacts will be sent to the Architect through the normal channels.

U. The Commissioning Authority is not authorized to release, revoke, alter or expand requirements of Contract Documents, to approve or accept any portion of the work or to perform any duties of the Sub contractor.

1.07 COMMISSIONING PLAN
A. The Commissioning Plan is a tool through which the commissioning process is described and incorporates the Owner, Architect, Sub contractor and Commissioning Authority roles relative to the commissioning process. Commissioning team members are all sub contractors, contractors and design professionals whose participation is of benefit in the delivery of a fully functioning building to the Owner. The plan shall describe the communication, authority and responsibility of commissioning team members. The Commissioning Plan will include the following:
   1. The purpose of commissioning
   2. Detail the commissioning process
   3. Commissioning team members' responsibilities
   4. Describe Pre-functional Construction Checklist Procedures
   5. Provide a guideline for acceptance of each piece of equipment or system
   6. Systems to be commissioned

1.08 SYSTEMS TO BE COMMISSIONED
A. Systems and Equipment to Be Functionally Tested: The above system features are to be functionally tested and other building features will be evaluated for installation quality during construction. The functional performance testing will include the following systems and equipment:
   (note: If there is 1 failure encountered during TAB or functional testing, the Sampling Rate shall increase by 10%).
1.09 COMMISSIONING ACTIVITIES

A. The Commissioning Schedule: This schedule defines the milestones and conditions that must be achieved before system testing and other commissioning activities can commence. The schedule also includes the expected duration of the various tasks so that the commissioning process can be incorporated into the overall construction schedule.

B. Preparation for Testing: To prepare for the system performance testing, the Commissioning Authority will examine the design and Construction Documents, develop with appropriate Sub contractors Pre-functional Construction Checklists of construction responsibilities that must be completed prior to testing and develop detailed Functional Test Procedures and data forms.

C. Using the Pre-functional Construction Checklists, the Sub contractor must verify that the systems they install are in compliance with the Construction Documents and are fully functional. Commissioning is not intended to be a testing or inspection function that replaces any of the Sub contractors’ obligations for testing and proof of performance. Functional testing will only begin when checklists are completed by the appropriate subcontractors, submitted on line and verified by the Commissioning Authority.

D. Functional Testing: Functional testing is performed by experienced and qualified technicians of the Sub contractor(s), responsible for installation as facilitated by the Commissioning Authority and may be observed by other members of the commissioning team. Functional testing will verify proper sequencing, operation and performance of installed equipment and systems under realistic operating conditions. The functional testing will follow with written Functional Test Procedures with test results documented for permanent record.

E. Documentation: In addition to the Pre-functional Construction Checklists and Functional Test Procedures, written documentation will be maintained for all other commissioning activities. Project communication reports shall be issued by the Commissioning Authority to the Sub

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Total Quantity</th>
</tr>
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</tr>
<tr>
<td>Variable Air Volume Units</td>
<td>New and Existing</td>
<td>13</td>
</tr>
</tbody>
</table>
contractor and key members of the commissioning team to document apparent deficiencies identified during examination of design and construction documents, daily activities on-site, construction deficiencies and successful or unsuccessful functional test results. At the end of the commissioning process, all documentation will be assembled and summarized in the Final Commissioning Report.

F. Deficiency Resolution: When a Project Report is issued to address an identified deficiency, the Sub contractor shall forward the reports to the appropriate parties to initiate corrective action in an expeditious manner. The designer is relied on for supplemental instructions or design modifications and issuance of final design details and the Sub contractors are relied on for implementation of that design. Change orders must be issued through proper contract channels.

1.10 FUNCTIONAL TEST PROCEDURES
A. The Functional Test Procedures include, but are not limited to, the following:
   1. Verification of testing, adjusting and balancing performance.
   2. Verification of all equipment’s ability to perform to the design intent.
   3. Verification of the performance of sub-systems consisting of combinations of equipment (e.g., refrigeration cycle, pumps and interconnecting piping).
   4. Verification of the performance of the automatic controls in all seasonal modes.
   5. Verification of the performance of the HVAC system as a whole.
   6. Verification of the performance of all life safety devices and systems that interface with the HVAC systems.

PART 2 PRODUCTS
2.01 Not used in this section.

PART 3 EXECUTION
3.01 GENERAL
A. Operating equipment and systems shall be tested in presence of Owner’s Commissioning Authority to demonstrate compliance with specified requirements.
   1. Notify Owner, in writing, fourteen (14) days prior to tests scheduled under requirements of this Section.
   2. Testing shall be conducted under specified design operating conditions as recommended or approved by Owner.
B. Functional performance testing shall be completed and accepted by Owner as a condition of final completion.
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C. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each sub-system, followed by entire system, followed by entireties to other major systems.

D. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing sub contractor. Manufacturer shall provide the test equipment, demonstrate its use, and assist the Commissioning Authority in the commissioning process.

E. Acceptance Documentation: A copy of the functional performance tests results shall be necessary acceptance documentation along with other specified requirements.

3.02 ACCEPTANCE PROCEDURES

A. Prior to functional performance testing of each system, the Commissioning Authority shall observe and verify that the physical installation of components and systems being tested is substantially installed in accordance with the Contract Documents.

B. Sub contractor’s Tests

1. System shall be checked for proper installation, shall be adjusted and calibrated to verify that it is ready to function as specified.

2. All system elements shall be checked to verify that they have been installed properly and that all connections have been made correctly.

3. All discrete elements and sub-systems shall be adjusted and checked for proper operation.

4. Start-up and operational tests shall be complete, with all required Pre-functional Construction Checklists submitted for review by Commissioning Authority within five (5) days of each activity, prior to starting functional performance testing.

C. CxA-witnessed Functional Tests

1. Objective of these tests is to demonstrate that system is operating and complying with specified performance requirements.

2. Owner-witnessed functional performance tests shall be performed on complete system. Each function shall be demonstrated to satisfaction of the Owner’s Commissioning Authority on paragraph-by-paragraph basis of Commissioning Authority’s written test procedure, developed to demonstrate conformance to requirements of the Specifications.

3. Functional performance tests shall be witnessed and endorsed by the Commissioning Authority upon satisfactory completion.

4. Actual testing program shall be conducted in accordance with prior approved procedures and shall be documented as required herein.
5. Sub contractor shall notify Commissioning Authority and Owner at least two (2) weeks prior to date of functional performance tests.

D. The functional performance testing process shall be accomplished for all equipment, sub-systems, systems and system interfaces. All must be tested for acceptances and there shall be a separate checklist for each to ensure documentation specific to each is complete.

E. Each system shall be operated through all modes of system operation (e.g., seasonal, occupied, unoccupied, warm-up, cool-down, etc., as applicable) including every individual interlock and conditional control logic, all control sequences, both full-load and part-load conditions and simulation of all abnormal conditions for which there is a specified system or controls response. The warm-up and cool-down test shall be a performance test.

F. Temporary upsets of systems, such as distribution fault, control loss, setpoint change, equilibrium upset and component failure, shall be imposed at different operation loads to determine system stability and recovery time.

G. When the functional performance of all individual systems has been proven, the interface or coordinated responses between systems shall be checked. The systems involved may be within the overall HVAC work or they may involve other systems, such as emergency systems for life safety.

H. Corrective Measures: If acceptable performance cannot be achieved, the cause of the deficiency will be identified. If it is determined that the deficiency was caused by the system or component not being installed per the manufacturer’s recommendations or Contract Documents, the necessary corrective measures shall be carried out by the Sub contractor. Every check or test for which acceptable performance was not achieved shall be repeated after the necessary corrective measures have been completed. This re-testing process should be repeated until acceptable performance is achieved. The Sub contractor will be allowed one retest after initial testing of the equipment. If the retest fails the Sub contractor shall be financially responsible, at standard rates, to reimburse the Commissioning Authority for the additional time taken to achieve acceptable performance.

3.03 TRAINING AND INSTRUCTION

A. Training and instruction of Owner personnel is a part of the commissioning process and essential for the proper operation of the facility. The sub contractors and vendors providing the training will complete training plans and submit to the Commissioning Authority for review and approval in conjunction with the Owner’s representative.

3.04 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

A. Seasonal commissioning pertains to testing under full-load conditions during peak heating and peak cooling seasons, as well as part-load conditions in the spring and fall. Initial commissioning will be done as soon
as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons.

B. All equipment and systems will be tested and commissioned in a peak season to observe full-load performance. Heating equipment will be tested during winter design extremes. Cooling equipment will be tested during summer design extremes, with a fully occupied building. Each Sub contractor and supplier will be responsible to participate in the initial and the alternate peak season test of the systems required to demonstrate performance.

C. Subsequent commissioning may be required under conditions of minimum and/or maximum occupancy or use. All equipment and systems affected by occupancy variations will be tested and commissioned at the minimum and peak loads to observe system performance. Each Contactor and supplier will be responsible to participate in the occupancy sensitive testing of systems to provide verification of adequate performance.

3.05 RETESTING OR ADDITIONAL TESTING DUE TO FAILURES

A. The cost, including the CxA’s time, to retest a PC or FPT shall be the Construction Manager’s (CM).

B. The time for the CxA to direct any retesting required because a specific PC or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the Construction Manager, who may choose to recover costs from the party responsible for executing the faulty pre-functional test.

C. If a second, subsequent startup, retest, or increased sampling is required, for any reason, or if Installing Sub contractor is not ready for a startup or test at the scheduled time, the CM shall compensate the Owner for the CxA’s additional time and expenses. Compensation shall be computed by multiplying hours worked by CxA times CxA’s established billing rate and adding the cost of CxA’s expenses (including by way of example but not limitation: air travel, car rental, lodging, long distance, reproduction, special insurance, procured equipment, leased equipment, delivery service, and postage). CM may unilaterally withhold said funds from payments otherwise due to Installing Sub contractor.

1. The Sub contractor shall respond in writing to the CxA and CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

2. The CxA retains the original non-conformance forms until the end of the project.

3. Any required retesting or increased test sampling by any sub
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contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime sub contractor.

D. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the CM. In such case, the Sub contractor shall provide the Owner with the following:

1. Within one week of notification from the CM, the Sub contractor or manufacturer’s representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM within two weeks of the original notice.

2. Within two weeks of the original notification, the Sub contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

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

4. Two examples of the proposed solution will be installed by the Sub contractor and the CM will be allowed to test the installations for up to one week, upon which the CM will decide whether to accept the solution.

5. Upon acceptance, the Sub contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

3.06 SCHEDULE
A. Refer to Commissioning Plan for commissioning milestones that need to be incorporated into construction schedule.

END OF SECTION 019113
PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Repair procedures for selective demolition operations.

B. Related Sections include the following:

1. Division 1 for use of the premises and phasing requirements.
2. Division 1 for restrictions on use of the premises due to Owner occupancy.
3. Division 1 for temporary construction and environmental-protection measures for selective demolition operations.
4. Division 2 for cutting and patching procedures for selective demolition operations.
5. Sections for demolishing, cutting, patching, or relocating mechanical items.
6. Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner’s property, demolished materials shall become Contractor’s property and shall be removed from Project site.

1.5 SUBMITTALS

A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of temporary partitions and means of egress.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Professional Engineer Qualifications: Where a professional engineer is required to determine the structural suitability of demolition and/or shoring, employ a Professional Engineer licensed by the State of Missouri.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Demolition in a Fire-Rated System: When any pipe, duct, louver, damper, accessory, equipment or other element is indicated (or required to permit the completion of the work) to be abandoned or removed from an existing fire rated floor, wall, ceiling or roof system, the ensuing opening shall be patched to match the surrounding in a manner to comply with code requirements and to match the required fire rating of the existing surrounding construction whether or not specifically detailed or noted on the Drawings. If the patching is in an exposed area, the patching shall match existing. If new equipment or construction fills the majority of the opening, the seal between the old and new construction shall be installed to comply with no less than the fire rating of the existing construction.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials:

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

C. Utility Requirements: Refer to Divisions 22, 23, 26, 27 and 28 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

D. Terminate MEP utilities per UM System requirements.

3.3 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Airborne construction dust containment control from ceiling to deck:
   a. If not feasible/possible to extend partition to deck, extend and seal tight 6-mil fire retardant polyethylene listed by Fire Underwriter's Laboratories, Griffolyn #T55R or Star-Tex of Lakeville, MN 55044 with Griffolyn Fire retardant tape, or approved equal, from ceiling to deck.

2. Contamination Control Mats outside of dust enclosure:
   a. Tacky Mat 800030 (High tack) by Liberty Industries, 133 Commerce Street, East Berlin, Connecticut, 06023, 1-800-828-5656, or approved equal.

E. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Remove all abandoned and permanently disconnected items. Do not abandon in place. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches without written permission of the Owner and until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
   a. Maintain adequate ventilation when using cutting torches.

5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

7. Dispose of demolished items and materials promptly.

8. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Owner, items may be removed to a suitable, protected storage location during selective and reinstalled in their original locations after selective demolition operations are complete.

C. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

D. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
   1. Clean, salvage and bind one pallet of blended face brick salvaged during demolition. Cleaned and salvaged brick shall be suitable for future installation in other areas of the building. Contractor shall move pallet to location as directed by Owner's Representative.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

3.5 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Division 2.

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
   1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
   2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
a. In areas where refinishing of existing surfaces is required as part of the selective demolition operation or called for as part of the overall finishing of a given area, the existing surfaces shall be properly prepared by patching, filling of indentations, sanding and smoothing of existing finish surfaces, and priming in preparation of finishing the surfaces.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
SECTION 02 4126 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include:
   1. See Division 07 Section "Penetration Firestopping" for patching fire-rated construction.
   2. See Divisions 02 through 28 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching, in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected
3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching.

1. Cut existing construction and subsequently patch to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction.

1. In general, cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

C. Patching: Patch construction with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

2. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. In areas where refinishing of existing surfaces is required as part of the selective demolition operation or called for as part of the overall finishing of a given area, the existing surfaces shall be properly prepared by patching.
filling of indentations, sanding and smoothing of existing finish surfaces, and priming in preparation of finishing the surfaces.

b. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch – from corner to corner at the logical breaking point for the finish, unless specifically noted otherwise. Provide additional coats until patch blends with adjacent surfaces.

3. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 02 4126
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim, and miscellaneous trim units.
4. Solid Surface countertops.

B. Architectural woodwork specified in this Section and detailed on the Drawings shall be custom fabrications constructed and installed by a qualified woodwork fabricator for undivided responsibility. The use of "modular casework" in an attempt to achieve the same layout and design as indicated will not be allowed.

C. Related Sections include the following:

1. Division 08 Section "Flush Wood Doors."
2. Division 09 Section "Painting" for field finishing of interior architectural wood trim.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

C. Samples for Verification: For the following:

1. Lumber with or for transparent finish, 50 sq. in. (300 sq. cm) for each species and cut, finished on 1 side and 1 edge.
2. Wood-veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
D. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork.

C. Quality Standard: Unless otherwise indicated, comply with AWI’s “Architectural Woodwork Quality Standards” for grades of interior architectural woodwork, construction, finishes, and other requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in “Project Conditions”.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS
A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: Plain Sliced Red Oak to match existing.

C. Wood Products: Comply with the following:
   2. High Performance Particleboard Core:
      a. Particleboard shall be of 47 lb. density, and balanced construction with moisture content not to exceed 8%. Three-ply particleboard shall exceed the requirements for its type and classification under Commercial Standard CS-236-66, Federal Specifications LLL-B-800A, and ASTM D 1037-78.
         1) Provide Extira™ Treated Exterior Composite as manufactured by CMI (1-866-382-8701) at all wet area countertops and backsplashes. Use only adhesives recommended by CMI. Water based adhesives are not recommended.

D. Thermoset Decorative Overlay (Melamine): Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
   1. Colors per Finish Schedule.

E. High-Pressure Decorative Laminate: NEMA LD 3, grade, colors and patterns as indicated, or if not indicated, as required by woodwork quality standard.

F. Adhesive for Bonding Plastic Laminate: Urea-formaldehyde.

G. Cabinet Backs at Exposed Fixed or Adjustable Shelving (Base or Upper Cabinets): Unless noted otherwise on the Drawings, the exposed back and the inside vertical ends of the unit, any vertical standards or divisions in the shelving unit, and the shelves themselves shall be 3/4 inch thick particleboard (min.) covered with plastic laminate to match the face of the adjacent cabinets. No melamine shall be exposed.

H. Shelving Fixed or Adjustable: Shelves shall be 3/4 inch thick particleboard (min.), unless noted or specified otherwise, covered with plastic laminate or Melamine – top, bottom and all edges.

2.2 SOLID SURFACE

A. Solid Polymer Components:
   1. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6, having minimum physical and performance properties specified.
   2. Flat sheet products shall comply with material and performance requirements in ASSFA-2-01 (2002). ISSFA is the International Solid Surface Fabricators Association established to regulate the solid surface industry.
3. Superficial damage to a depth of 0.010 inch (.25 mm) shall be repairable by sanding and/or polishing.

4. Products: Subject to compliance with requirements, provide one of the following:
   
   a. Avonite; Avonite, Inc.
   b. Corian; DuPont Polymers.
   c. Formica® Solid Surfacing; Formica Corporation.
   d. Swanstone; Swan Corporation (The).
   e. Gibraltar; Wilsonart International, Div. of Premark International, Inc.

B. Provide continuous countertop reinforcement at ALL SOLID SURFACE COUNTERTOPS. Reinforcement shall consist of a sub top made from 1" thick "Extira" composite panel material, adhered to underside of countertops using Polyseam seal.

C. All solid surface joints shall be glued with manufacturer’s 2-part solid surface seaming adhesive.

D. All field applied backsplashes are to be glued to tops using manufacturer’s 2-part solid surface seaming adhesive. **Any other sealant will be removed at the installer’s expense.**

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section “Door Hardware. All exposed cabinet fasteners shall be tamper-resistant.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
2. Satin Stainless Steel: BHMA 630.

D. For concealed hardware, provide manufacturer’s standard finish that complies with product class requirements in BHMA A156.9.

E. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal.

F. Back-Mounted Pulls: BHMA A156.9, B02011.

G. Wire Pulls: Back mounted, 4 inches (100 mm) long, 5/16 inches (8 mm) in diameter.

H. Catches: Magnetic catches, BHMA A156.9, B03141. At cabinets exceeding 36” in height, provide two per door located at the top and bottom.

I. Adjustable Shelf Standards and Supports: End of Shelf Supports, BHMA A156.9, B04071; with shelf rests, B04081. Furnish and install KV 85-185 double slot standards with brackets for shelving mounted to back of wall.
J. Shelf Rests for Drilled Holes: BHMA A156.9, B04013.
   1. Provide metal shelf rests, unless noted otherwise.

K. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:
   1. Box Drawer Slides: 100 lbf (440 N).
   3. NO METABOX DRAWER SYSTEMS ALLOWED, NO EXCEPTIONS.

L. Undercounter Metal Support Brackets: Provide Work Station Brackets, in sizes required, as marketed by A & M Hardware, Inc., Website: www.AandMhardware.com, Phone: 888-647-0200, Fax: 717-664-4582. Brackets shall be spaced no farther apart than 3'-0' o.c. Refer to Drawings for suggested location of undercounter brackets and coordinate final location on shop drawings after reviewing jobsite conditions (outlet and communication boxes, etc.) with the Architect.
   1. Maximum spacing for metal undercounter supports shall be 36"o.c. Coordinate spacing with elevations on the drawings and adjust location(s) of brackets so as to not interfere with wall outlets and undercounter devices. Also coordinate location of brackets with any webbing provided with the countertop for support of heavy appliances to be located on the countertop above. If location of undercounter support does not coordinate with the mentioned webbing or if the countertop does not require webbing, provide a 1x4 blocking member at the location of every support bracket.
   2. Factory-Primed and Field Painted: Color as selected by the Architect.

M. Door Locks: BHMA A156.11, E07121.

N. Drawer Locks: BHMA A156.11, E07041.

O. Provide panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above locked compartments and drawers (between locked and non-locked components), unless located directly under tops.

P. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, brown, molded-plastic grommets and matching plastic caps with slot for wire passage.
   1. Product: Subject to compliance with requirements, provide grommets by Doug Mockett and Co., Inc.

Q. File Hangers: 1/8-inch x 1-inch aluminum bars rabbeted in drawers for use with ‘Pendaflex’ hanging files at all drawers noted as ‘file’.
   1. Casework manufacturer to verify that files are deep enough to provide clear glide of hanging files with plastic insert tabs on top. Files are to hang in the drawer without dragging on bottom of drawer and without plastic tab markers dragging on top of the drawer or impeding the closing of the drawer.

2.4 INSTALLATION MATERIALS
A. **Furring, Blocking, Shims, and Hanging Strips:** Metal strap blocking shall be used at all locations where blocking is required for the installation of interior architectural woodwork. **No wood blocking will be allowed.**

B. **Anchors:** Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

### 2.5 FABRICATION, GENERAL

A. **Interior Woodwork Grade:** Provide Premium grade interior woodwork complying with the referenced quality standard.

B. **Wood Moisture Content:** Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
2. Edges of Laminate counter tops and other fabrications: Bevel one of the laminate sheets at the edge as indicated AWI 400C-G-1, unless noted otherwise.
4. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).

E. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

F. **NO LENGTH OF SHELVING**, exposed to view or concealed, **MAY EXCEED 30' IN LENGTH without support on three sides of the shelf or by compensating for the additional length by an increase in thickness of the shelf, or by additional edge support on the face and rear of the shelf.**

G. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

H. **Install glass to comply with applicable requirements in Division 8 Section "Glazing" and in GANA's "Glazing Manual."** For glass in wood frames, secure glass with removable stops.
2.6 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI Section 400 (400B) requirements for laminate cabinets.

B. Grade: Premium.

C. AWI Type of Cabinet Construction: Reveal overlay on face frame.

D. Reveal Dimension: 1/2 inch (13 mm), unless noted otherwise.

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. Grade: Premium.

C. High-Pressure Decorative Laminate Grade: HGS - 0.048 inch, 1.2 mm.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. Provide Architect's selections from manufacturer's full range of colors and finishes.

E. Edge Treatment:
   1. Countertops: 3 mm PVC edge – Color as shown on the finish schedule.
   2. Cabinet Doors & Drawers: Self-edge

F. Core Material: Plywood

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS AND WINDOW SURROUNDS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

B. Grade: Premium.

C. Solid-Surfacing-Material Thickness: 1/2 inch (13 mm).

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
   1. Match color, pattern, and finish as indicated by manufacturer's designations for these characteristics.
   3. Provide Architect's selections from manufacturer's full range of colors and finishes.

E. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

2.9 SOLID SURFACE INTEGRAL BOWL SINKS
A. Basis of Design: Corian, Glacier White

B. Sink “S1”: Corian 859

2.10 SHOP FINISHING

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation. The extent to which the final finish is applied at fabrication shop is Contractor's option, except shop apply at least the prime coat before delivery.

D. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed, tamper resistant fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening,
countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches (1500 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head, tamper resistant sheet metal screws through metal backing or metal framing behind wall finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
4. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

H. Complete the finishing work specified in this Section to extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in shop.

I. Refer to Division 9 Sections for final finishing of installed architectural woodwork.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.
C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 4023
SECTION 07 8413 - THROUGH-PENETRATION FIRESTOP SYSTEMS [PENETRATION FIRESTOPPING]

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Walls and partitions.
2. Floors.
3. Smoke Barriers.

B. Related Sections include the following:

1. Division 23 Sections specifying duct and piping penetrations.
2. Division 26, 27, 28 Sections specifying cable and conduit penetrations, including but not limited to, EZ Path devices.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated floor assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per UL 1479 or ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.
3. Penetrations located in construction containing fire-protection-rated openings.
4. Penetrating items larger than 4-inch- (100-mm-) diameter nominal pipe or 16 sq. in. (100 sq. cm) in overall cross-sectional area.
D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical
damage, provide products that after curing do not deteriorate when exposed to these
conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide
moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and
exposed to possible loading and traffic, provide firestop systems capable of
supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop
systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-
spread ratings of less than 25 and smoke-developed ratings of less than 450, as
determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of
construction condition penetrated, relationships to adjoining construction and kind of
penetrating item. Include firestop design designation of testing and inspection agency
acceptable to authorities having jurisdiction that evidences compliance with
requirements for each condition indicated.
1. For those firestop applications that exist for which no UL tested system is available,
and engineering judgment derived from similar UL Systems designs or other tests
shall be submitted to local authorities having jurisdiction for their review and
approval prior to installation. Engineer Judgments drawings must follow
requirements set forth by the International Firestop Council.

C. Qualification Data: For firms and persons specified in “Quality Assurance” Article to
demonstrate their capabilities and experience. Include lists of completed projects with
project names and addresses, names and addresses of architects and owners, and
other information specified.

D. Product Certificates: Signed by manufacturers of through-penetration firestop system
products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating through-penetration
firestop system complies with requirements, based on comprehensive testing of current
products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Must be a single installer and a firm experienced in installing
penetration fire stopping similar in material, design, and extent to that indicated for this
Project, whose work has resulted in construction with a record of successful
performance. Installer shall be certified, licensed, FM approved in accordance with PM
4991, certified by UL as a qualified contractor. Fire-Test-Response Characteristics:
Penetration fire stopping shall comply with the following requirements: Penetration fire
stopping tests are performed by a qualified testing agency acceptable to authorities
having jurisdiction. Penetration fire stopping is identical to those tested per testing
standard referenced in "Penetration Fire stopping" Article. Provide rated systems complying with the following requirements: A. Penetration fire stopping products bear classification marking of a qualified testing and inspecting agency. B. Classification markings on penetration fire stopping correspond to designations listed by the following: 1) UL in its "Fire Resistance Directory." C. Obtain fire stop systems for each type of penetration or joint opening and construction condition indicated from a single manufacturer. Fire Stopping Contractor shall submit certificates and qualifications for approval prior to commencement of work.

1. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Firestop system installation must meet requirements of UL 1479 or ASTM E-814 tested assemblies that provide a fire rating equal to that of construction being penetrated.

D. Proposed firestop materials and methods shall conform to applicable governing codes having jurisdiction.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers’ labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. Do not use damaged or expired materials.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

C. Do not use materials that contain flammable solvents.

D. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

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

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hilti, Inc. (800) 879-8000
2. 3M Fire Protection Products.
4. It is the intent to have all firestopping materials (penetration and fire-resistive joint systems) installed in one color.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.

2. Temporary forming materials.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture. Product shall be equal to Hilti FS-One intumescent firestop sealant.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant. Product shall be equal to Hilti CP 642 and CP 643 firestop collar.

D. Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways. Product shall be equal to Hilti FS 635 FIRE BLOCK and Hilti FS 635 Trowelable Firestop Compound.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds. Product shall be equal to Hilti CP 618 Firestop Putty Stick.


G. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Polyurethane Foams: Two part polyurethane foam for sealing hard to reach penetrations. Product shall be equal to Hilti CP 620.

I. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.


J. Provide an "F"-rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.
2.4 MIXING

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

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system’s seal with substrates.

3.2 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION


B. Manufacturer’s Instructions: Comply with manufacturer’s written installation instructions and published drawings for products and applications indicated.

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

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
D. Install fill materials for firestop systems by proven techniques to produce the following results:

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

E. Install wall-mounted, self-adhesive labels at each penetration upon completion of installation.

3.3 FIELD QUALITY CONTROL

A. All areas of work must be accessible until inspection by the applicable Code Authorities.

B. Correct unacceptable firestops and provide additional inspection to verify compliance with this specification at no additional cost to the Owner.

1. Identify damaged, improperly installed or re-entered seals for repair or modification.
2. Modifications to penetrations shall be accomplished per the firestop material manufacturer’s recommendations.
3. Only materials used in the original seal and designated by the manufacturer as suitable for said repair shall be used for this purpose.

C. Do not proceed to enclose through-penetration firestop with other construction until reports of approval by examinations are issued.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

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

END OF SECTION 07 8413
SECTION 07 8446 - FIRE-RESISTIVE SMOKE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fire-resistive joint systems for the following:

1. Floor-to-wall joints.
2. Head-of-wall joints.
3. Wall-to-wall joints.
4. Joints requiring restriction of smoke migration

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
2. Division 07 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General:  For joints in the following constructions, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed:

1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated floor assemblies.

B. Fire Resistance of Joint Systems:  Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction and kind of penetrating item. Include firestop design designation of testing and inspection agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. For those firestop applications that exist for which no UL tested system is available, and engineering judgment derived from similar UL Systems designs or other tests shall be submitted to local authorities having jurisdiction for their review and
approval prior to installation. Engineer Judgments drawings must follow requirements set forth by the International Firestop Council.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Compatibility and Adhesion Test Reports: From fire-resistive joint system manufacturer indicating the following:

1. Materials forming joint substrates have been tested for compatibility and adhesion with fill materials.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.


G. Research/Evaluation Reports: For each type of fire-resistive joint system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Must be a single installer and a firm experienced in installing fire resistive smoke joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Installer shall be certified, licensed, FM approved in accordance with PM 4991, certified by UL as a qualified contractor. Fire-Test-Response Characteristics: Fire resistive smoke joint systems shall comply with the following requirements: Fire resistive smoke joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction. Fire resistive smoke joint systems are identical to those tested per testing standard referenced in "Fire resistive smoke joint systems" Article. Provide rated systems complying with the following requirements: A. Fire resistive smoke joint systems products bear classification marking of a qualified testing and inspecting agency. B. Fire resistive smoke joint systems markings on penetration fire stopping correspond to designations listed by the following: 1) UL in its "Fire Resistance Directory." C. Obtain fire stop systems for each type of Fire resistive smoke joint systems and construction condition indicated from a single manufacturer. Fire Stopping Contractor shall submit certificates and qualifications for approval prior to commencement of work.

1. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

B. Source Limitations: Obtain fire-resistive joint systems for each kind of joint and construction condition indicated through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing
testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.

2. Fire-resistive joint systems are identical to those tested per UL 2079. Provide rated systems complying with the following requirements:

   a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
   b. Fire-resistive joint systems correspond to those indicated by referencing system designations listed by the following:

      1) UL in its "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

   A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

   B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

   A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

   B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

   A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

   B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

   C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   a. Fire-Resistive Joint Systems:
      1) Hilti, Inc.
      2) Specified Technologies Inc.
      3) 3M Fire Protection Products.

   b. Smoke-Resistive Joint Systems
      1) Hilti, Inc. CP506 Smoke and Acoustic Sealant
      2) Specified Technologies Inc.: Smoke ‘N’ Sound Sealant

B. It is the intent to have all firestopping materials (penetration and fire-resistant joint systems) installed in one color.

2.2 FIRE-RESISTIVE JOINT SYSTEMS, GENERAL

A. Compatibility: Provide fire-resistant joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistant joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistant joint systems, including forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistant joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

2.3 FIRE-RESISTIVE JOINT SYSTEMS

A. Where UL-classified fire-resistant joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

B. Floor-to-Wall, Fire-Resistive Joint Systems:
   1. Available UL-Classified Products:
      a. Submit manufacturer’s assembly to satisfy requirement.
   2. Assembly Rating: Per drawings.
   3. Joint Width: Per drawings, field verify.
   4. Movement Capabilities: Class I

C. Head-of-Wall, Fire-Resistive Joint Systems:
   1. Available UL-Classified Products:
      a. Submit manufacturer’s assembly to satisfy requirement.
   2. Assembly Rating: Per drawings.
   3. Joint Width: Per drawings, field verify.
   4. Movement Capabilities: Class I
D. Wall-to-Wall, Fire-Resistive Joint System:

1. Available UL-Classified Products:
   a. Submit manufacturer’s assembly to satisfy requirement.

2. Assembly Rating: Per drawings.
3. Joint Width: Per drawings, field verify.
4. Movement Capabilities: Class I

2.4 SMOKE-RESISTIVE JOINT SYSTEMS

A. Use smoke-resistive joint sealant systems where the construction requires a smoke-rating but is a Non Fire-Rated Assembly. Smoke-resistive joint sealant shall be passed the Air Leakage test (Modified UL 2079 L-Rating, or other air leakage testing.)

B. Compatibility: Provide smoke-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by smoke-resistive joint system manufacturer based on testing and field experience.

C. Accessories: Provide components of smoke-resistive joint systems that are needed to install materials and to comply with Code requirements. Use only components specified by smoke-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.

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

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer’s written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer’s recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system’s seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 “Performance Requirements” Article and fire-resistive joint system manufacturer’s written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Install wall-mounted, self-adhesive labels at each penetration upon completion of installation.

3.4 FIELD QUALITY CONTROL

A. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and inspecting agency has approved installed fire-resistive joint systems.

B. If deficiencies are found, repair or replace fire-resistive joint systems so they comply with requirements.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

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

END OF SECTION 07 8446.13
SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Vertical joints on exposed surfaces of walls and partitions.
   d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   f. Other joints as indicated.

B. Related Sections include the following:

1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
2. Division 08 Section "Glazing" for glazing sealants.
3. Division 09 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Division 09 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
D. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
B. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

C. Single-Component Neutral-Curing Silicone Sealant:

1. Products:
   a. Dow Corning Corporation; 791.  [Class 50, Use NT]
   b. GE Silicones; SilPruf NB SCS9000.  [Class 50, Use NT]
   c. Pecora Corporation; 865.  [Class 50, Use NT]

2. Type and Grade: S (single component) and NS (nonsag).

3. Class: As indicated.

4. Use Related to Exposure: As indicated; NT (nontraffic).

5. Uses Related to Joint Substrates:
   a. As applicable to joint substrates indicated, O.
      
      1) Ceramic tile
      2) Plastic laminate to gypsum drywall/CMU at backsplashes

D. Sink Areas: All sink areas shall be sealed with "Poly-Seam-Seal." Latex caulk shall not be allowed in these areas.

E. Door Jamb / Floor Intersections: Seal joint at intersection of door jambs and VCT flooring with Pecora 898 Silicone Sanitary Sealant.

2.4 Contractor's Option for Urethane Sealants: At the contractor's option, the urethane sealants may be single- or multi-component. However, the sealant systems used must meet the Use Classification of the joints being sealed. A list of potential urethane sealants is listed below.

A. Nonsag Urethane Sealant - Multicomponent:

1. Products:
   a. Pecora Corporation; Dynatrol II.  [Class 50, Use NT]
   b. Tremco; Dymeric 240.  [Class 50, Use NT]
   c. Sika Corporation, Inc.; Sikaflex - 2c NS TG.  [Class 25, Use NT & T]
   d. Sonneborn, Division of ChemRex Inc.; NP 2.  [Class 25, Use NT & T]
   e. Tremco; Vulkem 227.  [Class 25, Use NT & T]

2. Type and Grade: M (multicomponent) and NS (nonsag).

3. Class: As indicated.

4. Uses Related to Exposure: As indicated.

5. Uses Related to Joint Substrates:
   a. M - masonry
   b. G - glass
   c. A - aluminum
   d. And, as applicable to joint substrates indicated, O.
1) Color anodic aluminum
2) Aluminum coated with a high-performance coating
3) Galvanized steel
4) Brick
5) Granite
6) Limestone
7) Marble
8) Ceramic tile
9) Wood

B. Nonsag Urethane Sealant - Single-Component:

1. Products:
   a. Sika Corporation, Inc.; Sikaflex - 15LM. [Class 100/50, Use NT & T]
   b. Sonneborn, Division of ChemRex Inc.; NP 1. [Class 25, Use NT & T]
   c. Tremco; Vulkem 116. [Class 25, Use NT & T]
   d. Bostik Findley; Chem-Calk 900. [Class 25, Use NT]
   e. Pecora Corporation; Dynatrol I-XL. [Class 25, Use NT]
   f. Tremco; DyMonic. [Class 25, Use NT]
   g. Tremco; Vulkem 931. [Class 100/50, Use NT]

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: As indicated.
4. Uses Related to Exposure: As indicated.
5. Uses Related to Joint Substrates:
   a. M - masonry
   b. G - glass
   c. A - aluminum
   d. And, as applicable to joint substrates indicated, O.

   1) Color anodic aluminum
   2) Aluminum coated with a high-performance coating
   3) Galvanized steel
   4) Brick
   5) Granite
   6) Marble
   7) Ceramic tile
   8) Wood

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical sealants are specified in Section "Gypsum Board Assemblies."

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

   a. Concrete.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

   a. Metal.
   b. Glass.
   c. Porcelain enamel.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer and/or based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer’s written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer’s written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form
smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 9200
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Hollow metal door frames.
   2. Fire-rated door frames.

B. Related Sections include the following:
   1. Division 08 Section “Flush Wood Doors” for wood doors installed in hollow metal frames.
   2. Division 08 Section "Door Hardware" for door hardware and weather stripping.
   3. Division 08 Section “Glazing” for glass in glazed openings in doors and frames.
   4. Division 09 Section "Painting" for field painting factory-primed doors and frames.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

A. Product Data: For each type of frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

B. Shop Drawings: Show the following:
   1. Frame details for each frame type including dimensioned profiles.
   2. Details and locations of reinforcement and preparations for hardware.
   3. Details of each different wall opening condition.
   4. Details of anchorages, accessories, joints, and connections.
   5. Coordination of glazing frames and stops with glass and glazing requirements.

C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

1.5 QUALITY ASSURANCE

A. Hollow metal Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having
jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test using positive-pressure testing, unless otherwise noted or allowed by authorities having jurisdiction.

2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished frames.

B. Inspect frames on delivery for damage and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Do not use plastic or canvas shelters. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hollow Metal Frames:
   a. Amweld Building Products, Inc.
   b. Ceco Door Products; a United Dominion Company.
   c. CURRIES Company; an ASSA ABLOY Group Company.
   d. Steelcraft; a division of Ingersoll-Rand.
   e. Substitutions must meet and comply with SDI and be current members.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets for All Door Faces: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets for Exterior Doors and Frames: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 (ZF120) zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
D. Electrolytic Zinc-Coated Steel Sheet for Interior Doors and Frames: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

2.3 FRAMES

A. General: Provide hollow metal frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Interior Door Frames of 0.053-inch- (1.3-mm-) [16 gage] minimum thick steel sheet for:

1. All interior doors, unless noted otherwise.

C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

D. Supports and Anchors: Fabricated from not less than 0.042-inch- (1.0-mm-) thick, electrolytic zinc-coated or metallic-coated steel sheet.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.4 FABRICATION

A. General: Fabricate hollow metal frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer’s plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Frame Construction: Fabricate frames to shape shown.

1. For interior applications, fabricate frames according to ANSI/SDI A250.8, conforming to the definition of Fully Welded Frames that are completely welded along all elements (along the face, soffit, stops, and rabbets).
2. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops required wider dimension on glass side of frame.
3. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 46-inch and wider with mortise/butt type hinges at top hinge location.
4. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

C. Reinforce frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

D. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
E. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- (0.8-mm-) thick steel sheet.

1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

2.5 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install hollow metal doors, frames, and accessories according to Shop Drawings, manufacturer’s data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
2. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
3. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
4. Install fire-rated frames according to NFPA 80.
5. For openings 90 inches (2286 mm) or more in height, install an additional anchor at hinge and strike jambs.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08 1113
SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. High Impact acrylic modified vinyl faced doors.

B. Related Sections include the following:

1. Division 08 Section "Door Hardware" for required door hardware.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire ratings for fire doors.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with the following WDMA Performance Duty Level:

1. Adhesive Bonding Durability: WDMA TM-6
2. Cycle Slam: WDMA TM-7
3. Hinge Loading: WDMA TM-8
4. Screw Holding: WDMA TM-10
   a. Door Face
   b. Vertical Door Edge
   c. Horizontal Door Edge

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 and IBC that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 and IBC.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer’s written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect for the Life of installation.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A-11, “Architectural Wood Flush Doors”.

B. WMDA I.S. 1-A Performance Grade:
   1. Extra Heavy Duty.
      a. All doors must meet specified WDMA Performance Duty Level, including face screw holding requirement. Surface applied hardware shall be installed with screws.

2.2 HIGH IMPACT, ACRYLIC MODIFIED VINYL FACED DOORS

A. Basis of Design Product: Subject to compliance with requirements, provide Masonite Asprio Series “High-Impact Door” or an approved equal product by one of the following

1. Masonite Architectural
2. Eggers Industries
3. Acrovyn Door Systems
B. Color: Red Alder
C. Grade: WDMA Premium Grade
D. WDMA Performance Grade I.S.1-A: Extra Heavy Duty.
E. Faces: Chemical and stain resistant, high-impact, acrylic modified vinyl faces. Color as selected from manufacturer’s full range of wood grain patterns.
F. Vertical edges shall be 1/8 inch matching high impact acrylic material bonded to structural composite lumber. Removable edges are not permitted.
G. Horizontal edges: Bond smooth PVC edge band to structural composite lumber to provide cleanable surface.
H. Core: Wood-based particleboard, structural composite lumber, fire-resistant composite or specialty core as required.
I. Construction: Five plies. Stile and rails are bonded to core, then entire unit is abrasive planed before faces and crossbands are applied.

2.3 FABRICATION

A. Factory fit doors to suit field verified and frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
   1. Comply with clearance requirements of referenced quality standard for fitting.
   2. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate measurements of hardware mortises in existing and new metal frames to verify dimensions and alignment before factory machining.
   2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
   1. Light Openings: Trim openings with moldings of material and profile indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Field-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

   a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Trim bottom rail only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Factory-Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416
SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes access doors for mechanical access installations in the following type of construction:

1. Gypsum drywall.

B. Type of units required are:

1. Ceiling units; non-rated and fire-rated.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s technical data and installation instructions for access door assembly, including setting drawings, templates, instructions and directions for installation of anchorage devices.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain access doors from one source from a single manufacturer.

B. Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters Laboratories, Inc.’s “Building Materials Directory” for rating shown.

1. Provide UL Label on each fire-rated access door.

C. Size Variations: Obtain Architect’s acceptance of manufacturer’s standard size units which may vary slightly from sizes indicated.

D. Coordination: Furnish inserts and anchoring devices which must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.5 PROJECT CONDITIONS

A. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and submit for verification.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide access doors by one of the following:

1. Bilco
3. Milcor, Inc.
4. Nystrom Products Co.
5. John A. Sandberg Company, Inc.

2.2 MATERIALS AND FABRICATION

A. Furnish each access door assembly manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of support shown.

C. Frames: Fabricate from 16-gage steel.

1. Fabricated frame with exposed flange nominal 1” wide around perimeter of frame for units installed in the following construction:
   a. Drywall finish.

2. For gypsum drywall furnish perforated frames with drywall bead.

D. Flush Panel Doors: Fabricate from not less than 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open to 175 degrees. Finish with manufacturer’s factory-applied prime paint.

1. For fire-rated units, provide manufacturer’s standard insulated flush panel/doors, with continuous piano hinge and closing mechanism.

E. Locking Devices:

1. For access doors located on 3rd floor, furnish one cylinder lock per access door. Furnish 2 keys per lock. Key all locks alike.

2. For access doors located on 1st or 2nd floor, furnish two screwdriver driven cam locks per access door.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer’s instructions for installation of access doors.

B. Coordinate installation with work of other trades.
3.2 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION 08 3113
SECTION 08 7111 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes finish hardware for the proper operation and control of all doors in the Project. Prior to bidding, notify Architect of any doors that do not have hardware meeting this intention.

B. Hardware supplier will be responsible to furnish and install hardware on labeled doors to satisfy State and Local Building Codes.

C. Related Sections include the following:

1. Division 8 Section "Hollow Metal Doors and Frames."
2. Division 8 Section "Flush Wood Doors."

1.3 SUBMITTALS

A. Product Data: For each product and material indicated, submit manufacturer’s technical product data. Include information necessary to show compliance with requirements, installation instructions and maintenance instructions.

B. Hardware Schedule: Submit a hardware schedule organized into sets, including the information below. Designations for door numbers and hardware sets shall match those used in the construction documents.

1. Opening Number
2. Door Type and Size
3. Frame Type and Size
4. Frame Anchoring Method
5. Hardware Set
6. Assembly Rating

C. Hardware Schedule shall be coordinated with the doors, frames and related work to ensure proper size, thickness, hand function and finish of door hardware

1.4 QUALITY ASSURANCE

A. Supplier Qualifications: A recognized Architectural Finish Hardware Supplier, with warehousing facilities, who has been furnishing hardware in the Project’s vicinity for a period of not less than two (2) years. Supplier shall be or employ an experienced Architectural Hardware Consultant (AHC) who is certified by and member of the Door and Hardware Institute. The Architectural hardware Consultant shall be available, at reasonable times during the course of the work, for consultation about Project’s hardware requirements, to Owner, Architect and Contractor.
B. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80, No. 101 and local building code requirements. Provide only hardware, which has been tested and listed, by UL, FM or Warnock Hersey for types and sizes of doors required and complies with requirements of door and door frame labels.

C. Standards: Comply with the requirements of the latest edition of the following standards unless indicated otherwise:

1. American National Standards Institute Publications:
   a. A115 Series – Door and Frame Preparation
   b. A156 Series – Hardware

2. Builders Hardware Manufacturer’s Association Publications:
   a. 1201 – Auxiliary Hardware
   b. 1301 – Materials and Finishes

3. Door and Hardware Institute Publications:
   a. Keying – Procedures, Systems and Nomenclature
   b. Abbreviations and Symbols
   c. Hardware for Labeled Fire Doors
   d. Recommended Locations for Builder’s Hardware for Standard and Custom Steel Doors and Frames
   e. Wood Door Standards W1, W2, WDHS-2, WDHS-3

   a. NFPA 80 – Standards for Fire Doors and Windows


1.5 DELIVERY, STORAGE, AND HANDLING

A. Package each hardware item in separate containers with all screws, wrenches, installation instructions and installation templates. Mark each box with hardware heading and door number according to approved hardware schedule.

B. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation: Provide a complete packing list showing items, door numbers and hardware headings with each shipment.

C. Store hardware in shipping cartons above ground and under cover to prevent damage. Provide secure lockup for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable -so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with delivery and/or installation when ambient and substrate temperature conditions are outside limits permitted by material manufacturers.

PART 2 - PRODUCTS
2.1 HARDWARE GENERAL

A. Provide the materials of products indicated by trade names, manufacturer’s name, or catalog number. Substitutions will not be permitted except as described in Division 1.

B. Provide manufacturer’s standard products meeting the design intent of this Specification, free of imperfections affecting appearance or serviceability.

1. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.

2. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

3. Furnish screws for installation with each hardware item. Provide Phillips flat head screws except as otherwise indicated or approved. Finish screws exposed under any condition to match hardware finish, or, if exposed in surface of other work, to match finish of such other work as closely as possible. Use machine screws for metal connections and wood screws for connections to wood. Use manufacturer’s screws to secure hardware.

4. Provide concealed fasteners for hardware unit with care exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt, head or nut on opposite face is exposed in other work, except where indicated otherwise or where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

5. Special Tools: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner’s continued adjustment, maintenance and removal and replacement of finish hardware.

C. Hardware is specified in the hardware schedule by set, type and functions, which have been selected as best meeting the application requirements. Acceptable products for each category are specified in Paragraph 2.5 “Hardware Products”.

2.2 SPECIAL REQUIREMENTS

A. General:

1. Where new doors and hardware are scheduled to be installed in existing frames, contractor to coordinate hinge sizes and locations, lockset backsets, strikes, hardware mounting heights, etc with existing frames to ensure new door and hardware fits and functions properly in existing frame.

B. Hinges:

1. Use nonrising pins for all interior doors.

C. Locksets:

1. All locksets to be grade 1 heavy duty cylindrical or as specified.

D. Closers:
1. Comply with manufacturer’s recommendations for unit size based on door size and usage.
2. Provide parallel arms for all overhead closers, except as otherwise indicated.
3. All closers UL Listed Certified to be in compliance with UBC 7.2 and UL 10C.
4. Closers with Pressure Relief Valves will not be acceptable.
5. Supplier to provide any brackets or plates required for proper installation of door closers.

E. Exit Devices:
   1. All latchbolts to be deadlatching type.
   2. All touchbars to be stainless steel.

2.3 KEYING
A. All cylinders to be keyed to existing master key system. Keying schedule must be approved by Owner prior to ordering locks.
B. Key all locks separately or alike, as directed by Owner.
C. Provide keys as follows:
   1. Change Keys: 2 per lock
   2. Master Keys: 6 required (per system)
D. Identification: Stamp all (master-type) keys with the following:
   1. “Do Not Duplicate”
   2. Key Change number (all keys)

2.4 FINISHES
A. Standard: Comply with BHMA A156.18
   1. All door hardware to be US26D throughout project.
B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer’s standards, but in no case less than specified by referenced standards for the application units of hardware.
C. Protect finishes on exposed surfaces from any damage by applying a strippable temporary protective covering before shipping.
D. BHMA Designations: Comply with base material and finish requirements indicated by BHMA standards.

2.5 HARDWARE PRODUCTS
<table>
<thead>
<tr>
<th>ITEM</th>
<th>SPECIFIED</th>
<th>APPROVED EQUAL</th>
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<tr>
<td>Hinges</td>
<td>Ives</td>
<td>Stanley</td>
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<tr>
<td>Locksets</td>
<td>Best</td>
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<td>Closers</td>
<td>LCN</td>
<td>Burns, Rockwood, Trimco</td>
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<tr>
<td>Flatgoods</td>
<td>Ives</td>
<td>Burns, Rockwood, Trimco</td>
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<tr>
<td>Stops</td>
<td>Ives</td>
<td>Burns, Rockwood, Trimco</td>
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</table>
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames with installer present for compliance with the requirements, for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine rough-in for electrical source power to verify actual locations of wiring connections before electrified door hardware installation.

C. Notify Architect of any discrepancies or conflicts between the door schedule, door types, frame types, drawings, scheduled hardware and built condition.

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

3.2 PREPARATION

A. Steel Frames: Comply with ANSI/DHI A115 Series


3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights indicated in the following applicable publications, or as required to comply with governing regulations:

   2. Custom Steel Doors and Frames: DHI’s “Recommended Locations for Builder’s Hardware for Custom Steel Doors and Frames.”

B. Install each door hardware item to complete with manufacturer’s written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage and reinstallation of surface protective trim units to with finishing work. Do not install surface mounted items until finishes have been completed on substrates involved.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in written report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING
A. Initial Adjustment: Adjust and check each operating items of door hardware and each door to ensure proper operation of function of every unit. Replace units that cannot be adjusted to operate as intended and/or required. Adjust door control devices to compensation for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper finish and provide final protection and maintain condition that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMOISTRATION AND TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain door hardware and door hardware finishes.

3.8 DOOR HARDWARE SETS

Hardware Set #1 – Interior | Single | Non-Rated | Passage | Lead-Lined
Openings: C4001A
1. Geared Hinge  Roton 780 HD LL Series  Alum  HAG
1. Passage Latchset  9K37 – N – 14D  626  BEST
1. Closer (Pull Side Mount)  4040XP Series  626  LCN
1. Overhead Stop  26D  RO
1. set Silencers  TAN

Set Notes:
1. Provide lead-lined hardware as necessary to maintain lead shielding.

Hardware Set #2 – Interior | Pair | Non-Rated | Classroom | Lead-Lined
Openings: C4001
1. Geared Hinge (Large Leaf)  Roton 780 HD LL Series  Alum  HAG
3. Spring Hinges (Small Leaf)  1250 HT  26D  HAG
1. Classroom Lockset  9K37 – R – 14D  626  BEST
1. Dummy Trim  9K30 – 2DT – 14D  626  BEST
1. Auto Flush Bolts (Top Only)  42B  IVES
1. Metal Astragal (Lead Lined)
1. Closer (Pull Side Mount)  4040XP Series  626  LCN
2. Overhead Stop  26D  RO
1. set Seals  MBKS88  TAN  MC

Set Notes:
1. Provide lead-lined hardware as necessary to maintain lead shielding.

Hardware Set #3 – Interior | Single | Non-Rated | Passage
Openings: C4001B
3. Hinges  BB1168  26D  HAG
1. Passage Latchset  9K37 – N – 14D  626  BEST
1. Wall Stop  409  26D  RO
1. set Silencers  TAN
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<thead>
<tr>
<th>Hardware Set #4 – Interior</th>
<th>Pair</th>
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<th>Passage</th>
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<tr>
<td>Openings: C4002</td>
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<td>626</td>
<td>BEST</td>
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<td>1 Auto Flush Bolts (Top Only)</td>
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<td>IVES</td>
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<td>2 Overhead Stop</td>
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<tr>
<td>1 set Silencers</td>
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<thead>
<tr>
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<th>Storeroom Function</th>
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<td>BEST</td>
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<tr>
<td>1 Electric Strike</td>
<td>7240</td>
<td>US26D</td>
<td>ADA</td>
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<td>1 Closer</td>
<td>4040 Series with stop arm</td>
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<td>1 Wall Stop</td>
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<td>26D</td>
<td>RO</td>
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<td>HAG</td>
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<tr>
<td>1 Classroom Lockset</td>
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<td>626</td>
<td>BEST</td>
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<td>1 Wall Stop</td>
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<td>1 set Seals</td>
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<td>26D</td>
<td>HAG</td>
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<tr>
<td>1 Classroom Lockset</td>
<td>9K37 – R – 14D</td>
<td>626</td>
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<td>1 Overhead Stop</td>
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<th>Passage</th>
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<td>Openings: C4007</td>
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<td>HAG</td>
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<td>1 Passage Latchset</td>
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<td>BEST</td>
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<td>4040 Series with Hold Open</td>
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<tr>
<td>1 set Seals</td>
<td>MBKS88</td>
<td>TAN</td>
<td>MC</td>
</tr>
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</table>
### Hardware Set #10 – Interior | Single | Non-Rated | Privacy Function

- **Openings**: C4014, C4031A
- 3 **Hinges**: BB1168, 26D, HAG
- 1 **Privacy Lockset**: 9K37 – LL – 14D, 626, BEST
- 1 **Wall Stop**: 409, 26D, RO
- 1 **set Seals**: MBKS88, TAN, MC

### Hardware Set #11 – Interior | Single | Non-Rated | Privacy Function

- **Openings**: C4029A
- 3 **Hinges**: BB1168, 26D, HAG
- 1 **Privacy Lockset**: 9K37 – LL – 14D, 626, BEST
- 1 **Overhead Stop**: 26D, RO
- 1 **set Silencers**:  

### Hardware Set #12 – Interior | Single | Non-Rated | Storeroom Function | Secured

- **Openings**: C4014A, C4014B, C4029, C4029B
- 3 **Hinges**: BB1168 – 4.5" x 4.5", 26D, HAG
- 1 **Storeroom Lockset**: 9K37 – D – 14D, 626, BEST
- 1 **Electric Strike**: 7240, US26D, ADA
- 1 **Card Reader**: Owner Furnished, Contractor Installed
- 1 **Closer**: 4040 Series, LCN
- 1 **Wall Stop**: 409, 26D, RO
- 1 **set Seals**: MBKS88, TAN, MC

### Hardware Set #13 – Interior | Single | Non-Rated | Storeroom Function | Secured

- **Openings**: C4031, C4031B
- 3 **Hinges**: BB1168 – 4.5" x 4.5", 26D, HAG
- 1 **Storeroom Lockset**: 9K37 – D – 14D, 626, BEST
- 1 **Electric Strike**: 7240, US26D, ADA
- 1 **Card Reader**: Owner Furnished, Contractor Installed
- 1 **Closer**: 4040 Series with stop arm, LCN
- 1 **set Seals**: MBKS88, TAN, MC

END OF SECTION 08 7111
SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
3. Stenciling fire and smoke ratings on rated partitions.

B. Related Sections include the following:

1. Division 09 Section “Gypsum Board Shaft Wall Assemblies” for framing, gypsum panels, and other components of shaft wall assemblies.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

B. Wet Area Definition: The definition of a wet area shall conform to the definition given in TCA, "Handbook for Ceramic Tile Installation", which is as follows:

1. "Tile surfaces that are either soaked, saturated, or subject to moisture or liquids (usually water) such as gang showers, tub enclosures, showers, laundries, saunas, steam rooms, swimming pools, hot tubs, and exterior areas."

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.


B. Stencil fire and/or smoke rating of each rated assembly on each side of the wall above ceiling, or above 9’-0” where no ceiling is scheduled. Refer to labeling requirements at the end of this Section.

C. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer’s written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

1. Steel Framing and Furring:
   a. Clark Steel Framing Systems.
   b. Consolidated Systems, Inc.
   d. Dietrich Industries, Inc.
   e. MarinoWare; Division of Ware Ind.
   g. Scafco Corporation.
   h. Unimast, Inc.
   i. Western Metal Lath & Steel Framing Systems.

2. Grid Suspension System for Interior Ceilings:
   a. Armstrong World Industries, Inc.
   b. Chicago Metallic Corporation.
c. USG Interiors, Inc.

3. Gypsum Boards and Related Products:
   a. American Gypsum Co.
   b. G-P Gypsum Corp.
   c. National Gypsum Company.
   d. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

   A. Components, General: Comply with ASTM C 645 and ASTM C 754 for conditions indicated.

   B. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

   C. Hanger Attachments to Concrete: As follows:

      1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching hanger wires and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by a qualified independent testing agency.
         a. Type: Postinstalled, expansion anchor.

      2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by a qualified independent testing agency.

   D. Hangers: As follows:

      1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

   E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (1.37 mm), a minimum 1/2-inch- (12.7-mm-) wide flange, with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized in areas of normal humidity; ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized in humid areas such as kitchens, showers and swimming

      1. Depth: As indicated.

   F. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized ASTM A 653/A 653M in areas of normal humidity; G60 (Z180), hot-dip galvanized in humid areas

      1. Cold Rolled Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange, 3/4 inch (19.1 mm) deep.

      2. Steel Studs: ASTM C 645.
a. Minimum Base Metal Thickness: .0179 inch (0.45 mm)
b. Depth: As indicated.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.
   a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm)

4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.

G. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Chicago Metallic Corporation; Drywall Furring 640 System.
      c. USG Interiors, Inc.; Drywall Suspension System.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:
   1. Comply with ASTM C 754 for conditions indicated.

B. Partition/Soffit Support Materials:
   1. Studs: Steel sheet components complying with ASTM C 645 requirements for metal and with ASTM A53/A 653M, hot dip galvanized; standard G40 unless as noted below. The minimum base metal thickness to be used for stud partition construction shall be 0.0312 inch (20 gage) (0.79 mm), unless otherwise indicated and with special arrangement at door jamb and opening construction specified in Part 3 below.
   2. Use G60 studs in all exterior walls and wet applications and G40 studs for normal interior partitions and dry applications.
      a. Depth of Section: 3-5/8", except as otherwise indicated.
      b. Runners: Match studs; type recommended by stud manufacturer for floor and ceiling support of studs, and for vertical abutment of drywall work at other work.

C. Deflection Track: Provide a slotted track with positive attachment for wall strength and to allow vertical movement. Track shall meet requirements of all standard building codes, ICBO - ER 5344 and be UL Classified R19236, and the latest seismic cycling standards found in UL2079 and ASTM 1966. Anchorage of the studs to the track shall be as recommended by the manufacturer with #8 waterhead screws. Refer to the Drawings and to manufacturer's details.
D. Firestop Track: Provide a slotted track with positive attachment for wall strength and to allow vertical movement. Track shall meet requirements of all standard building codes, ICBO - ER 5344 and be UL Classified R19236, and the latest seismic cycling standards found in UL2079 and ASTM 1966. Refer to Drawings for referenced UL assembly number. Anchorage of the studs to the track shall be as recommended by the manufacturer with #8 waferhead screws. Refer to the Drawings and to manufacturer’s details.

E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch (12.7-mm-) wide flange.
1. Depth: 1-1/2 inches (38.1 mm), unless noted otherwise.
2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch (1.73-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0179 inch (25 gage) (0.45 mm), unless noted otherwise.
2. Depth: 7/8 inch (22.2 mm), unless noted otherwise.

G. Resilient Furring Channels: 1/2-inch (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

H. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch (12.7-mm-) wide flange.
1. Depth: 3/4 inch (19.1 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch (1.59-mm-) diameter wire, or double strand of 0.0475-inch (1.21-mm-) diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

J. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 PANEL PRODUCTS, GENERAL

A. Panel Size, General: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. "GREEN BOARD" or "BLUE BOARD" will not be allowed for use as a "WATER-RESISTANT GYPSUM BOARD" nor "TILE BACKING BOARD" application.

2.5 GENERAL-USE GYPSUM WALLBOARD AND CEILING BOARD

A. Provide the following general-use wallboard for all applications:
1. in areas that are not defined as wet areas or abuse resistant
2. or in areas where moisture, mold, and mildew resistance is not required.


1. Type X Wallboard: Provide at all vertical and soffit gypsum wallboard as Type X, 5/8" thickness whether used in a rated assembly or not, with long edges tapered.


1. Sag-Resistant Ceiling Board: Provide at all gypsum board ceilings as 1/2 inch (12.7 mm) thickness, and with long edges tapered. Manufactured to have more sag resistance than regular-type gypsum board.

2. Products:
   b. National Gypsum: 1/2" High Strength Ceiling Board.
   c. United States Gypsum: Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.

2.6 MOISTURE/ MOLD/ MILDEW RESISTANT GYPSUM WALLBOARD

A. Moisture/ Mold/ Mildew Resistant Gypsum Wallboard: Manufactured with additives to enhance the fire resistance and moisture/ mold/ mildew resistance. Complying with ASTM C630/ 1396 or ASTM C 1278. Product shall have a mold and mildew resistance score of "10" when tested in accordance with ASTM D 3237.

1. Acceptable Products:

2. Thickness: 5/8 inch (15.9 mm).
3. Core: Type X, Fire-Resistant.
5. Length: 8 ft., 10 ft., or 12 ft.
7. Location: Use Moisture/ Mold/ Mildew Resistant board in the following locations:
   a. All areas where moisture, mold, and mildew resistance is required
   b. As a tile backer board in dry areas
   c. In areas with limited water exposure such as toilet/sink areas, janitor closets
   d. In areas above tile in tubs and showers, soiled utility
   e. Within 48" horizontally either side of all other plumbing fixtures.
   f. Interior side of exterior walls where moisture intrusion may occur.

B. Joint Treatment for Moisture, Mold and Mildew Resistant Gypsum Board: Setting type powder compound used for covering fasteners, pre-filling and taping joints of all Moisture, Mold, and Mildew Resistant Gypsum Board. Complying with ASTM C 475.
1. Acceptable Products per gypsum board manufacturer’s installation recommendations:
   a. National Gypsum Company: ProForm® Brand XP™ Ready Mix: Drying type pre-mixed compound manufactured with additives for optimum mold and mildew resistance.
   b. National Gypsum Company: ProForm® Brand Sta-Smooth/ Sta-Smooth Lite setting compounds.
   c. United States Gypsum Company: Sheetrock® Brand Durabond® setting compound.

2.7 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Provide the following at porcelain wall tile in dry installations:

1. Water-Resistant Gypsum Tile Backing Board: Manufactured from a blend of gypsum/cellulose-fiber combination, with tapered edges and of type and thickness indicated; in maximum lengths available to minimize end-to-end butt joints. Product shall also have been tested per ASTM D 3273-00 "Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber," and score an “10”.

   a. Type: Type X - fire-rated, unless otherwise indicated.
   b. Thickness: 5/8 inch, unless otherwise indicated.
   c. Use this product as a tile backing board; not as a finish surface.
   d. Products:
      1) USG Fiberock® Aqua-Tough™ Tile Backerboard.
      2) National Gypsum Gold Bond® Brand XP™ Fire Shield Gypsum Wallboard.
      3) An approved equal.

   e. Location: As a tile backing board in the following locations:

      1) In all areas as a tile backer board where tile is not subject to wetting by liquid water moisture.

C. Provide the following at porcelain wall tile in wet installations:


   a. Products: Subject to compliance with requirements, provide [one of] the following:

      1) 1/2” Wonderboard, Custom Building Products.
      2) 1/2” Durock® Brand Cement Board as manufactured by USG Corporation. [Textured side for tile and smooth side for finish]
3) 1/2” HardieBacker™ Cement Board as manufactured by JamesHardie International. [Smooth for tile or finish]

b. Extend cement board a minimum of 4 feet past wet area.

c. Thickness: As indicated.

d. Location: As a tile backing board in the following locations:

1) In all "wet areas" as a tile backer board where tile is subject to wetting by liquid water moisture.

2.8 ABUSE-RESISTANT GYPSUM WALLBOARD

A. Proprietary Abuse-Resistant Gypsum Wallboard: ASTM C 36, manufactured to produce greater resistance to surface indentation and through-penetration than standard gypsum panels.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.


2. Core: 5/8 inch (15.9 mm), Type X.


4. Location: As indicated

B. Provide abuse-resistant wallboard in all patient rooms.

2.9 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc. Plastic edge trim is not permitted.

2. Shapes:

   a. Cornerbead: Use at outside corners.

   b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.

   c. Expansion (Control) Joint: Use where indicated or required.

   d. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.

2.10 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

2. Tile Backing Panels: As recommended by panel manufacturer.
C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats. Use drying-type unless otherwise noted.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by manufacturer.
3. Cementitious Backer Units: As recommended by manufacturer.

2.11 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.12 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards, notes and details shown on drawings, and manufacturer’s written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Screws for Cold-Formed Metal Framing: Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. Screws for Cementitious Backer Units: For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

D. In-Wall Metal Blocking: Install 20-gauge steel backing at 10 inches above floors along all corridors, handrails, cabinetry, and any wall hung items exceeding 20 pounds, including but not limited to monitors, televisions, and baby changing stations. Blocking shall be installed whether shown on the drawings or not.
E. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

1. Furnish concrete inserts and other devises indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
   a. Use deep-leg deflection track where indicated.
   b. Use firestop track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Suspend ceiling hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member and transversely between parallel members.

C. Seismic Bracing: Sway-brace suspended steel framing with hangers used for support, as required by Authorities having jurisdiction.

D. Wire-tie furring channels to supports, as required to comply with requirements for assemblies indicated.

E. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards. If spacings not indicated, the following are maximum spacings.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING
A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue double studs at door jambs and framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated and/or STC-rated partitions that must extend to the underside of continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
   a. Terminate partition framing at suspended ceilings where indicated.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
2. Multilayer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 as a minimum requirement and with gypsum board manufacturer's applicable written recommendations, and as specified below.

1. Door Jamb Framing: Frame door openings with vertical studs securely attached by screws at each jamb either directly to frames or to jamb anchor clips on door frame; install runner track sections (for cripple studs) at head and secure to jamb studs.
   a. Runner Tracks at Head of Door Openings: Provide runner tracks at head of same gage as jamb studs. Space cripple studs at same spacing and gage as partition studs.
   b. Jambs of All Interior Door Conditions: As a minimum, double studs shall be provided at all interior door conditions. Strap all jamb studs with 18-gage minimum 1" wide bands at 16" o.c. maximum vertically, floor to bottom of structure above. Install angle bracing above ceiling to structure in each direction at strike side of door except as noted.
1) Single Door Openings Less Than 4'-0" Wide: Install double, 0.0312 inch (20 gage) (0.79 mm) studs at each jamb. Extend studs to deck above and anchor.

2) Doors Openings 4'-0" Wide and Greater: Install triple 20-gage studs at each jamb. Extend studs to deck above and anchor. Provide kickers at ends and midpoint of openings.

2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint.

3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

H. Sound-Attenuation Batt:

1. Erect sound attenuating batts in cavities formed by framing members according to the manufacturer's recommendations. Place batts in cavities to produce a friction fit between edges of insulation and adjoining framing members. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced batts mechanically and support faced batts by taping stapling flanges to flanges of metal studs. Install supplementary framing, runners, furring, blocking and backing at opening and termination in the work, and at locations required to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported directly on gypsum board alone.

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints with space between edges of adjoining gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

L. Sound Treatment: Whether indicated on the drawings in the details or not, provide the following as minimum sound treatment requirements for gypsum partitions around private offices, patient exam rooms, consulting rooms, toilet rooms (public or private), corridor walls and any other sound-sensitive areas. Sound gasketing shall be required at any doors through these walls (whether indicated in the Hardware Schedule or not). If not indicated, provide a set of Sound Gasket Seal 5050B, brown in color, by NGP or equal as a minimum requirement.
   1. Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at perimeters of both faces of partitions and at any through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
   1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

N. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.
3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
3. Do not butt boards to concrete floor. Maintain a minimum 1/4" to a maximum 3/8" space between bottom of board and concrete.
   a. Stagger abutting end joints not less than one framing member in alternate courses of board.
   b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

D. Multilayer Fastening Methods: If required for fire-rated assemblies, fasten base layers and face layers separately to supports with screws. Otherwise, fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

E. Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
2. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer’s written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
3. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
4. Areas Not Subject to Wetting: Install standard gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.
5. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.

B. Control Joints: Install control joints (beaded type) according to ASTM C 840 and in specific locations approved by Architect for visual effect.
1. At any point where the mass of the wall is reduced.
2. At continuous vertical expanses of drywall such as at stairwells, place horizontal control joints at each floor level.
3. Locate joints where no expanse of drywall (including joints in ceilings, soffits/ceiling drops, and partitions) exceeds 30 feet in any direction, verify locations with Architect before proceeding.
4. Provide a vertical control joint on the strike side of all single doors, both sides of the wall, extending to the top of the gypsum board. Provide a vertical control joint on each hinge side of all double doors, both sides of the wall, extending to the top of the gypsum board.
5. Seal joints with acoustical sealant.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

   1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
   2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
   3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
      a. LEVEL FOUR TO BE THE MINIMUM LEVEL OF FINISH AT ALL NEW WALLS, UNLESS NOTED OTHERWISE.
   4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where indicated in the Finish Schedule.
      a. LEVEL FIVE FINISH TO THE MINIMUM LEVEL OF FINISH AT ALL WALLS SCHEDULED TO RECEIVE AF-1.

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.10 LABELING PARTITIONS/CEILINGS
A. **Partition Identification:** The Gypsum Board contractor shall be responsible for labeling any/all of the following applicable gypsum board partitions/ceilings. Label shall be stenciled in 4-inch high RED letters, 12 inches above the ceiling, **on both sides of the partition** and at a maximum 8-foot apart maximum; a minimum of one label per partition elevation. Where no ceiling occurs, the stencil shall be located 9'-0” above the finished floor.

B. **Changes in Wall Type:** Where changes in wall type occur, a vertical line shall be stenciled (ceiling to 12” above the ceiling) at the center line of the change and the correct wall type shall be stenciled immediately to each side of the line.

C. **Rating Changes:** Work shall include the re-stenciling of walls where the construction type changes, this includes removal of stencils (painting over) on walls that are "decommissioned."

D. The following identifications shall be applied; text to match exactly as given below. The text can be stenciled on using either one line of text or two; whichever fits. Labeling shall apply to all the partition/ceiling types listed.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Stencil Text</th>
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<tbody>
<tr>
<td>At Non-Rated Smoke Partitions</td>
<td>O-HR SMOKE PARTITION</td>
</tr>
<tr>
<td>At 1-Hour Rated Fire Partitions</td>
<td>1-HR FIRE PARTITION</td>
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<tr>
<td>At 1-Hour Rated Fire Barrier</td>
<td>1-HR FIRE BARRIER</td>
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<td>At 2-Hour Rated Fire Barriers</td>
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<td>At 1-Hour Rated Bearing Walls the stencil shall read:</td>
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<td>At 3-Hour Rated Bearing Walls the stencil shall read:</td>
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<td>At 1-Hour Rated Exterior Walls the stencil shall read:</td>
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<td>At 2-Hour Rated Exterior Walls the stencil shall read:</td>
<td>2-HR EXTERIOR WALL</td>
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<tr>
<td>At 3-Hour Rated Exterior Walls the stencil shall read:</td>
<td>3-HR EXTERIOR WALL</td>
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<tr>
<td>At 1-Hour Rated Floor-Ceiling Assemblies (gypsum board assemblies only) apply one stencil in a visible location in each room. The stencil shall read:</td>
<td>1-HR FLOOR-CEILING</td>
</tr>
<tr>
<td>At 2-Hour Rated Floor-Ceiling Assemblies (gypsum board assemblies only) apply one stencil in a visible location in each room. The stencil shall read:</td>
<td>2-HR FLOOR-CEILING</td>
</tr>
<tr>
<td>At 1-Hour Rated Roof-Ceiling Assemblies (gypsum board assemblies only) apply one stencil in a visible location in each room. The stencil shall read:</td>
<td>1-HR ROOF-CEILING</td>
</tr>
<tr>
<td>At 1 1/2-Hour Rated Roof-Ceiling Assemblies (gypsum board assemblies only) apply one stencil in a visible location in each room. The stencil shall read:</td>
<td>1 1/2-HR ROOF-CEILING</td>
</tr>
<tr>
<td>At Lead Shielding Partitions the stencil shall read:</td>
<td>LEAD SHIELDING _&quot; THICK</td>
</tr>
</tbody>
</table>

3.11 CLEANING AND PROTECTION

A. Promptly remove any residual joint compound from adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that will ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 2116
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Porcelain tile.
2. Glass tile.
3. Crack-suppression membrane for thin-set tile installations.
4. Metal edge strips installed as part of tile installations.

B. Related Sections include the following:

1. Division 07 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Division 09 Section "Gypsum Board Assemblies" for glass-mat, water-resistant backer board.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required.

D. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.9 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. Tile and Trim Units: Furnish quantity of full-size units equal to 5-10 percent of amount installed, for each type, composition, color, pattern, and size indicated.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Products: Subject to compliance with requirements, provide one of the products specified in the finish materials legend.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

   1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
   2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.


C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

   1. As selected by Architect from manufacturer's full range.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

   1. Tile in Wet Areas: Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.
2.3 TILE PRODUCTS

A. Refer to Finish Schedule for tile products.

2.4 CRACK-SUPPRESSION MEMBRANES FOR THIN-SET TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10, selected from the following.

B. Chlorinated-Polyethylene-Sheet Product: Nonplasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric, for adhering to latex-portland cement mortar; 60 inches (1524 mm) wide by 0.030-inch (0.76-mm) nominal thickness.

1. Product: Noble Company (The); Nobleseal TS.

C. Latex-Portland Cement Product: Flexible mortar consisting of cement-based mix and acrylic-latex additive.

1. Products:
   a. Boiardi Products Corporation; Elastiment 323.
   b. MAPEI Corporation; PRP 315.
   c. Southern Grouts & Mortars, Inc.; Southcrete 1100.
   d. TEC Specialty Products Inc.; TA-324, Triple Flex.

2.5 SETTING AND GROUTING MATERIALS

A. Manufacturers:

2. Boiardi Products Corporation.
5. C-Cure.
6. Custom Building Products.
7. DAP, Inc.
8. Jamo Inc.
9. LATICRETE International Inc.
10. MAPEI Corporation.
11. Southern Grouts & Mortars, Inc.
12. Summitville Tiles, Inc.
13. TEC Specialty Products Inc.


1. For wall applications, provide nonsagging mortar that complies with Paragraph C-4.6.1 in addition to the other requirements in ANSI A118.1.

C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:

1. Prepackaged dry-mortar mix combined with liquid-latex additive.
a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

2.6 SETTING MATERIALS

A. Polymer-Modified Mortar: Mortar meeting or exceeding ANSI A128.4 and ANSI A118.11 requirements. Provide the following professional-grade, single-component, high-performance, polymer-modified thin-set mortar for interior and exterior installations of dimensional stone, ceramic, porcelain and quarry tile:

1. Ultraflex® 2 as manufactured by Mapei. For tile 16 x 16 or larger use Ultraflex™ LTF.
2. An approved equal product from TEC Specialty Products Inc.
3. An Architect approved equal product.

2.7 GROUTING MATERIALS

A. Cement-Based Polymer-Modified Tile Grout: ANSI A118.7, color as selected by the Architect.

1. Polymer Type: Manufacturer's proprietary polymer, in dry, redispersible form, prepackaged with other dry ingredients.
   a. Unsanded grout mixture for joints 1/8 inch (3.2 mm) and narrower.
2. Provide one of the following:
   a. Hydroment epoxy grout, as manufactured by Bostik
   b. AccuColor XT™ Next Generation Sanded Grout as manufactured by TEC Specialty Products Inc.
3. Grout does not require a sealer.
4. Installation of grout and cleaning of tile must be in accordance with grout manufacturer's recommendations.

B. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.

C. Standard Sanded Cement Grout: ANSI A118.6, color as indicated.

D. Standard Unsanded Cement Grout: ANSI A118.6, color as indicated.

2.8 ELASTOMERIC SEALANTS

A. Refer to Division 07 Section "Joint Sealants."

2.9 MISCELLANEOUS MATERIALS
A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Corner Trim: Provide metal corner trim for all outside corners for corner protection. Installation shall also include any end cap or other trim pieces where required for a complete installation. Corner trim shall be anodized aluminum units, Schluter®-RONDEC, sized to complement the thickness of tile and mortar setting. Units shall be as manufactured by Schluter® Systems, or an approved equal.

1. An Approved Equal: Made in USA Products by the following:
   a. Genotek
      41840 McAlby Court
      Murrieta, CA 92562
      800.741.8936
      800.963.5576 fax
      www.genotek website

C. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

1. Products:
   b. Bostik; CeramaSeal Grout Sealer.
   c. C-Cure; Penetrating Sealer 978.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, areas, and conditions where tile will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with adhesives or thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.


C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in substrates.
2. Expansion (Movement) Joints for Exterior Tile: All exterior expansion joints shall be a minimum of 3/8" for joints 12’ on center, minimum 1/2" for joints 16’ on center. Minimum widths must be increased 1/16" for each 15 deg F tile surface temperature change greater than 100 deg F between summer high and winter low.

H. Grout tile to comply with requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

3.4 CRACK-SUPPRESSION MEMBRANE INSTALLATION

A. Install crack-suppression membrane to comply with manufacturer’s written instructions to produce membrane of uniform thickness bonded securely to substrate.

3.5 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Install metal lath and scratch coat for walls to comply with ANSI A108.1A, Section 4.1.

C. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.

a. Large tiles 8 by 8 inches (200 by 200 mm) or larger, ceramics or mosaics, or sheet of tiles.

b. Rib-backed tiles.

D. Joint Widths: Install tile on walls with the following joint widths:

1. Porcelain Tile: 1/8 inch, unless noted otherwise.

3.6 CLEANING AND PROTECTING
A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer’s written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 3000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 DEFINITIONS

A. CAC: Ceiling Attenuation Class.

B. LR: Light Reflectance coefficient.

C. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.

2. Suspension System: Obtain each type through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

   a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

   b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 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. Tile Units: Furnish quantity of full-size units equal to 5-10 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer/Products:
1. ACT 1: Armstrong Ultima #1910, 24 x 24, or approved equal.
2. ACT 2: Armstrong Mesa #680, 24 x 24, or approved equal.
3. ACT 3: Not Used
4. ACT 4: Armstrong Ceramaguard –Unperforated #605, 24 x 48, or approved equal.
2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated by manufacturer's proprietary product designations for each product type.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
   1. Anchors in Concrete: Expansion anchors fabricated from corrosion-resistant materials with holes or loops for attaching hangers of type indicated and with capability to sustain without failure a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

   D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
      2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

F. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS

A. Available Products:
   1. Chicago Metallic #200 Snap Grid Intermediate Duty or equal. Color shall be white.

2.5 METAL EDGE MOLDINGS AND TRIM
A. Type and profile that are manufacturer's standard moldings for edges and penetrations that fit acoustical pane ledge details and suspension systems indicated.

2.6 ACOUSTICAL SEALANT

A. Refer to Division 9 Section "Gypsum Board Assemblies."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling or as indicated on the drawings. Unless specifically shown on the drawings, avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-acted fasteners that extend through forms into concrete.

8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.66 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange square directionally patterned acoustical panels as follows:
   a. Install panels with pattern running in one direction parallel to short axis of space, unless otherwise noted.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in locations shown on the drawings.

3.4 CLEANING
A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113
SECTION 09 6513 - RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Rubber, vulcanized thermoset, wall base.
   2. Accessories.

B. Related Sections include the following:
   1. Division 09 Section “Resilient Sheet Flooring” for areas where resilient base will be required.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

1.3 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

1.4 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. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 COLORS

A. Colors: Refer to the Materials Legend – Finish Plan.

2.3 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.
   1. Basis of Design: Johnsonite Wall Base
   2. Acceptable Manufacturers:
      a. Armstrong
      b. VPI, LLC, Floor products Division
      c. Burke Mercer Flooring Products, A Division of Burke Industries, Inc.
      d. Roppe Corporation

B. Type (Material Requirement): TS (rubber, vulcanized thermoset).

C. Group (Manufacturing Method): I (solid).

D. Style:
   1. B1 – TightLock Wall Base Profile

E. Minimum Thickness: 0.125 inch (3.2 mm).

F. Height: 4.375 – 4.5 inches

G. Lengths: Coils in manufacturer’s standard length. **Stick base is not allowed.**

H. Outside Corners: Job formed.

I. Inside Corners: Job formed.

J. Surface: Smooth.

2.4 RESILIENT MOLDING ACCESSORY

A. Resilient Edge Strips: 1/8” thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color to match flooring, or as selected by the Architect from standard colors available; not less than 1” wide.

B. Subfloor Leveler: Provide a solid, homogeneous, thermoplastic rubber Subfloor Leveler – made from first quality recycled materials for indoor use. Product shall be extruded to provide a smooth transition between uneven subfloors and immediately accept
new flooring. Product shall be Roppe Subfloor Leveling Product #303 (1/2" x 18").
Product shall have pre-scored markings for the most commonly needed transition
depths for ease of site trimming.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement
   based or blended hydraulic cement-based formulation provided or approved by
   resilient product manufacturers for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient
   products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure
   adhesion of resilient products.

B. Concrete Substrates for Accessories: Prepare according to ASTM F 710.

   1. Verify that substrates are dry and free of curing compounds, sealers, and
      hardeners.
      Proceed with installation only after substrates pass testing.
   3. Moisture Testing:

      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with
         installation only after substrates have maximum moisture-vapor-emission
         rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform tests recommended by manufacturer. Proceed with installation
         only after substrates pass testing.

C. Remove substrate coatings and other substances that are incompatible with adhesives
   and that contain soap, wax, oil, or silicone, using mechanical methods recommended
   by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and
   depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be
   installed at least 48 hours in advance of installation.

   1. Do not install resilient products until they are the same temperature as the space
      where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products
   immediately before installation. After cleaning, examine substrates for moisture,
   alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory
   conditions have been corrected.
3.2 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.

2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.
   a. Do not wash surfaces until after time period recommended by manufacturer.
   b. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09 6513
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes sheet vinyl floor coverings, without backings.

B. Related Sections include the following:

1. Division 09 Section "Resilient Base" for resilient base installed in other areas.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (150- by-230-mm) sections of each different color and pattern of floor covering required.

C. Heat-Welded Seam Samples: For each flooring product and welding bead color and pattern combination required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm), sample applied to a rigid backing and prepared by Installer for this Project.

D. Qualification Data: For Installer.

E. Maintenance Data: For floor coverings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project that are competent in heat-welding techniques required by manufacturer for floor covering installation.

1. Engage an installer who employs workers for this Project that are trained or certified by floor covering manufacturer for heat-welding techniques required.

B. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
D. Floor Pattern Layout: Layout of designed floor patterns shall be verified in the field, in the presence of the Architect or with his/her approval of the overall layout on the slab before laying of flooring shall commence in these areas. Any required adjustments to the patterns (to make them fit the space) will be made at this time without additional cost to the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store rolls upright.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 SHEET VINYL FLOOR COVERING

A. Acceptable Manufacturer/ Products: Refer to Materials Legend - Finish Plan for selected manufacturer and product.
B. Seaming Method: Heat welded.

C. Fire-Test-Response Characteristics:
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

D. Integral Base: Provide 4" integral cove base with metal cap strip where indicated in the Materials Legend - Finish Plan and on the Drawings. This includes extending the integral cove base into the toe space at all casework installations.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by floor covering manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit sheet vinyl floor covering and substrate conditions indicated.
   1. Use adhesives that have a VOC content of not more than 60 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive at Hospital Beds: The area under the hospital bed must be adhered with epoxy adhesive. This area shall be centered on the headwall and extend from the headwall to the footwall in a 4 foot min. wide strip. In no case shall the entire room be installed using epoxy adhesive. Coordinate installation with information shown on the Drawings.

   1. Color: As selected by Architect from manufacturer's full range.

D. Integral-Flash-Cove-Base Accessories:
   1. Cove Support Strip: Self adhesive, resilient quarter-round plastic (FLEXCO #195 Cove Stick Fillet) or wood cove stick.
   2. Cap Strip: Square metal cap strip provided or approved by floor covering manufacturer.
   3. Corners: If required by the flooring manufacturer, provide metal inside and outside corners and end stops provided or approved by floor covering manufacturer.

E. Sheet Vinyl Installation at wet locations, including patient showers.
   1. Comply with manufacturer’s recommended details and products, including adhesives, regardless of details in architectural drawings.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer’s written recommendations to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:
   a. Test for Relative Humidity: Testing for moisture using a Humidity Probe and Digital Meter (ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes) will require 3 tests for the first 1,000 sq. ft., and at least one additional test for each 1,000 sq. ft. thereafter. Maximum allowable reading shall be 75% RH.
   b. Existing slab on grade as well as elevated slabs (new and existing) must be tested.
   c. Report test results to Owner and Architect. Do not proceed with installation of flooring until acceptable test results are obtained.
4. At flooring testing positive for ACM, the following is the Owner’s standard floor preparation. **Note we do not remove any ACM floor fill per an agreement with EH&S, we do however remove all floor finishes and adhesives on all projects and do not lay over existing floor finishes except in special circumstances which need to be reviewed and approved by MUHC Engineering Services.**

1. Remove all floor tiles, seamless flooring and adhesives containing ACM. If the floor fill tests positive for ACM please use the prescribed method for floor prep.
2. Abate the floor finish and adhesive with EH&S recommended removal process.
3. Prior to starting any floor work after ACM removal it is important for the floor to dry out for as long as possible before proceeding with any new flooring.
4. If not already locked down by the Abatement personnel after removal completion. Remove any debris from the surface of the floor.
5. Apply Acrylic 60 bonding agent (or manufacturers recommended product) tinted with red paint colorant to the floor and allow to dry tack free. Surface of the floor should appear red when dry.
6. Apply 2 or more layers of Ardex feather finish till floor surface is level and smooth for the new flooring.
7. Hand scrape or light sand Ardex feather finish to desired smoothness. If any of the substrate is viewing as red while sanding (STOP) and add additional layers of Ardex feather finish until you achieve desired smoothness necessary to lay the new flooring.

C. Remove substrate coatings and other substances that are incompatible with floor covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

E. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

F. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

   1. Do not install floor coverings until they are same temperature as space where they are to be installed.

G. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Unroll sheet vinyl floor coverings and allow them to stabilize before cutting and fitting.

B. Lay out sheet vinyl floor coverings as follows:

   1. Maintain uniformity of floor covering direction.
   2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in floor covering substrates.
   3. Match edges of floor coverings for color shading at seams.
   4. Avoid cross seams.

C. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Install flooring prior to the installation of all equipment items, unless noted otherwise.

D. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

E. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

F. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of floor coverings installed on covers. Tightly adhere floor covering edges to substrates.
that abut covers and to cover perimeters.

G. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

I. Integral Flash Cove Base: Cove floor coverings 4 inches (102 mm) up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
   1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing floor covering installation:
   1. Remove adhesive and other blemishes from floor covering surfaces.
   2. Sweep and vacuum floor coverings thoroughly.
   3. Damp-mop floor coverings to remove marks and soil.
      a. Do not wash floor coverings until after time period recommended by manufacturer.

B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
   1. Apply protective floor polish to surfaces that are free from soil, visible adhesive, and blemishes if recommended in writing by manufacturer.
   2. Cover floor coverings with undyed, untreated building paper until Substantial Completion.
   3. Do not move heavy and sharp objects directly over floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 6516
SECTION 09 9100 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed interior items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
   2. Work of this Section includes surface preparation, priming, and finish coats specified in this Section. Surfaces which have shop priming and surface treatment specified in other Sections that is in satisfactory condition, need only the required surface preparation (cleaning) and two finish coats, unless specifically noted otherwise.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment which have been factory primed but do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Prefinished items include the following factory-finished components:
      a. Architectural woodwork and casework.
      b. Metal toilet enclosures.
      c. Metal lockers.
      d. Elevator entrance doors and frames.
      e. Finished mechanical and electrical equipment.
      f. Light fixtures.
      g. Distribution cabinets.
   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Utility tunnels.
      e. Pipe spaces.
      f. Duct shafts.
      g. Elevator shafts.
   3. Finished metal surfaces include the following:
a. Anodized aluminum.
b. Stainless steel.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels, stamps, or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
   1. Division 05 Section "Structural Steel Framing" for shop priming structural steel.
   2. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
   3. Division 06 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
   4. Division 08 Section "Hollow Metal Doors and Frames" for factory priming steel doors and frames.
   5. Division 09 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.
   6. Division 09 Section "Vinyl-Faced Fabric Wall Coverings" for substrate sealer under wall coverings.
   7. Division 09 Section "Epoxy Coatings" for special coatings.
   8. Division 15: Painting of mechanical work is specified in Division 15.
   10. Division 32 Section "Concrete Paving" for traffic-marking paint.

E. Alternates: Refer to Division 01 Section "Alternates" for description of Work in this Section affected by alternates.

1.3 DEFINITIONS

A. Standard coating terms defined by MPI apply to this Section:

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>Gloss at 60 degrees</th>
<th>Sheen at 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gloss 1: a traditional matte finish - flat</td>
<td>maximum 5 units</td>
<td>maximum 10 units</td>
</tr>
<tr>
<td>2</td>
<td>Gloss 2: a high side sheen flat - a ‘velvet-like’ finish</td>
<td>maximum 10 units</td>
<td>10-35 units</td>
</tr>
<tr>
<td>3</td>
<td>Gloss 3: a traditional ‘eggshell-like’ finish</td>
<td>10-25 units</td>
<td>10-35 units</td>
</tr>
<tr>
<td>4</td>
<td>Gloss 4: a ‘satin-like’ finish</td>
<td>20-35 units</td>
<td>minimum 35 units</td>
</tr>
<tr>
<td>5</td>
<td>Gloss 5: a traditional semi-gloss</td>
<td>35-70 units</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Gloss 6: a traditional gloss</td>
<td>70-85 units</td>
<td></td>
</tr>
</tbody>
</table>
1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.
   1. Material List: An inclusive list of required coating materials. Indicate each material
      and cross-reference specific coating, finish system, and application. Identify
      each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information, including label
      analysis and instructions for handling, storing, and applying each coating
      material.

B. Samples for Verification: For each color and material to be applied, with texture to
   simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and
      primers. Use representative colors when preparing Samples for review. Resubmit
      until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label
      each Sample for location and application.

C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and
   coatings similar in material, design, and extent to those indicated for this Project, whose
   work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the
   same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and
   containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a
   minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a
   clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and
      waste daily. Take necessary measures to ensure that workers and work areas are
protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
   1. Quantity: Furnish Owner with an additional 5 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in the Finish Schedule on the Drawings.

B. Manufacturers’ Names: Shortened versions (shown in parentheses) of the following manufacturers’ names are used in other Part 2 articles:
   2. Diamond Vogel Paints (DVP).
   4. Kwal Paint (Kwal)
   5. PPG Industries, Inc. (Pittsburgh).
   6. Pratt & Lambert, Inc. (P & L)
   7. Sherwin-Williams Co. (S-W).
   8. Tnemec where indicated, (Tnemec).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
B. Material Quality: Provide manufacturer’s best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer’s proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match colors selected by the Architect and indicated by reference to manufacturer’s color designations. If required, provide custom colors to match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
   c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
   c. If transparent finish is required, backprime with spar varnish.
   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 10/NACE No. 2.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. 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 prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
10. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer’s written instructions.
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.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer’s recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:
   1. Uninsulated metal piping.
   2. Uninsulated plastic piping.
   3. Pipe hangers and supports.
   4. Tanks that do not have factory-applied final finishes.
   5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   6. Duct, equipment, and pipe insulation having “all-service jacket” or other paintable jacket material.
   7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Electrical items to be painted include, but are not limited to, the following:
   1. Electrical equipment that is indicated to have a factory-primed finish for field painting.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

I. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.
L. **Stipple Enamel Finish:** Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

M. **Completed Work:** Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.4 CLEANING

A. **Cleanup:** At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

### 3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

### 3.6 INTERIOR PAINT SCHEDULE

A. **GB - Interior Gypsum Board**
   1. **GB - PGB - Interior Gypsum Board Primer:** Provide 1 coat of primer where required for vinyl wall covering installation.
      a. **PGB - Interior Gypsum Board Primer:** Factory-formulated latex-based primer for interior application. Note: The following primer shall be used as a primer/sealer for vinyl wall coverings. Verify the acceptability of the proposed primer with the wall covering manufacturer to assure compatibility of the primer and vinyl wall covering adhesive.
   2. 
      1) **Moore:** Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
      2) **DVP:** Interior Acrylic Primer/Sealer, DU-1502: Applied at a dry film thickness of 1.5 to 2.0 mils (0.038 to 0.051 mm).
      3) **Glidden Pro:** High Hide Interior Primer Sealer 1000-1200: Applied at a dry film thickness of not less than 1.3 mils.
      4) **IPM:** Prime Line Hi Hide PVA Primer: Applied at a dry film thickness of not less than 1.5 mils. Delete
      5) **Kwal:** 0890 Accu-Pro Sandable Primer: Applied at a dry film thickness of not less than 1.5 mils.
      6) **Pittsburgh:** 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
7) P & L: Z-1004 Suprime "4" Interior Latex Wallprimer: Applied at a dry film thickness of not less than 1.2 mils.

8) S-W: PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

   a. NOTE: At offices and non-patient care areas, finish to be GL4. At patient care areas and trim, finish to be GL5, typical.
   b. PGB - Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.

1) DVP; Interior PVA Primer/Sealer, DU-1507: Applied at a dry film thickness of 2.0 to 3.0 mils (0.051 to 0.0762 mm).

2) Glidden Pro; High Hide Interior Primer Sealer 1000-1200: Applied at a dry film thickness of not less than 1.3 mils.

3) IPM; Prime Line Hi Hiding PVA Primer #514: Applied at a dry film thickness of not less than 1.5 mils.

4) Kwal; 0890 Accu-Pro Sandable Primer: Applied at a dry film thickness of not less than 1.5 mils.

5) Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).

6) Pittsburgh; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).

7) P & L: Z-1004 Suprime "4" Interior Latex Wallprimer: Applied at a dry film thickness of not less than 1.2 mils.

8) S-W: PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).


d. NOTE: At offices and non-patient care areas, finish to be GL4. At patient care areas and trim, finish to be GL5, typical.

1) DVP; Pro Plus Interior Latex Eggshell Enamel, DE-Series: Applied at a dry film thickness of 2.0 to 3.0 mils (0.051 to 0.0762 mm).

2) Glidden Pro; Ultra-Hide 250 Interior Eggshell Paint 1402N: Applied at a dry film thickness of not less than 1.4 mils.

3) IPM; Master Series Eggshell Enamel #2300: Applied at a dry film thickness of not less than 1.5 mils.

4) Kwal; 2100 Accu-Pro PC Latex Eggshell: Applied at a dry film thickness of not less than 1.5 mils.

5) Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).

6) Pittsburgh; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).

7) P & L: Z-8200 Pro-Hide Gold Interior Latex Eggshell: Applied at a dry film thickness of not less than 1.5 - 2.5 mils.

9) S-W: ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

B. FM - Interior Ferrous Metal
1. FM - SGALK - Interior Semigloss Alkyd Paint System: Provide 2 finish coats of GL5 alkyd enamel over a primer.
      1) DVP; Cote-All Multi-Purpose Alkyd Metal Primer, AZ-0400: Applied at a dry film thickness of 2.0 to 3.0 mils (0.0508 to 0.0762 mm).
      2) Glidden Pro; Devguard 4160 Multi-Purpose Tank & Structural Primer 4160 Series: Applied at a dry film thickness of not less than 2.0 mils.
      3) IPM; Meta-Kote Rust Inhibitive Metal Primer #1064: Applied at a dry film thickness of not less than 2 mils.
      4) Kwal; 9210 Accu-Pro Rust Inhibitive Primer: Applied at a dry film thickness of not less than 2.0 mils.
      5) Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
      6) Pittsburgh; 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
      7) P & L; S3206/S3207 SteelTech Universal Primer: Applied at a dry film thickness of not less than 2 - 2.5 mils.
      8) S-W; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
   b. FM - SGALK Interior Semigloss Alkyd Enamel: Factory-formulated GL5 alkyd enamel for interior application.
      1) DVP; Pro Plus Alkyd Interior/Exterior Alkyd Semi-Gloss Enamel, CS-Series: Applied at a dry film thickness of 2.0 to 3.0 mils (0.051 to 0.0762 mm).
      2) Glidden Pro; Alkyd Semi-Gloss Paint 1516N Series: Applied at a dry film thickness of not less than 1.7 mils.
      3) IPM; Synex Semi Gloss Alkyd Enamel #302: Applied at a dry film thickness of not less than 2 mils.
      4) Kwal; 4600 Accu-Pro Alkyd Semi Gloss: Applied at a dry film thickness of not less than 1.7 mils.
      5) Moore; Moorcraft Super Spec Alkyd Semi-Gloss Enamel No. 271: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
      6) Pittsburgh; 6-1510 Speedhide Int/Ext WB Alkyd Semi-Gloss: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
      7) P & L; S-8800 Pro-Hide Gold Alkyd Semi-Gloss: Applied at a dry film thickness of not less than 1.5 mils.
      8) S-W; ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200 Series: Applied at a dry film thickness of not less than 1.7 mils (0.043 mm).

C. ZM - Interior Zinc-Coated Metal

   a. PZM - Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
      1) DVP; V-Cote 200 Acrylic Maintenance Primer/Finish, MC-1501: Applied at a dry film thickness of 2.0 to 3.0 mils (0.0508 to 0.0762 mm).
3) Glidden Pro; Devflex 4020PF Direct to Metal Flat Waterborne Primer & Finish: Applied at a dry film thickness of not less than 2.2 mils.
4) IPM; Meta-Cryl Pure Acrylic Galvanized Primer #1069: Applied at a dry film thickness of not less than .5 mils and not more than 1 mil. Delete
5) Kwal; 5810 Ambassador G-Prime Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.6 mils.
6) Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
7) Pittsburgh; 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).
8) P & L; Primer not required on new galvanized metal. Apply 2 finish coats.
9) S-W; primer not required over this substrate.

1) DVP; Pro Plus Interior Latex Eggshell Enamel, DE-Series: Applied at a dry film thickness of 2.0 to 3.0 mils (0.051 to 0.0762 mm).
2) Glidden Pro; Ultra-Hide 250 Interior Eggshell Paint 1402N: Applied at a dry film thickness of not less than 1.4 mils.
3) IPM; Master Series Eggshell Enamel #2300: Applied at a dry film thickness of not less than 1.5 mils. Delete
5) Kwal; 2100 Accu-Pro PC Latex Eggshell: Applied at a dry film thickness of not less than 1.5 mils.
6) Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
7) Pittsburgh; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils (0.032 mm).
8) P & L; Z-8200 Pro-Hide Gold Interior Latex Eggshell: Applied at a dry film thickness of not less than 1.5 - 2.5 mils
9) S-W; ProMar 200 Interior Latex Eggshell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

END OF SECTION 09 9100
SECTION 09 9656 - EPOXY COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field application of interior epoxy coating systems to items and surfaces scheduled. Type of epoxy systems required is as follows:

1. Two-component, epoxy emulsion.

B. Related Sections include the following:

1. Division 09 Section "Painting" for general field painting.

1.3 DEFINITIONS

A. Standard coating terms defined in ASTM D 16 apply to this Section.

B. Gloss ranges used in this Section include the following:

1. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
2. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each coating system indicated. Include primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.

B. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Provide stepped Samples defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. List of material and application for each coat of each sample. Label each sample for location and application.
3. Submit samples on the following substrates for Architect’s review of color and texture:
   a. Gypsum Drywall: Provide two 8-inch- (200-mm-) long samples of each color and material on drywall.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer’s original, unopened packages and containers bearing manufacturer’s name and label with the following information:

1. Name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer’s stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.7 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F (7 and 35 deg C).

1.8 EXTRA MATERIALS

A. Furnish extra high-performance coating materials from the same production run as materials applied and in quantities described below. Package coating materials in unopened, factory-sealed containers for storage and identify with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer/ Products: Refer to Finish Schedule for selected manufacturer and product. Alternate products may be used from the manufacturers listed below if samples of the proposed alternate products are submitted and approved by the Architect prior to ordering.

B. Manufacturers’ Names: The following manufacturers are referred to in the coating system descriptions by shortened versions of their names shown in parenthesis:

1. ICI Dulux Paints; Devoe Coatings (ICI Devoe).
2. Kwal Paint (Kwal).
4. Pittsburgh Paint; PPG Industries, Inc. (PPG).
5. Sherwin Williams; Industrial and Marine Coatings (S-W).

2.2 COATINGS MATERIALS, GENERAL

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer’s highest grade of the various high-performance coatings specified. Materials not displaying manufacturer’s product identification are not acceptable.

1. Proprietary Names: Use of manufacturer’s proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer’s material data and certificates of performance for proposed substitutions.

C. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less.

2.3 COLORS

A. Colors: Match colors indicated in the Finish Schedule (P-1, P-2, etc.) which reference the general paint manufacturer’s standard color designations indicated.

2.4 INTERIOR EPOXY COATING SYSTEMS

A. Provide the following coating systems for substrates indicated:

1. Where undercoats or other conditions show through final coat, apply additional coats until the cured film is of uniform coating finish, color, and appearance.
B. Drywall:

1. Two-Component, Epoxy Emulsion Coating: Provide two finish coats of factory-formulated, semigloss/gloss, epoxy emulsion over base coat.

   a. Prime Coat: Manufacturer's recommended latex primer which is compatible with the specified finish system.

      1) Kwal: 0890 Sandable Drywall Primer
      2) Moore: 253 Latex Drywall Primer.

   b. Finish Coats: Semigloss, epoxy emulsion.

      2) Kwal: 3190 Semi-Gloss W/B Catalyzed Epoxy
      5) S-W: Water Based Catalyzed Epoxy, B70 Series B60V25.

2.5 INTERIOR EPOXY COATING COLOR SCHEDULE


PART 3 - EXECUTION

3.1 EXAMINATION

A. With Applicator present, examine substrates and conditions under which high-performance coatings will be applied, for compliance with coating application requirements.

   1. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
   2. Start of application is construed as Applicator's acceptance of surfaces within that particular area.

B. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.

   1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:

      a. Confirmation of primer's suitability for expected service conditions.
      b. Confirmation of primer's ability to be top coated with materials specified.

   2. Notify Architect about anticipated problems before using the coatings specified over substrates primed by others.
3.2 PREPARATION

A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

B. Cleaning: Before applying high-performance coatings, clean substrates of substances that could impair bond of coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove primers and reprime substrate.

D. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.
2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
3. Use only the type of thinners approved by manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply epoxy coatings according to manufacturer's written instructions.

1. Use applicators and techniques best suited for the material being applied.
2. Do not apply high-performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
3. Coating colors, surface treatments, and finishes are indicated in the coating system descriptions.
4. Provide finish coats compatible with primers used.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

   a. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required is the same regardless of application method.
   a. Omit primer on metal surfaces that have been shop primed and touchup painted.
   b. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
   c. Where manufacturer's written instructions require sanding, sand between applications to produce a smooth, even surface.
   d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause undercoat to lift or lose adhesion.

2. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance. Give special attention to edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

C. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
   a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
   b. Brush out and work brush coats into surfaces in an even film.
   c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.

3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
   a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
   b. Apply each coat to provide the equivalent hiding of brush-applied coats.
   c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.

D. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.
E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.

1. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

F. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 CLEANING

A. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

1. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.

2. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION 09 9656
SECTION 10 1123.16 - FABRIC WRAPPED HOMASOTE PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Fabric wrapped panels

1.2 SUBMITTALS

A. Product Data: For type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Show location of panel joints.

C. Samples: For type of visual display surface indicated.

D. Product test reports for surface-burning characteristics of polyester fabrics.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide fabrics with the surface-burning characteristics indicated, as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver shop fabricated visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   1. Basis-of-Design Product: The design for each visual display surface is based on Homasote wrapped panels specified. Subject to compliance with requirements, provide either the named product or a comparable product.
2.2 MATERIALS, GENERAL

A. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with flame-spread index of 25 or less when tested according to ASTM E 84. Refer to Materials Legend – Casework on the drawings.

B. Fabric-Wrapped Panel Substrate: NCFR (R) fiberboard manufactured from 100 percent recycled wood fiber material as manufactured by Homasote Company; physical properties as follows:

1. Thickness: 1/2 inch (13 mm).
2. Density: 34-40pcf (545-640 kg/cubic m).
3. NCR: 0.20.
4. Flame Spread: 25, per ASTM E 84.
5. Smoke Developed: 20, per ASTM E 84.
7. Classification: Class A, per NFPA.

C. Laminating Adhesive: Manufacturer’s standard moisture-resistant thermoplastic type.

2.3 TACK ASSEMBLIES

A. Fabric-Faced Homasote Tackable Surfaces: See substrate specified above.

2.4 FABRICATION

A. Fabricate visual display surfaces to sizes indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Follow manufacturer’s instructions for allowing panels to be exposed to environmental temperature and humidity conditions for not less than 24 hours before start of installation.

B. Temporarily position panels in place and request Architect’s approval, to ensure that desired appearance is obtained.

3.2 INSTALLATION

A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

B. Install tack surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
C. Tack Boards: Attach visual display boards to wall surfaces with egg-size adhesive gobs at 16 inches (400 mm) o.c. horizontally and vertically, unless another method of attachment is indicated on the Drawings.

END OF SECTION 10 1123.1
SECTION 10 2123 – CUBICLE CURTAINS AND CEILING TRACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions, apply to this Section.

1.2 SUMMARY

A. The extent of curtain tracks is indicated on drawings. Tracks include the following:

1. Cubicle Curtains
2. Cubicle Tracks.
3. Shower Curtain Tracks

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for tracks.
B. Shop Drawings: Submit shop drawings for the fabrication and installation of tracks and associated components.
C. Samples: Submit samples of each component, material and finish which will be exposed to view.

1.4 PERFORMANCE REQUIREMENTS

A. Curtains: Provide curtain fabrics with the following characteristics:

1. Fabrics are launderable to a temperature of not less than 160 deg F (71 deg C).
2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
   a. Identify fabrics with appropriate markings of applicable testing and inspecting agency.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but not less than 2 units.

PART 2 - PRODUCTS

2.1 TRACKS
A. Cubicle Tracks: Extruded aluminum hookless type track: Provide with end stops, attachment devices, track splices.

2. Finish: Baked enamel, acrylic, or powder coat.
3. Manufacturers:
4. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

B. Cubicle Curtain Construction: Fabric shall be Contractor Furnished, Contractor Installed.

2.2 CURTAINS

A. Curtain Fabric: Refer to finish legend.

B. Mesh Top: No 40 nylon mesh. Mesh color shall be selected from manufacturer’s full range of color.

2.3 CURTAIN FABRICATION

A. Fabricate curtains to comply with the following requirements:
   1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches (305 mm) added fullness.
   2. Length: Equal to floor-to-ceiling height with 20 inch mesh top, and minus distance above finished floor at bottom as follows:
      a. Cubicle Curtains: 12 inches (305 mm).
   3. Top Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lock stitched.
   4. Mesh Top: Top hem not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lock stitched. Double lock stitch bottom of mesh directly to 1/2-inch (12.7-mm) triple thickness, top hem of curtain fabric.
   5. Bottom Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, double thickness and single lock stitched.
   6. Side Hems: Not less than 1/2 inch (12.7 mm) and not more than 1-1/4 inches (31.8 mm) wide, with double turned edges, and single lock stitched.
   7. Vertical Seams: Not less than 1/2 inch (12.7 mm) wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units and components at the locations shown or as directed by Architect
securely mounted. Attach to substrate in accordance with the manufacturer's instructions, unless otherwise shown.

B. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation.

C. Install level, plumb, and at the proper height. Cooperate with other trades for installation of units to finish surfaces. Repair or replace damaged units as directed by the Architect.

D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

E. Curtains: Hang curtains on each curtain track.

END OF SECTION 10 2123.13
SECTION 10 2600 - WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Corner guards.
2. Wall Protection
3. Handrails/crash rails.

1.2 SUBMITTALS

A. Product Data: For each product indicated.
B. Shop Drawings: Include locations and extent of impact-resistant wall protection and details of installation.
C. Samples: For each for each unit and for each color and texture required.
D. Maintenance data.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide components with flame-spread and smoke-developed indices of not more than 25 and 450, respectively, when tested per ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

1.4 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. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to 2 percent of each type, color, and texture of each type of unit installed, but no fewer than two units.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the listed manufacturer following:

2.2 MATERIALS AND COMPONENTS:

A. Corner Guards: Provide Acrovyn corner guards as follows. Provide corner guards complete with anchors as required to suit the adjoining wall construction in which they are installed.
1. **CG1**: Acrovyn SSM-20N, color per finish schedule

B. **Sheet Wall Protection (WPx)**: Provide Acrovyn corner guards as follows. Provide adhesives as required to suit the adjoining wall construction in which they are installed.

1. Sheet color: Per finish schedule.
2. Sheet thickness: 0.060"
3. Sheet texture: Velvet

**PART 3 - EXECUTION**

3.1 **INSTALLATION**

A. Preparation: Complete finishing operations, including painting, before installing impact-resistant wall protection system components. Before installation, clean substrate to remove dust, debris, and loose particles.

B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.

1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

C. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run.

D. Immediately on completion of installation, clean plastic covers and accessories using standard ammonia-based household cleaning agent. Clean metal components according to manufacturer's written instructions.

1. Remove excess adhesive using methods and materials recommended by manufacturer.

END OF SECTION 10 2600
SECTION 10 2813 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessories Schedule and room designations indicated on Drawings in product schedule.

D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
B. Manufacturer’s Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work may be supplied from one of the approved manufacturers listed below.

1. Toilet and Bath Accessories:
   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.
   d. Royse Rolls

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.


F. Silvered Mirrored Glass: Tempered, clear float glass with successive layers of chemically deposited silver, electrically or chemically deposited copper, and manufacturer’s standard organic protective coating applied to second glass surface to produce a coating system complying with FS DD-M-411.


H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 TOILET AND BATH ACCESSORIES

A. Grab Bars: Bobrick B-6806 Series or equal.
   1. GB18 = B-6806 x 18
   2. GB24 = B-6806 x 24
3. GB36 = B-6806 x 36
4. GB42 = B-6806 x 42

B. Toilet Paper Dispenser (TPD1) = Bobrick B-2888 or equal.

C. Feminine Napkin Disposal Unit (FND1) = Bobrick B-354 or equal.

D. Towel Hook (TH1) = Bobrick B-233 or equal.

E. Mirror (MIR1) = Bobrick B-165 1836 or equal.

2.4 FABRICATION

A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

   1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

   1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
   2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

3.2 ADJUSTING AND CLEANING
A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer’s written recommendations.

END OF SECTION 10 2813
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Fire-protection cabinets for the following:
   a. Fire extinguisher cabinets and brackets.
   b. NOTE: Fire Extinguishers are Owner Furnished, Owner Installed.

B. Related Sections include the following:

1. Division 07 Section “Through-Penetration Firestop Systems” for firestopping sealants at fire-rated cabinets.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.

1. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.

1. Size: 6 by 6 inches (150 by 150 mm) square.

C. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire-protection cabinets through one source from a single manufacturer.

B. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2. Basis-of-Design Product: The design for each product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
B. Stainless-Steel Sheet: ASTM A 666, Type 304.
C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FIRE-PROTECTION CABINET

A. Basis-of-Design Product: JL Industries, Ambassador Series OR a comparable product by one of the following:

B. Manufacturers:

2. Kidde Fyrmatics.
3. Larsen’s Manufacturing Company.
4. Modern Metal Products; Div. of Technico.
5. Potter Roemer; Div. of Smith Industries, Inc.
6. Watrous; Div. of American Specialties, Inc.

C. Cabinet Type: Suitable for fire extinguisher.

D. Cabinet Construction: Refer to drawings for cabinet locations in fire rated walls.

E. Cabinet Material: Cold rolled steel.

F. Semirecessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

G. Cabinet Trim Material: Cold rolled steel.

H. Door Material: Cold rolled steel.
I. Door Style: Solid Door, cold rolled steel.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide projecting door pull and friction latch.
   2. Provide continuous hinge or concealed hinge permitting door to open 180 degrees.

K. Door Latch: At first floor locations, roller latch is acceptable. At third floor locations, provide key lock with removable cylinder core. Core to be keyed to building standards per Door Hardware specifications.

L. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER,"
         1) Location: Applied to cabinet door
         3) Lettering Color: Red.
         4) Orientation: Vertical unless door style is better suited for horizontal orientation.

M. Finishes:
   1. Color to be White.

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material.
      a. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
   2. Miter and weld perimeter door frames.
C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 FINISHES, GENERAL

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed or semirecessed cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.

   1. Remove and replace damaged, defective, or undercharged units.

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

3.2 PREPARATION

A. Prepare recesses for recessed or semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

   1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

D. Identification: Apply decals at locations indicated.
3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer’s written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4400
SECTION 10 5113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes lockers.

1. Locker Configuration: Multiple-tier box lockers – refer to drawings for sizes and locations.

1.2 SUBMITTALS
A. Product Data: For each type of locker indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Show locker fillers, trim, and accessories. Include locker-numbering sequence.

C. Samples: For each exposed finish and for each color and texture required.

D. Maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DeBourgh Manufacturing Co.
2. Hadrian Manufacturing, Inc.
3. Interior/Medart.
4. List Industries, Inc.
5. Lyon Metal Products, Inc.
7. Republic Storage Systems Co., Inc.
8. Tennsco Corporation.

2.2 MATERIALS
A. Cold-Rolled Steel Sheet: ASTM A 366/A 366M, matte finish, suitable for exposed applications, and of stretcher-leveled flatness.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

2.3 MULTIPLE TIER BOX LOCKERS
A. Body: Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; flanged for double thickness at back vertical corners.

1. Back-Material Sheet Thickness: 0.0239 inch (24 gage)(0.60 mm).
2. Side-Material Sheet Thickness: 0.0239 inch (24 gage)(0.60 mm).

B. Frames: Form channel frames from minimum 0.0598-inch- (16 gage)(1.50-mm-) thick steel sheet; lapped and welded at corners. Form continuous integral door strike on vertical frame members. Provide resilient bumpers to cushion door closing.

1. Latch Hooks: Form from minimum 0.1046-inch- (12 gage)(2.70-mm-) thick steel; welded or riveted to door frames.

C. Doors: One-piece steel sheet, formed into channel shape at vertical edges and flanged at right angles at top and bottom edges. Fabricate to prevent springing when opening or closing, and to swing 180 degrees.

1. Sheet Thickness: 0.0598 inch (16 gage)(1.50 mm) minimum.
2. Acoustical Treatment: Fabricate lockers for quiet operation with manufacturer’s standard rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact.
3. Vents: Stamped louvered in door face.

D. Hinges: Steel, full loop, 5 or 7 knuckle; tight pin; minimum 2 inches (51 mm) high. Weld to inside of door frame and attach to door with at least two factory-installed fasteners that are completely concealed and tamper resistant when door is closed.

1. Provide at least 2 hinges for each door 42 inches (1067 mm) high or less.

E. Recessed Handle and Latch: Manufacturer’s standard housing, formed from 0.0359-inch- (0.90-mm-) thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; nonprotruding latch lifter; and automatic, prelocking, pry-resistant latch.

1. Provide minimum 2-point latching for each door 42 inches (1067 mm) high or less.
   Provide strike and eye for padlock.

F. Locks: Combination padlock, provided by others.

2.4 LOCKER ACCESSORIES

A. Number Plates: Manufacturer’s standard etched, embossed, or stamped, aluminum number plates with numerals at least 3/8 inch (9 mm) high. Number lockers in sequence indicated. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

B. Recess Trim: Manufacturer’s standard; fabricated from minimum 0.0478-inch- (1.20-mm-) thick steel sheet, minimum 2-1/2-inch (64-mm) face width, and finished to match lockers. Fabricate trim in lengths as long as practicable.

C. Interior Equipment: Furnish each locker with the following items, unless otherwise indicated:
1. Hooks: Manufacturer's standard zinc-plated, ball-pointed steel. Provide one double-prong ceiling hook, and not fewer than two single-prong wall hooks for single-, double-, and triple-tier units. Attach hooks with at least two fasteners.

D. Continuous Metal Base: Minimum 0.0598-inch- (1.50-mm-) thick steel sheet, channel or zee profiled for stiffness, fabricated in lengths as long as practicable to enclose base and base ends of lockers, and finished to match lockers.

   1. Height: 4 inches (102 mm).

E. Finished End Panels: Manufacturer's standard; fabricated from minimum 0.0239-inch- (0.60-mm-) thick steel sheet, finished to match lockers, and designed for concealing exposed ends of nonrecessed lockers.

   1. Provide one-piece panels for double-row (back-to-back) locker ends.

F. Continuously Sloping Tops: Manufacturer's standard, fabricated from minimum 0.0359-inch- (0.90-mm-) thick steel sheet, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practicable, without visible fasteners at splice locations, finished to match lockers. Provide fasteners, filler plates, supports, and closures, as follows:


2.5 FABRICATION

   A. Unit Principle: Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.

   B. Knocked-Down Construction: Fabricate lockers for nominal assembly at Project site.

   C. Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.

     1. Form locker-body panels, doors, and accessories from one-piece steel sheet, unless otherwise indicated.

2.6 FINISHES

   A. Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plated surfaces.

   B. Steel Sheet Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

   C. Steel Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 1.4 mils (0.036 mm) on doors, frames, and legs, and 1.1 mils (0.028 mm) elsewhere.
1. Color and Gloss: As selected from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install metal lockers and accessories level, plumb, rigid, and flush according to manufacturer’s written instructions.

B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces and face frames.

C. Anchor lockers to floors and walls at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Install anchors through backup reinforcing plates where necessary to avoid metal distortion, using concealed fasteners.

D. Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

E. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed lockers.

F. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 10 5113
SECTION 13 4900 - RADIATION PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Lead sheet, strip, and plate.
2. Lead glass.
3. Lead-lined building materials and products including the following:
   a. Gypsum board.
   b. Steel door frames.
   c. Wood doors.
   d. Observation-window frames.
4. Owner Provide Physicist Report, showing thickness and locations of shielding.

B. Related Sections include the following:

1. Division 09 Section "Gypsum Board Assemblies" for metal framing and furring for lead-lined gypsum board and for finishing materials, accessories, and trim applied to lead-lined gypsum board.
2. Division 16 Sections for conduit, wire, and switch boxes for connecting components of neutron-shielding doors, including operators.

1.3 DEFINITIONS

A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.

1. Lead equivalence specified for materials used in this project is as measured at 100 kV, unless otherwise indicated.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.

1. Materials, thicknesses, and configurations indicated are based on radiation protection design prepared by Owner's radiation health physicist. This design is available to Contractor on request.

B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets,
and other items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.

C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in Product Data.

1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection together with details of penetrations.
2. Show details of neutron-shielding doors and frames, including anchorage to and coordination with other work. Show locations of electrical conduit and boxes for connecting door operators, door operator switches, and door interlock switches.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of radiation protection product through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver materials in original packages, containers, or bundles bearing the brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.

D. Lead-Lined Steel Frames: Comply with requirements in Division 08 Section “Hollow Metal Doors and Frames” for delivery, storage, and handling.

E. Lead-Lined Wood Doors: Comply with manufacturer’s written instructions and requirements in NWWDA I.S.1-A.

1. Package doors individually in plastic bags or cardboard cartons.
2. Mark each door on top and bottom rail with opening number used on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 MATERIALS

A. Lead Sheet, Strip, and Plate: ASTM B 749, alloy UNS No. L51121 (chemical-copper lead).

B. Lead Glass: Lead-barium, polished plate glass containing more than 60 percent heavy metal oxides, including 55 percent lead oxide by weight.

1. Manufacturers:
   a. Amerope Enterprises, Inc.
   b. McGrory Glass, Inc.

2. Trim to wood members.

C. Lead-Lined Gypsum Board: 5/8-inch- (15.9-mm-) thick gypsum board complying with Division 09 Section “Gypsum Board Assemblies,” of width and length required for support spacing and to prevent cracking during handling, and with a single sheet of lead laminated to the back of the board.

1. Provide lead lining full width of board and length necessary to extend from floor to 84 inches (2133 mm) above floor.
2. Provide 3-inch- (75-mm-) wide lead strips for wrapping metal stud flanges.
3. Provide 2-inch- (50-mm-) wide lead strips for backing joints.
4. Provide 5/8-inch (16-mm) lead disks for covering screw heads.
5. Provide lead-headed nails for fastening gypsum board, accessories, and trim to wood members.

D. Accessories and Fasteners: Provide manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.

2.3 MANUFACTURED UNITS

A. Lead-Lined Steel Door Frames: Steel door frames complying with NAAMM HMMA 861, except 0.0667 inch (1.7 mm) thick, and lined with lead sheet of thickness not less than that required for doors and walls where frames are used.

1. Manufacturers:
   a. American Steel Products Corp.
   b. Deronde Products.
   c. Karpen Steel Custom Doors & Frames.
   d. Kewanee Corp.
   e. Pioneer Industries.
   f. Precision Metals, Inc.
   g. Security Metal Products Corp.
   h. A & L Shielding Inc.
   i. El Dorado Metals, Inc.
j. Lead Shield, Inc./LSI Sales, Inc.
k. Mayfield Manufacturing Company.
l. NELCO, Inc.
m. Radiation Protection Products, Inc.
n. Ray-Bar Engineering Corp.

2. Provide additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.
3. Form lead sheet to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Fabricate lead lining wide enough to maintain an effective lap with lead of adjacent shielding.

B. Lead-Lined Wood Doors: Flush wood doors with lead lining.

1. Manufacturers:
   a. Masonite Architectural.
   b. VT Industries Inc.

2. Door Construction: Plastic Laminate face to match other doors in the project, five ply, bonded structural composite lumber core.
3. Lead Lining: One continuous sheet of lead extending from top to bottom and edge to edge, constructed in the core. Assemble lead lining and core with poured lead fasteners or steel bolts. Space fasteners not more than 1-1/2 inches (38 mm) from door edge and about 8 inches (200 mm) o.c. Countersink bolt heads and cover with lead.
4. Comply with Division 08 Section "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements, unless otherwise indicated.
6. Factory finish with stain and transparent catalyzed lacquer or conversion varnish.
7. Factory fit doors to suit frame openings indicated with 1/16-inch (1.5-mm) clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.
8. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.
9. Prepare doors to receive view windows and louvers as indicated. Provide removable wood stops for glazed openings.
10. Provide lead-lined astragals for pairs of doors.

C. Lead-Lined Observation-Window Frames: Fabricate from 0.0428-inch- (1.1-mm-) thick, formed-steel sheet or 0.064-inch- (1.6-mm-) thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.

1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.
2. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch (9.5 mm) and provide removable stops.
3. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review Owner Furnished Physicist’s Report at end of this section for thicknesses and locations of lead shielding.

B. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.

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

3.2 INSTALLATION OF LEAD-LINED GYPSUM BOARD

A. Install with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints. Install using construction adhesive and supplementary fasteners.

B. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum-board manufacturer. Apply lead disks over screw heads and recess flush with surface of board.

1. Install lead strips, 1-1/2 inches (38 mm) wide minimum and same thickness as lead lining, to face of supports and blocking where joints occur. Secure lead strips with construction adhesive. Provide shims at intermediate supports.

2. Apply lead disks recessed flush with surface of board over heads of screws securing trim.

C. Openings: Extend lead-lined gypsum board into frames of openings, lapping lead lining with lead frames or frame linings at least 1 inch (25 mm). Arrange board around openings so neither horizontal nor vertical joints occur at corners of openings.

D. Install control and expansion joints where indicated, with appropriate time accessories. Install lead strip on face of framing, extending across joint, and lap with lead lining of gypsum board.

3.3 INSTALLATION OF DOORS AND FRAMES

A. Install lead-lined steel door frames according to Division 08 Section “Hollow Metal Doors and Frames,” unless otherwise indicated.

1. Apply a coat of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.

B. Install lead-lined wood doors according to Division 08 Section “Flush Wood Doors,” unless otherwise indicated.
C. Frames: Comply with NAAMM HMMA 840, unless otherwise indicated. Except for frames located in existing walls or partitions, place frames before constructing walls. Set frames accurately in position, plumb, and brace securely until permanent anchors are set.

1. Provide three anchors per jamb, located adjacent to hinge on hinge jamb and at corresponding heights on strike jamb.
2. In masonry construction, use wire or T-strap anchors and apply a coat of asphalt mastic or paint to lead lining where lead will come in contact with masonry or grout.
3. In metal stud construction, use wall anchors attached to studs with screws.
4. In wood stud construction, use strap anchors attached to studs with screws.

D. Lap lead lining of frames over lining in walls at least 1 inch (25 mm).

E. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls where frames are used. Form lead to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch (25 mm).

F. Install doors in frames level and plumb, aligned with frames and with uniform clearance at each edge.

G. Line astragals with lead sheet.

H. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Division 08 Section "Door Hardware" for other installation requirements.

I. Touch up damaged finishes with compatible coating after sanding smooth.

J. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.4 INSTALLATION OF PENETRATING ITEMS

A. At penetrations of lead linings, provide lead shields to maintain continuity of protection.

B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.

C. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners, unless indicated on Drawings.

D. Outlet Boxes and Conduit: Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch (25 mm). Wrap conduit with lead sheet for 10 inches (250 mm) from box.

E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to three times the largest opening dimension. Lap lead sheet with adjacent lead lining at least 1 inch (25 mm).
F. Piping: Unless otherwise indicated, wrap piping with lead sheet for 10 inches (250 mm) from point of penetration.

3.5 FIELD QUALITY CONTROL

A. Field Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

C. Testing: After radiology equipment has been installed and placed in operating condition, Owner will engage a radiation health physicist to test radiation protection.

D. Correct deficiencies in or remove and replace radiation protection that testing indicates does not comply with specified requirements, including finishes and other work covering defective work.

3.6 PROTECTION

A. Lock radiation-protected rooms once doors and locks are installed and limit access to only those persons performing work in the rooms.

END OF SECTION 13 4900
20 00 00 BASIC MECHANICAL CONDITIONS

20 00 01 GENERAL

A. This Section includes general contractual, administrative and procedural requirements for the Work of Divisions 20 – 29 to supplement the requirements specified in Division 1.

B. The organization of the Specifications into Divisions, Sections and Subsections, and the arrangement of the Plans shall not in and of itself divide the Work among the Contractors and Subcontractors nor establish the Work to be performed by any trade.

C. The “Scope of Work” and “Work Included” under each respective sectional heading, nevertheless, attempts to segregate the Work by known contracting activities. In the final analysis, the General Contractor shall be responsible for scoping the work for each trade based on local practice to include all the Work of a given type in the related proposal, regardless of where and how identified in the Bid Documents.

20 00 02 SCOPE OF WORK

A. This project is for a renovation on the 4th floor of the Critical Care Addition at MU Healthcare’s University Hospital.

B. The Mechanical Work for this project shall include all material, labor and services necessary for and incidental to providing the following systems (respective Sections of the Specifications are noted in the right hand column):

1. Basic Mechanical Materials and Methods 20
2. Insulation Work 20
3. Fire protection system 21
4. Plumbing Work 22
5. HVAC Piping and Equipment 23
6. Air Distribution 24
7. Temperature Control Systems 25

20 00 03 REFERENCES

A. The Plans, the general provisions of the Contract, including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.

B. All provisions and conditions cited in this Section shall apply to Work for all other sections of Divisions 20 – 29 of these Specifications.

20 00 04 REFERENCES, REGULATORY REQUIREMENTS

A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where relevant standards have been established (see also Paragraph 20 00 60). Material and equipment, which are not covered by UL Standards, will be acceptable provided they meet safety requirements of a nationally recognized testing laboratory. Products which no nationally recognized testing laboratory accepts, lists, labels, certifies or determines to be safe will be considered if inspected or tested in accordance with national industrial standards such as NEMA or ANSI. Evidence of compliance shall include test reports and definitive submittals.
B. Pressure vessels and pressure retaining safety devices shall be certified in accordance with applicable requirements of the ASME Boiler Code.

C. Definitions:

1. “Listed”: A product is “listed” if of a kind mentioned in a list which: Is published by a nationally recognized laboratory which makes periodic inspections of such production. States that such product meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. “Labeled”: The product is “labeled” if: It embodies a valid label or other identifying mark of a nationally recognized testing laboratory such as UL, Inc. Production is inspected periodically by a nationally recognized testing laboratory. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

3. “Certified”: The product is “certified” if: The product has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in specific manner. Production is inspected periodically by a nationally recognized testing laboratory. The product bears a label, tag or other record of certification.

4. “Nationally recognized testing laboratory:”

A. The term “Work” used in this Division shall be the furnishing of material, labor and/or services necessary for and reasonably incidental to providing specific component(s), consideration(s) and/or system(s) of the design for the mechanical facilities for this Project as hereinafter defined by the Project Documents.

B. The term “Project Documents” used in this Division shall be the compilation of the Specifications, the Plans and any Attachment and Addendum which collectively define the design and the intent of the Work to construct the Project.

C. The terms “Architect” and “Engineer” as used in this Division of the Specifications shall be the professional individual and/or company developing the respective portion(s) of the Project Documents and administering the responsibility for the adherence to the intent of these documents. The “Architect/Engineer” is the agent of the “Owner”, and shall represent and discharge authority on all matters unless the matter is referred to the Owner or the Owner elects to perform in their own behalf.

D. The term “General Contractor, Construction Manager, or Prime Contractor” as used in Division 20 shall mean the Contractor who has the prime contract with the Owner and who is responsible for general conditions of the project and is responsible for seeking experienced and qualified Trade Subcontractors to perform the Work.

E. The terms “Contractor” and “Subcontractor” where used in this Division shall mean any Company, regularly in business, to perform the type of work for which the Contract was sought, who has contracted with the Owner or General Contractor to perform the work included in and defined by this section and any other section or sections of this Division.

F. The term “submittal” as used in this Section of the Specifications shall be construed to be information in various forms compiled by the Contractor to transmit to the Architect/Engineer for review, comment and/or approval and return same to the Contractor with notice to react. The information shall support and/or substantiate that the given product complies with the intent of the Project Documents, should be incorporated in the Work and therefore, warrants approval to permit proceeding with that Work. The information may be any form or accepted practice of shop drawings, data, published catalogs, etc. that sufficiently provide the Architect/Engineer with basis of making a determination.
G. The term “unfinished space” as used in Division 20 - 25 of the Specifications shall be a mechanical or electrical equipment room. These are rooms that are generally unpainted and accessible only to building maintenance personnel.

H. The term “finished space” as used in Division 20 - 25 of the Specifications shall mean any space not defined as “unfinished space” (i.e. occupied rooms, corridors, stairways, closets, etc.).

I. The term “exterior” or “outdoors” as used in Division 20 - 25 of the Specifications shall mean exposed to atmospheric weather conditions.

J. The term “interior” or “indoors” as used in Division 20 - 25 of the Specifications shall mean not exposed to atmospheric weather conditions.

K. The term “concealed” as used in Division 20 - 25 of the Specifications shall mean anything that is not visible in a “finished space”.

L. The term “inaccessible” as used in Division 20 - 25 of the Specifications shall mean located within walls or above non-lay-in ceiling (i.e., drywall, plaster).

M. The term “packaged” as used in Division 20 - 25 of the Specifications shall be construed to be a factory manufactured piece of equipment for which all components are totally assembled, prepipied and prewired within its own structure and ready to operate when connected to proper external mechanical and electrical services.

N. The term “cold piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media at or below 79 degrees F temperature.

O. The term “ambient piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media which is neither heated nor chilled and remains at a temperature range between 80 and 109 degrees F temperature.

P. The term “hot piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media at or above 110 degrees temperature.

Q. The term “medical gas” as used in Division 20 - 25 of the Specifications shall include gaseous oxygen, nitrous oxide and medical (clinical) air, all installed per NFPA 99.

R. The term “medical vacuum” as used in Division 20 - 25 of the Specifications shall include vacuum, installed in accordance with NFPA 99.

20 00 06 CODES, STANDARDS, ETC.

A. The material, workmanship and systems for Work of this Division shall comply with all applicable codes, standards, regulations and laws of the legal governmental jurisdiction at the project site.

B. Should the Contractor perform any work that does not comply with the requirements of the applicable codes, standards, regulations, statutes, laws, acts, or which does not receive the approval of the responsible inspection authority, Contractor shall bear all costs arising in correcting the deficiencies.

C. Applicable requirements of the current and accepted edition of the following codes shall apply to the Work for Divisions 20 – 29:

  International Building Code 2018
  International Existing Building Code 2018
  International Mechanical Code 2018
International Plumbing Code 2018
International Fire Code 2018
International Fuel Gas Code 2018
National Electrical Code, 2011 & 2017
NFPA 110 - 2016
NFPA 101 – 2012
NFPA 99 – 2012
NFPA 96 - 2017
NFPA 90A – 2015
NFPA 72 – 2010 & 2016
NFPA 45 – 2015
NFPA 20 - 2016
ASHRAE 90.1 – 2016
ASHRAE 170 - 2017
ASME A17.1
Americans with Disabilities Act – Standards for Accessible Design 2010
Facility Guidelines Institute – 2014

D. Applicable requirements of the current and accepted edition of the following industry standards, codes and specifications shall apply to the Work for Divisions 20 - 29:

AGA American Gas Association
AMCA Air Moving and Conditioning Association
ANSI American National Standards Institute
ASHRAE American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME American Society of Mechanical Engineers
ASSE American Society of Sanitary Engineers
ASTM American Society of Testing and Materials
AWS American Welding Society
AWWA American Water Works Association
CISPI Cast Iron Soil Pipe Institution
IEEE Institute of Electrical & Electronic Engineers
IPCEA Insulated Power Cable Engineers Association
MSS Manufacturers Standardization Society of Valve and Fitting Industry
NIST Institute of Science and Technology
NEC National Electric Code, including amendments by local authority having jurisdiction
NEMA National Electrical Manufacturers Association
NFPA National Fire Protection Association
NSF National Sanitation Foundation
NIOSH National Institute of Occupational Safety and Health
OSHA Occupational Safety and Health Act
SMACNA Sheet Metal and Air Conditioning Contractors National Association
UL Underwriters Laboratory, Inc.

E. Applicable requirements of all the relevant Federal laws including current and accepted edition of the Americans with Disabilities Act (ADA).
20 00 10 CONDITIONS, BID

20 00 11 REQUEST FOR PROPOSAL

A. The terms for Contractor's proposal shall be as described in the General Conditions, Supplementary and/or Special Conditions and Specification Sections of Division 1.

20 00 13 FREIGHT

A. The respective Contractor or Subcontractor shall pay all shipping and/or freight charges coincidental with the purchase of material and equipment for the fulfillment of their respective Work.

20 00 14 PERMITS AND FEES

A. The respective Contractor or Subcontractor shall apply for, obtain and pay for all charges for permits and fees required to install the respective Work. The Contractor shall arrange for and pay all required charges and/or fees to inspect and accept the Work by the appropriate authority.

B. Any deficiency arising from the improper administering or complying with requirements for permits, fees, or inspections shall be corrected by the Contractor without additional compensation.

20 00 20 CONDITIONS, JOBSITE

20 00 21 TEMPORARY FACILITIES

A. General

In general, the General Contractor or the Owner to the extent as described in Division 1 of the Specifications will provide temporary facilities. However, if that is not the case, the specific conditions of this project are identified as follows:

B. CONSTRUCTION ELECTRIC POWER and LIGHTING:

1. The General Contractor shall provide 120 volt, 60 Hz, single phase electric service to a single distribution panel at the job site and shall provide minimal temporary lighting throughout the Project.

2. It shall be the responsibility of the respective Contractor or Subcontractor to provide extension(s) and any necessary protection devices from the distribution panel(s) for their requirement(s). All cords shall be grounded.

3. The respective Contractor or Subcontractor shall provide his own three (3) phase electric power requirements.

C. TEMPORARY CONDITIONING OF AIR (HEATING/COOLING):

1. The permanent heating, ventilating and air conditioning systems and machinery shall not be used for temporary heating or cooling during construction. Any devices required for temporary conditioning of the spaces would be the responsibility of the General Contractor.

2. The respective Contractor or Subcontractor shall provide temporary conditioning to all areas affected by the scope of work. All spaces affected shall have no interruptions in any utility services including, heating, ventilation, air conditioning, plumbing, compressed air, specialty gases, steam, ect.. Contractor shall provide temporary piping, ductwork, spot
coolers/heaters as necessary to maintain the existing conditions of all spaces affected by
the scope of work.

3. If the Contractor should request through a separate agreement with the Owner to utilize the
permanent systems or equipment for temporary space conditioning, the following minimum
conditions will be a part of that agreement:
   a. The return air system shall not be used. This shall include the return air ductwork,
return air inlets at air devices and return air connections at air handling equipment.
   Air shall be returned directly through the filter section at the air handling equipment
   and the return air system shall be isolated and sealed tightly.
   b. All safety devices shall be installed and operative.
   c. Temporary filters shall be installed in the filter section(s). These filters shall be
removed and discarded at the end of the temporary period.
   d. At the end of the temporary period and before acceptance, all coils shall be
chemically cleaned, and all supply air system(s) including ductwork, plenums, and air
devices shall be cleaned and return air system(s) activated all to the satisfaction of
the Architect/Engineer.

D. TEMPORARY TOILETS and WATER:

1. The General Contractor shall be responsible for providing temporary toilets and water for
contractor's use during construction.

E. JOB SITE SECURITY:

1. The Contractor shall cooperate with the General Contractor in the procedures and
requirements for opening and securing the job site for each workday.

F. JOB SITE PARKING:

1. Contractor shall park in only the designated areas assigned to them for use by the General
Contractor or Owner. See Division 1 for additional requirements or restrictions.

20 00 22 REQUIREMENTS TO PURSUE THE WORK

A. Work space: The respective Contractors and Subcontractors shall be assigned areas at the
job site for construction trailers, lay-down, storage and work spaces as arranged with the
General Contractor/Owner. All spaces shall be accessible to the Architect/Engineer. All
material and equipment shall be protected during the course of construction against weather,
dirt, comprehensive damage and theft. All items subject to water damage shall be adequately
protected. Damage occurring or defects detected before acceptance shall be repaired or
replaced at no additional compensation.

B. Tools: The Contractors and Subcontractors shall provide their own tools and services to
perform their respective Work. Rented or leased services shall have proper and adequate
insurance in accordance with requirements of Division 1.

C. Temporary storage: The Contractors and Subcontractors shall be responsible for any
requirements to temporarily store material and equipment until it is incorporated into the
Project.
20 00 31 GENERAL

A. The Plans and the Specifications are intended to define complete and satisfactorily functioning systems. The Contractor shall be responsible for providing all necessary material, labor and services to provide the completed, operating systems at no additional compensation even though each and every element thereof is not specifically identified.

B. The Plans are diagrammatic and indicate general arrangements, approximate sizes and relative locations of principal equipment and materials to provide for the design and intent of the Mechanical Work, and shall be followed as closely as actual building and site conditions and other work permit. Because of the scale of the drawings, the Plans do not represent every offset, fitting, accessory, etc. that may be required for the piping, ductwork or other appurtenances, nor is it implied that all conflicts between elements of the Work or building components have been resolved. The Contractor shall prepare details and/or coordination drawings where it may be required and submit to the Architect/Engineer for approval before proceeding with the Work (see Subsection 20 10 53, Coordination).

C. To the extent contained in the Project Documents, elevations, sections, isometrics, typical details, and schematic diagrams are included for instructions to the craftsperson. If any additional isometrics or diagrams are desired and/or required for further instruction to the craftsperson, for permit applications, or for any other reason, the Contractor shall develop the drawings.

D. Significant discrepancies and/or changes required to accomplish the intent of the Project Documents, in the opinion of the Contractor, shall be identified and submitted to the Architect/Engineer for approval before proceeding with the Work in question. Changes originated by the Architect/Engineer shall be processed under the subsection heading "Changes in the Work".

E. The Plans and the Specifications are mutually complementary. Work required by one, but not the other, shall be performed as if required by both.

F. In the event of conflict between the Plans and the Specifications, the Contractor shall notify the Engineer for clarification. The Contractor shall assume that the stricter requirements apply when there is not sufficient time for the clarification request, or when there is not sufficient time for it to be answered.

20 00 32 PLANS

A. The Plans for the Work for Divisions 20 – 29 are as follows:

<table>
<thead>
<tr>
<th>Sheet No./Revision No.</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM200</td>
<td>PARTIAL 3RD FLOOR PLUMBING SANITARY DEMOLITION</td>
<td></td>
</tr>
<tr>
<td>DM201</td>
<td>PARTIAL 4TH FLOOR PLUMBING SANITARY DEMOLITION</td>
<td></td>
</tr>
<tr>
<td>DM203</td>
<td>PARTIAL 4TH FLOOR PLUMBING DOMESTIC/MEDGAS DEMOLITION</td>
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<tr>
<td>DM300</td>
<td>PARTIAL 3RD FLOOR HVAC DUCTWORK DEMOLITION</td>
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<tr>
<td>MD301</td>
<td>PARTIAL 4TH FLOOR HVAC PLAN - DEMOLITION</td>
<td></td>
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<tr>
<td>MD301A</td>
<td>ENLARGED 4TH FLOOR DUCTWORK DEMOLITION – AREA 'A'</td>
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<tr>
<td>MD301B</td>
<td>ENLARGED 4TH FLOOR DUCTWORK DEMOLITION – AREA 'B'</td>
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<tr>
<td>DM302</td>
<td>PARTIAL 4TH FLOOR HVAC PIPING DEMOLITION</td>
<td></td>
</tr>
</tbody>
</table>
20 00 33  SPECIFICATIONS

A. The specification for Divisions 20 – 29 includes the following sections:

20  Basic Mechanical Conditions
20  Basic Mechanical Materials and Methods
20  Insulation Work
21  Fire Protection System
22  Plumbing Systems
23  HVAC Piping and Equipment
24  Air Distribution System
25  Temperature Control System

B. Referenced sections of other Divisions whether attached or in separate volumes or binders shall be a part of the Contract Documents.

20 00 34  ADDENDUM

A. The Architect/Engineer may issue revisions, modifications, attachments or other documentation in the form of an “addendum” to the Project (Bid) Documents during the bidding phase only to change, detail or clarify the scope of the Work.

B. The “addendum” shall become a part of the Contract Documents. Contractor shall indicate on his Bid the addenda received and therefore included in the Bid.

20 00 35  INTERPRETATIONS

A. The Architect/Engineer shall be the sole source of interpretation of the design and intent of the Project Documents.
20 00 36 CONSTRUCTION SCHEDULE

A. The Contractor shall furnish sufficient manpower as the schedule dictates and is required to maintain the overall project schedule. Manpower or overtime to meet the project schedule including, but not limited to, premium time, inefficiencies associated with longer days/hours, inefficiencies associated with additional manpower, or other labor burdens shall be included in the Contract Sum.

B. The Work shall be scheduled in accordance with the General, Supplementary and/or Special Conditions and specification sections of Division 1. The respective contractor shall coordinate with this schedule in preparation of his schedule for his portion of the Work.

C. The respective Contractor shall cooperate with the General Contractor and other trades to develop an overall project schedule.

20 00 37 RECORD DRAWINGS

A. The respective Contractor shall maintain a separate set of plans at the jobsite, and mark thereon as a “record” any changes in the Work as the construction proceeds. These record drawings shall include exact locations and relevant details (i.e. inverts, elevations, sizes, dimensions related to building lines, etc.) of all underground work, all concealed work, all considerations requiring periodic attention and access thereto (i.e. valves, air vents, dampers, drives, control devices, terminal units, filters, steam traps, strainers, etc.).

20 00 38 AS-BUILT DRAWINGS

A. At the completion of the project, the Architect/Engineer will provide Contractor CADD files in AutoCAD, for the Contractors use to transfer all of the information on the “record” drawings to CADD. The layering system on the drawings provided shall be strictly adhered to. The Contractor for their representation and accuracy of the final installation conditions shall certify these “as-built” drawings. The “as-built” files and blue line prints shall be submitted to the Architect/Engineer for approval. Upon approval contractor shall provide hard copy prints in addition to the electronic files and blue line prints. The Contractor shall be responsible for all costs associated with the preparation and printing of the “as-built” drawings.

B. In addition to the information on the “record” drawings the “as-built” drawings will contain the following information: Updated Equipment Schedules with shop drawing data and valve tag numbers placed on the flow diagrams.

C. Contractor shall maintain one copy of the specification, including addenda as Record Specifications. Mark to show variations in Work performed in comparison with the text of the specifications. Such variations shall only be permitted where agreed to by the Architect/Engineer in writing.

20 00 40 DUTIES OF CONTRACTOR

20 00 41 GENERAL (PURSUIT OF WORK)

A. The Contractor shall thoroughly examine all Bid Documents before submitting a bid/proposal for the Work. If in the opinion of the Contractor there are any deficiencies in the Documents that might impact on the intent or the scope of the work, the Contractor shall bring the matter to the attention of the Architect/ Engineer for clarification. If in the judgment of the Architect/Engineer such clarification is warranted, an addendum to the Documents will be issued. If the Contractor fails to request clarification or otherwise submits a bid without qualifications; the Contractor thereby agrees to install a complete and functional system with no change in the contract price.
B. The Contractor shall be responsible for changes required for compliance with codes, standards, regulations, ordinances, etc. and implementing any such change at no change in contract price. In the event of conflict with the Project Documents or other requirements, the more stringent shall apply. The Contractor shall promptly notify the Architect/Engineer of any discrepancy.

C. The Contractor shall perform the Work to comply with all terms, conditions and intentions, whether explicit or implicit, of this Section and applicable requirements of other Sections of Divisions 20 - 29, the Plans and any other documentation so identified. Should the Contractor perform any Work, which does not comply with the Project Documents or is not in accordance with common trade practices, the Contractor shall bear all costs, at no change in contract price, arising in correcting the Work.

D. The Contractor shall be responsible for all aspects of the Work for their respective contractual agreement. The Work of the respective suppliers and subcontractors shall be administered properly to assure that all elements thereof have been provided for complete and functioning system(s).

20 00 42 SEISMIC ANCHORAGE, BRACING AND SWAY BRACING

A. The Contractor shall be responsible for preparing drawings, calculations and details for any anchorage, bracing and/or sway bracing as required by the Authority Having Jurisdiction. Submitted drawings, calculations and details shall be signed and sealed by a Professional Engineer licensed in the State of Missouri.

20 00 43 SUBMITTALS FOR APPROVAL

A. The Contractor shall submit a list of proposed subcontractors and equipment suppliers within two (2) weeks of a Notice to Proceed. The list shall identify the Work to be subcontracted and the name of the proposed subcontractor; the equipment to be provided including the make, model number and vendor's name and reference to the specific subsection(s) of the Specifications. Approval of this list does not obligate the Architect/Engineer to approve the subsequent detailed submittal if it is not acceptable.

B. Prior to submitting shop drawings, Contractor shall verify equipment delivery for compliance with the overall project schedule. Any delays due to delivery or due to submittals being late, inadequate, or incorrect and therefore rejected by the Architect/Engineer shall be the responsibility of the Contractor making said submittal. The Contractor shall bear all cost for expediting charges or obtaining materials from another vendor to meet the overall project schedule.

C. The Engineer may take up to three (3) weeks to review a submittal from the time it arrives at the Engineer's office until the time it is returned to the Architect. Resubmittals will be reviewed within two (2) weeks from the time they arrive at the Engineer's office until the time they are returned to the Architect.

D. The submittals shall include shop drawings, engineering data and support information to sufficiently substantiate compliance with the Project Documents, and shall have been processed in accordance with Subsection 20 00 43. All submittals must include the following information in order to be considered for review. Submittals found to be lacking will be processed without review.

1. Shop drawing shall be manufacturer's original documents; no reproductions or telefaxes will be accepted.
2. Stamped date of receipt by the Contractor.
3. Identification of the project name.
4. Indication that the Contractor has reviewed the submittal.
5. Identification of the Specification section or subsection that specifies the submitted item.
6. Identification of the submitted item by the same description that is used in the Project Documents.
7. Quantity to be provided. The Contractor shall make an independent count and not rely on the Project Documents.

E. The approval of the submittal shall not relieve the Contractor from complying with all of the terms and conditions of the Project Documents. The Contractor shall be responsible for all physical and performance requirements of equipment provided, including any differences in the cost of installation for variations from these requirements.

F. Include the manufacturer's installation instructions and maintenance manual with the equipment submittal for approval for inclusion in the Operations and Maintenance Manuals as specified in Subsection 20 00 46.

G. Items requiring submittals are listed in each section where the equipment or materials are specified. In general, all items purchased by Contractor for installation where a make and model is specified shall require submittals. Items required for the Work such as sand paper, bolts, gaskets, welding rods, etc. which are not specified are not required to be submitted unless specifically requested.

H. The following shall be submitted under this section of the specifications:
   1. List of subcontractors and equipment supplier.
   2. Detailed submittals.
   3. Catalog Data
   4. Operating and maintenance manuals.
   5. As-built drawings.
   6. Contractor developed details and coordination drawings (when applicable).
   7. Proposed substitution (when applicable).

20 00 44 CHANGES IN WORK

A. The only condition under which a change in the contract price will be considered is if there is to be a change in the scope of intent of the project requirements. Such changes would be limited to revisions in the project initiated by the Owner. The Architect/Engineer will issue a proposal for the new scope of work for the Contractor to prepare a price. When the price and time are agreed upon, the Architect/Engineer will prepare change order or change orders to adjust the contract sum and/or the contract time as necessary to carry out the changes.

B. No claim for an addition to the Contract Sum will be valid unless authorized as aforesaid in writing by the Owner. Any work completed by the Contractor outside the original project scope without written approval from the Owner will be deemed as a waiver by the Contractor for additional compensation for said work.

C. No requests for change orders will be reviewed or considered for approval that are not submitted with all of the following information. No cost associated with labor burden or manpower inefficiencies will be approved for a change order without documentation of the present labor burden, manpower requirements, and the critical path nature of the scope change.
   1. A complete and detailed line item takeoff of materials and equipment.
2. A unit cost identified for each line item with material cost, labor hours, and labor rate identified separately for each line item.

3. All fringes and mark-ups identified separately.

D. Where major subcontracts are involved, the respective subcontractor’s calculation, including all of the above data, shall be included with the Contractor’s request.

E. Where there are net differences, the above data shall be included for all items added and for all items deducted with the net calculation clearly identified. Mark-ups shall be applied only after net differences are calculated.

F. The overhead charged by the Contractor shall be considered to include, but not limited to, performance bond, insurance, job site office expense, normal hand tools, man-lifts, incidental job supervision, field supervision, safety training, general office overhead, and cost associated with the preparation of design documents, layout drawings, shop drawings, or as-built drawings.

G. In evaluating the value of the contractor’s request, for comparison purposes, the Architect/Engineer may use cost and unit data from the current edition of the R. S. Means Company’s Cost Data, or information from appropriate suppliers or vendors of the respective materials or equipment.

H. Any requests submitted without the above details will be returned without review for resubmittal in the proper form.

20 00 45 COMPLETION AND ACCEPTANCE

A. If, at the Owner's option, a portion of the building is to be occupied or a portion of the mechanical work is utilized for beneficial use by the Owner prior to completion and acceptance of the Project, the start of the guarantee shall begin with the “beneficial use” of the related Work.

B. The Engineer shall inspect the portion of the system for approval prior to acceptance of the system or subsystem.

C. The Contractor shall prepare a certificate of acceptance for approval by the Owner for that portion of the Work and submit a copy to the Architect/Engineer for record purposes.

20 00 46 OPERATIONS AND MAINTENANCE MANUALS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following to receive payment beyond 75% of the contract amount. This information shall be submitted as soon as practical and while the Contractor is on site.

1. Provide four (4) sets of manufacturers printed information in three (3) ring binders containing information on installation operation and maintenance for each piece of equipment supplied. Manufacturer’s information shall be original copies, no reproduction or telefaxes will be accepted.

2. The information shall list any maintenance requirements and schedule for required maintenance.

3. The information shall show all parts and part numbers of available replacement parts available for each piece of equipment.

4. A cross-index of material and equipment furnished containing:

5. An alphabetical listing of material and equipment.
6. An alphabetical listing by manufacturer's name, address and contact person of the local sales representative.

7. An alphabetical listing of all subcontractors including name, address, contact person, and specific work performed.

20 00 47 CATALOG DATA

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following to receive payment beyond 75% of the contract amount. This information shall be submitted as soon as all shop drawings have been approved and while the Contractor is on site.

1. Provide four (4) sets of only those shop drawings that were approved and incorporated into the project.
2. A cross-index of material and equipment furnished containing:
3. An alphabetical listing of material and equipment.
4. An alphabetical listing by manufacturer's name, address and contact person of the local sales representative.
5. An alphabetical listing of all subcontractors including name, address, contact person, and specific work performed.

20 00 48 CLOSE-OUT REQUIREMENTS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following before final payment will be released. This information shall be submitted as soon as practical after project completion:

1. Temperature controls as-built wiring diagrams, sequences of operation with daily, holiday and special operating schedules, and final calibrations of all instruments.
2. Valve tag list.
3. As-built drawings.
4. At the completion of the project, all contractors/subcontractors shall submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

20 00 49 GUARANTEE

A. The Contractor shall guarantee all material, equipment and workmanship provided for this project to be free from defects for a period of one (1) year after final acceptance. The guarantee shall include replacement of the defective part(s) and related labor. Manufacturer's written guarantees shall be provided where it is published.

B. Any obvious defects shall be corrected before final acceptance. For additional defects after final acceptance, the Owner shall advise the Contractor in writing, unless the situation is urgent, to address the deficiency or malfunction. The Contractor shall respond promptly and with no additional compensation for a valid guarantee claim.

C. Longer guarantee periods of time or special conditions may be specified. See particular specifications for these requirements.

D. If a written guarantee is offered for conditions or period exceeding specified requirements; this guarantee shall be included in the “Close-out” specifications of Subsection 20 00 48.
E. The Contractor shall not qualify the guarantee with requirements placed upon the Owner. If the Contractor has concerns with maintenance of a piece of equipment then Contractor shall allow for making periodic inspections, adjustments, etc. during the warranty period.

20 00 50 MATERIAL AND EQUIPMENT

A. General

B. All equipment and materials furnished and installed by Contractor shall be new. The equipment to be furnished and installed shall be standard cataloged products of manufacturers regularly engaged in the production of this type of equipment and shall be of the latest design. Equipment of the same general type shall be of the same make throughout the Project.

C. Manufacturers shall have been in business for two (2) consecutive years operating under the same name

D. Products shall be in production at time of the bid date. A scheduled release of a new product during construction is not acceptable. Prototype, alpha or beta products shall not be used.

E. Products for which fewer than 100 units have been produced and which have been in service for less than one year shall be submitted for approval, in writing, to the Engineer in writing prior to bid date.

F. The Contractor shall be responsible for the physical fit and configuration of the equipment to suit the space available and the intent of the Work. Due consideration shall be included for external connections and service maintenance access to the equipment.

G. The Contractor shall verify in the course of preparing the submittal that the respective material and equipment comply with the following criteria of the Project Documents:

H. The performance ratings meet the specified requirements.

I. The mechanical and electrical physical characteristics meet the specified requirements.

J. The identification of the material or equipment to catalog data is correct and proper.

K. Confirm (or establish) the quantity required.

L. The application of the material or equipment is acceptable to the manufacturer and to the intent of the scope of Work.

M. Any inability of material and/or equipment to comply with the aforementioned criteria shall be promptly brought to the attention of Architect/Engineer.

20 00 51 EQUIPMENT MANUFACTURERS

A. The equipment manufacturer may be specified in any one of the following manners. "Equivalent" shall mean, equivalent in the opinion of the Engineer. Where equipment is scheduled on the drawings, the scheduled manufacturer is what the design is based upon:

1. Single manufacturer named, "No substitution allowed":
   The intent is to use the particular make and model only, no other shall be considered.

2. Single manufacturer named followed by "or approved equivalent":
   The design has been based on this particular make and model for acceptable physical characteristics, performance and quality. Any other comparable and equivalent product
may be substituted in accordance with procedures for submittals and approvals (Subsection 20 00 43) and conditions of Subsection 20 00 52, Equipment substitution.

3. **Limited multiple manufacturers named:**
   The design has been based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and may be substituted in accordance with procedures for submittals and approvals (Subsection 20 00 43) and conditions of Subsection 20 00 52, Equipment substitution.

4. **Limited multiple manufacturers named followed by “or approved equivalent”:** The design is based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and along with other comparable and equivalent product may be substituted in accordance with procedures for submittals and approvals (Subsection 20 00 43) and conditions of Subsection 20 00 52, Equipment substitution.

5. **List of “Acceptable Manufacturers”:**
   Where a specific product from a manufacturer is listed along with the words “Acceptable Manufacturers” and a list of manufacturers this equal product(s) of any of the limited list may be submitted without concern from Subsection 20 00 52.

B. The Contractor shall follow the option specified from above as applied to each respective material and equipment specification subsection. The Contractor shall indicate within the options allowed the respective supply source(s) for the listing requested in Subsection 20 00 43. The Contractor shall assume all responsibilities and liabilities of “or equivalent” substitutions (see Subsection 20 00 52).

C. The Contractor shall prepare and transmit submittals for approval, even for the option of Subsection 20 00 51.

20 00 52  EQUIPMENT SUBSTITUTION

A. General: As previously stated, the design has been based on a single manufacturer and model. Substitution, where permitted (as described above), may cause consequential effects that may impact on the Project. These effects may take various forms and may require changes in the design. These changes and any additional costs associated therewith are the responsibility of the Contractor proposing the substitution; no additional compensation shall be provided to the Contractor.

B. A possible change in design may result from the proposed substitution from one or more of, but not limited to, the following conditions:
   1. **Architectural:** different physical configuration, size or fit, aesthetics effected.
   2. **Structural:** different bearing or heavier loading.
   3. **Capacity:** different performance, lesser output is unacceptable.
   4. **Mechanical:** change in flow rates (air, water, etc.), different configuration and size of external piping or ductwork connections.
   5. **Electrical:** different horsepower requirements, effect on distribution.
   6. **Controls:** interconnections with control devices and equipment, additional requirements.
   7. **Impact on environmental or energy efficiency issues.**
   8. **Departure from intent of original design or Project Documents.**

C. Changes in loading, sizing and/or performance of the proposed substitution shall consider the total requirements served or needed by the particular equipment. A revised design to accommodate the substitution shall be extended to the point where the change has no effect on the parameters used in the original design.
D. An equipment substitution requiring a change in the design shall be processed as follows:

1. The Contractor shall prepare and submit to the Architect/Engineer for review, a proposal to provide a substitution that shall require a change in the design. Substantiate that the substitution complies with the intent of the Project Documents and include sufficient information of the changes required so that a judgment may be rendered.

2. Proposal shall include an original drawing originated by the Contractor, and shall not be a catalog cut, assembly manual, or other generic documented printed by the manufacturer or their representative. The design shall show the intended installation to the same level of detail as that of the original design.

3. Prior to submitting the proposal, the Contractor shall notify all other contractors whose work may be affected and request details and pricing for their respective changes. This information along with the Contractor's details shall be transmitted to the Architect/Engineer for approval.

4. The Contractor in preparing the proposal recognizes that they shall compensate other trades that are affected by said proposal.

5. If the proposal and the substitution are acceptable, the Architect/Engineer will approve the submittal and initiate a change order, at no additional compensation, and a notice to proceed.

E. Equipment that was listed as a multiple manufacturer with a model number shall be submitted as a shop drawing. Contractor shall be responsible for all other provisions of Section 20 00 52. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Product Documents.

F. Equipment that is being proposed as 'or equivalent' or was listed as a multiple manufacturer without a model number shall be in the form of a written proposal before the shop drawing phase. 'Or equivalent' shall mean or equivalent in the opinion of the Architect/Engineer and they shall have sole discretion to determine whether or not a proposed substitute manufacturer and/or model is to be considered as acceptably equivalent and may be submitted in the form of shop drawings. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Project Documents.

G. If changes are in fact required or a delay in work occurs because of the material or equipment substitution which were not properly processed, the Contractor initiating the substitution shall be liable for all consequential effects and expenses to accommodate the change or delay.

END OF SECTION
20 10 00 BASIC MECHANICAL MATERIALS and METHODS

20 10 01 GENERAL
A. This Section describes and specifies basic mechanical materials and methods to be utilized in the Work included in other sections of Divisions 20 - 25.

B. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 25 of the Specifications.

C. Provisions and conditions cited in this Section shall apply, where and when relevant, to Work of other sections of Divisions 20 - 25 of these Specifications.

20 10 02 REGULATORY REQUIREMENTS
A. Work for this section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20.

20 10 03 RELATED SECTIONS of the SPECIFICATIONS
A. Requirements of the following Section(s) of the Specifications apply to Work of this Section:

B. Division 20 - Basic Mechanical Conditions

C. Requirements of this Section of the Specifications shall apply to Work of the following sections of Divisions 20 - 29:
   1. Division 20 - Insulation Work
   2. Division 21 - Fire Protection System
   3. Division 22 - Plumbing Work
   4. Division 23 - HVAC Piping and Equipment
   5. Division 24 - Air Distribution System
   6. Division 25 - Temperature Control System

20 10 04 WORK INCLUDED
A. Furnish material, labor and services necessary for and incidental to the installation of the following work where shown on the Plans and as hereinafter specified. Include all necessary work in related sections of the Specifications (sub-section 20 10 03) to perform the Work completely.

B. Identification of piping and equipment for the work of Divisions 20 - 25.

C. Testing, adjusting and balancing of systems for the work of Divisions 20 - 25.

D. Cleaning of piping and equipment for the work of Divisions 20 - 25.

E. Demolition for the work of Divisions 20 - 25.

20 10 05 WORK NOT INCLUDED
A. Materials and methods are specified in this section for the work of Divisions 20 - 25. The Work, itself, is specified in the respective sections of Divisions 20 - 25 of the Specifications.
A. The Contractor shall submit materials for the Work of Divisions 20 - 25 for approval in accordance with Section 20 00 43. The requirements are enumerated in the respective sections of Divisions 20 - 25 of the Specifications.

B. Single and multiple manufacturers are cited in this Sub-section as acceptable sources of piping material. While “or equivalent” is not included, the intent of this Section is to permit substitution as defined in Sub-section 20 00 51, EQUIPMENT MANUFACTURERS, unless “no substitution allowed” is noted.

C. The following shall be submitted under this section of the specification:

1. Firestop schedule and product data, see Section 20 10 20 for specific requirements.
2. Coordination drawings, see Section 20 10 53 for specific requirements.
3. Identification, see Section 20 10 90 for specific requirements.

A. Special requirements for work shall be specified in the respective sections of Divisions 20 - 25 of the Specifications.

A. General:

1. The intent of sub-sections 20 10 11, 20 10 12, and 20 10 13 is to identify materials that may be utilized for Divisions 20 - 25 Work as specified for each specific piping system. Piping, hangers, valves, fittings and joining materials for Division 21 Fire Protection shall be FM Global and U.L. listed as specified in Division 21 and may not necessarily be as specified in this section; however all methods and procedures which are not in conflict with those permitted by NFPA shall govern.

2. Respective piping materials shall be manufactured, fabricated and/or provided in accordance with the ANSI, ASTM, ASME or other accepted industry standard as specified herein.

A. General:

1. All pipe and tube material shall be uncoated, unless specified otherwise.
2. Manufacturer's mill reports and applicable documents to certify the validity of procured piping materials shall be on file at the Contractor's office.

B. Steel pipe:

1. Steel pipe shall be specified by finish, size by nominal diameter, ASTM specification number, manufacturing process, wall thickness (by schedule number or decimal dimension) and end preparation as follows:

2.

<table>
<thead>
<tr>
<th>ASTM finish</th>
<th>mfr. spec#</th>
<th>wall method</th>
<th>size thickness</th>
<th>end range</th>
<th>prep</th>
</tr>
</thead>
<tbody>
<tr>
<td>black</td>
<td>A-53</td>
<td>CW/ERW</td>
<td>Sch 40, 80</td>
<td>2” and smaller</td>
<td>T&amp;C</td>
</tr>
<tr>
<td>black</td>
<td>A-53</td>
<td>SMLs</td>
<td>Std, Sch 40,80</td>
<td>all</td>
<td>PE/T&amp;C</td>
</tr>
</tbody>
</table>
black A-106 SMLS Grade A Std, Sch 40,80 all PE/T&C
galv A-53 SMLS Grade A Std, Sch 40,80 all PE/T&C

a. Per ANSI B36.10, schedule 40 is standard weight pipe for 10” pipe size and smaller.
b. Schedule 80 in this pipe size range is extra strong pipe.
c. Standard weight pipe for all sizes 12” and larger is 0.375” wall thickness and are generally not referred to by schedule number.
d. Outside diameters of pipe sizes 14” and larger are even whole numbers (e.g. - 18” O.D., 20” O.D., etc.)

CW  = continuous weld
ERW  = electric resistance weld
SMLS = seamless
PE    = plain end
T&C   = threaded and coupled

3. All steel pipe shall be mill coated and rust free.

C. Copper tube:

1. Type K, L, and M copper tube shall be in accordance with ASTM B88. Tubing is available in various finished products and wall thickness, which must be called out as well as sizes being either “nominal” or “outside diameter” (O.D.) since there are overlaps in smaller sizes.

<table>
<thead>
<tr>
<th>type</th>
<th>size range</th>
<th>hard</th>
<th>soft</th>
<th>application</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>¼”-2”</td>
<td>x</td>
<td></td>
<td>heaviest wall, underground water (ASTM B-88)</td>
</tr>
<tr>
<td>L</td>
<td>¼”-8”</td>
<td></td>
<td>x</td>
<td>general use, HVAC, refrig., plumbing (ASTM B-88)</td>
</tr>
<tr>
<td>M</td>
<td>¼”-8”</td>
<td></td>
<td>x</td>
<td>lightest, gravity drains and vents (ASTM B-88)</td>
</tr>
<tr>
<td>DWV</td>
<td>1-1/4”-6”</td>
<td></td>
<td></td>
<td>plumbing drains and vents (ASTM B-306)</td>
</tr>
<tr>
<td>Refr./ACR</td>
<td>1/8”-4/1/8”</td>
<td></td>
<td>x</td>
<td>O.D. tube, refrigeration (ASTM B-280)</td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Type L</td>
<td>¼”-8”</td>
<td></td>
<td>x</td>
<td>Medical Gases above ground, 200 psig and less, (ASTM B-819)</td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Type K</td>
<td>¼”-8”</td>
<td></td>
<td>x</td>
<td>Underground medical gases and medical gas greater than 200 psig pressure (ASTM B-819)</td>
</tr>
</tbody>
</table>

D. Cast iron pipe:

1. Hub and spigot soil pipe shall be in accordance with ASTM A-74. Available in service weight and extra heavy, both with coal tar coating, 5 foot and 10 foot lengths, single and double hub ends, range 2” - 15” diameter.

2. No-hub soil pipe shall be in accordance with ASTM A-888, CISPI 301. Available with coal tar coating, 5 foot and 10 foot lengths, range 1-1/2” - 10” diameter.

E. Plastic pipe:

1. PVC pressure rated schedule 40 (white) and schedule 80 (gray) pipe shall be in conformance with ASTM D-1785.
2. CPVC pressure rated Schedule 40 and Schedule 80 pipe shall be in conformance with ASTM F-441.
3. PVC DWV pipe for non-pressure applications shall be schedule 40 pipe in conformance with ASTM D-1785.
A. Cast iron: Screwed fittings and flange unions: 125# standard and 250# extra heavy threaded in accordance with ANSI B16.4 (except plugs and bushings which are ANSI B16.14). Available in black or galvanized, range ¼” - 8”.

1. Flanged fittings and flanges: 125# standard, flat faced in accordance with ANSI B16.1. 250# extra heavy, raised face in accordance with ANSI B16.2. Flange facing and drilling shall be in accordance with ANSI B16.5. Available black and limited galvanized, range 1-1/2” - 12”.

2. Flanged elbows shall be long radius (1.5 x diameter), short radius elbow are not permitted, unless specifically noted.

3. Drainage fittings: recessed pitched threads for non-pressurized applications. Available in standard black uncoated, coated or galvanized, range 1-1/4” - 8”.

4. Soil pipe hub and spigot and no-hub fittings shall be accordance with ASTM A-74, ANSI A-112.5.1, CISPI std #301 and HS-82. Hub and spigot fittings available in service weight and extra heavy, coal tar coating, range 2” - 15” diameter. No-hub fittings with coal tar coating, range 1-1/2” - 10”.

B. Malleable iron:

1. Fittings: 150# Sat. steam (300 WOG), 300# Sat. steam (600 WOG), in accordance with ANSI B16.3. Available in black and galvanized, range 1/8” – 6”.

2. Unions: 150# Sat. steam (300 WOG), 250# Sat. steam (500 WOG), 300# Sat. steam (600 WOG), threads in accordance to ANSI B2.1, hexagonal stock ASTM A197, ground joint type bronze-to-iron, range 1/8” – 3”.

C. Forged steel:

1. Fittings: 2000#, 3000# and 6000# threaded in accordance with MSS SP49 - SP50. 3000# and 6000# socket weld in accordance with ANSI B16.11/MSS SP79. Available black and electro zinc plated; socket weld for schedule 80 bore. Range 1/8” - 4”.

2. Unions: 3000# threaded and socket weld, steel to steel and brass to steel; 6000# threaded and socket weld, steel to steel only all in accordance with MSS SP83. Available 3000# black and electro zinc plated, 6000# black only, range 1/8” - 4”.

3. “Weldolets, Threadolets, Sockolets and Elbolets”: In accordance with ANSI B36.10/ASTM A216, except Elbolets which are ANSI B16.11. Weldolets available standard and extra strong, black only, range 1/8” - 24”. Others available 3000# and 6000#, black only, range 1/8” - 4” (limited). Source: Bonney Forge.

D. Butt weld:

1. Butt welding fittings shall be in accordance with ASTM A-234 and ANSI B16.9. End preparation of butt welding fittings shall be in accordance with ANSI B16.25.

2. Elbows shall be long radius (1.5 x diameter), short radius elbows, and 180-degree returns are not permitted, unless specifically noted.

E. Forged steel flanges:

1. 150# and 300# forged steel flanges shall be manufactured to the requirements of ASTM A-181 with dimension in accordance to ANSI B16.5. Flange faces shall be flat or raised face as required.

2. Forged steel flanges shall be furnished as weld neck pattern. Slip-on, lightweight slip-on (drilled to 125# ANSI standards) and orifice flanges shall be provided only where specified and/or noted.

F. Copper (alloy and bronze) shall be in conformance with the following ANSI specifications:
1. Cast bronze threaded fittings: ANSI B16.15
2. Cast copper alloy solder fittings: ANSI B16.18
3. Wrought copper pressure solder fittings: ANSI B16.22
4. Cast copper DWV solder fittings: ANSI B16.23
6. Cast copper alloy for flared tubing: ANSI B16.26
7. Wrought copper DWV solder fittings: ANSI B16.29
8. Short radius 90 degrees elbows and 180 degree returns are not permitted, unless specified and/or specifically noted.

G. Grooved:
1. All grooved components shall be of one manufacturer made in accordance with ANSI B-31.1, B-31.9. Fittings shall be ANSI 150#, 300# cast of ductile iron in accordance with ASTM A-536, Grade 65-45-12. Fittings shall have an enamel finish. Segmentally welded fittings are not acceptable.
2. Only the following fittings will be accepted: Long radius (1.5 x diameter) 90° and 45° elbows, tee, reducing tee, concentric/eccentric reducers, and flange adapter nipples. Flange rings, reducing couplings, saddle tee, and others not listed above are not acceptable.

H. Plastic:
1. PVC pressure rated fittings for schedule 40 shall be “white”, socket solvent cement joint type in accordance with ASTM D-2466.
2. PVC pressure rated fittings for schedule 80 shall be “gray”, threaded joint type in accordance with ASTM D-2464; and socket solvent cement joint type in accordance with ASTM D-2467. Flanges and unions shall be in accordance with ASTM F-1970.
3. CPVC pressure rated fittings for schedule 80, threaded joint type in accordance with ASTM F-437; and socket solvent cement joint type in accordance with ASTM F-439. Flanges and unions shall be in accordance with ASTM F-1970.
4. PVC DWV fittings for non-pressure applications shall be in accordance with ASTM D-2665 and NSF Standard 14.

I. Miscellaneous
1. Dielectric flanges and unions:
2. Dielectric unions and flange unions shall be required in piping systems where an electrically insulated connection is needed to separate dissimilar metals from producing galvanic or electrolytic action. Unions shall be rated for 250#; flange unions for 175#. Range: unions ½” - 2”; flange unions 1-1/2” - 12”.
3. Steel threaded nipples:
4. General use: Made from ASTM A-120 pipe in standard (schedule 40) and extra strong (schedule 80). Available black and galvanized, range 1/8” - 6” pipe diameters.
5. High-pressure application: Made from ASTM A-53 seamless pipe and ASTM A106 seamless pressure tube in standard (schedule 40) and extra strong (schedule 80). Available black only, range 2” - 6” pipe diameters.
6. Close nipples are not permitted.
1. It is intended that valves specifications are for high quality HVAC / Plumbing applications, not lesser quality “Contractor / Value / Economy” series. Valves produced internationally shall be from the Manufacturer’s owned facilities. Valves shall not be manufactured by third party OEM suppliers. Valve submittal shall indicate where the valve is assembled and tested.

2. When two or more valves of the same type are to be used in the same service, all valves of this type shall be of the same manufacturer.

3. Only general valve series are specified. Valves shall have all options, trim, seat material, and accessories as specified whether or not listed as a prefix, suffix or valve number.

4. All valve manufacturers and models listed shall be considered as “acceptable manufacturers” and may be submitted without concern from subsection 20 00 62.

5. All valves for use in “cold” piping shall have stem or neck extensions allowing proper insulation and a continuous vapor barrier.

6. No asbestos packing allowed.

B. Ball Valve:

1. 2” and smaller: Bronze ASTM B584 (or low lead bronze for lead-free), 2-piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, stem extension (for “cold” applications), full port, virgin TFE seats, all stainless steel trim, threaded or soldered ends. Nibco S-585-70-66, Apollo 77-240, Watts Series B-6081, Hammond 8311 or approved equivalent. Full port valves 2 ½” and 3” the same model numbers as the 2” and smaller valves are also acceptable.

2. 2-1/2” - 3”: Bronze ASTM B584 (or low lead bronze for lead-free), 2-piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, stem extension (for “cold” applications), standard port, virgin TFE seats, all stainless steel trim, threaded or soldered ends. Nibco S-585-66, Apollo 70-240, Watts Series B-6001, Hammond 8511 or approved equivalent. Full port valves 2 ½” and 3” the same model numbers as the 2” and smaller valves are also acceptable.

3. 2-1/2” and smaller: Bronze 3 piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, stem extension (for “cold” applications), full port, TFE seats, bronze trim, threaded or soldered ends. NIBCO figure 595-Y-66, Apollo 82-200, Milwaukee BA-360, Hammond 8613, Watts B-6800, or approved equivalent. Full port valves 2 ½” and 3” the same model numbers as the 2” and smaller valves are also acceptable.

4. Medical Gas and Medical Vacuum 4” and smaller: Bronze 3 piece body, 400 psi WOG, vacuum service to 29” Hg, quarter turn lever handle, blow-out proof stem, full port, virgin TFE seats, bronze trim, Type K tubing extensions with soldered ends, 1/8” NPTF port on tube extension, cleaned and packaged for oxygen service per NFPA 99, valve handle shall indicate service, and pad-lockable handle for valves in concealed spaces. Allied Healthcare Products 77-03 or approved equivalent.

5. Gauge cocks where not specified or specifically identified shall be ¼” bronze 2 piece body ball valves with lever handle and threaded ends per the above specification.

6. Drain valves and air vents shall be ¾” bronze 2 piece body ball valves per the above specification, with ¼” hose end adapter cap and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain.

C. Butterfly:

1. 2” - 24”: Class 200 ASTM A395 ductile iron body, threaded lug type, 1/4 turn, extended neck, peroxide cured EPDM molded-in seat liner, aluminum bronze disc, 416 SS stem, lubersized bronze or Teflon bushings, and stem seals material matching the seat material. Conforms to MSS SP-67 & API 609. Bi-directional bubble tight dead end service with no downstream flange required rated at 200 psi for 2-12”, or 150psi 14” and larger. Valve body
shall an integrally cast top plate for direct flush mounting of manual or power actuators without the use of brackets or adapters.

a. Refer to subsequent paragraphs for operator type based on size and service.

b. Valves shall be chemically compatible with: up to 4ppm of Chloramines (NH₂Cl, NHCl₂, NO₃) 40°F-200°F, propylene glycol 0°F-200°F; and NSF-61 rated 40°F-180°F.

c. Where used in potable water valve shall be “lead free” per 2011 Reduction of Lead in Drinking Water Act.

d. Valve submittal shall indicate where the valve is assembled and tested.

e. Valves shall be NIBCO figure LD 2000, Milwaukee ML-133E, Hammond 6411, Bray 31H, Apollo LD-145, Watts DBF-03, or approved equivalent. The following valves are NOT equivalent NIBCO N200, Milwaukee CL series, Hammond 5000 series, Apollo LC series, Watts BF series, or Crane 200 series.

2. Service valves 6” and less shall have a 10-position lever handle; balance valves shall have infinitely adjustable lever handle with memory stop locking option. Service valves and balance valves 8’ and larger shall have position indicating worm gear operators with handwheel operator. Control valves shall have actuators as specified in Division 25.

3. Where valves are located above 15'-0” AFF provide gear operator with chain wheel and guide. Provide chain hoods where required, to prevent fouling of chains on equipment and to clear walkways. Terminate chains approximately 6'-3” above the floor.

D. Balancing Valves:

1. General: Balance valves shall provide positive shut-off for service and shall have adjustable memory stops to allow returning to original balanced position after servicing.

2. 3” and smaller: Body shall be bronze or Dezincification Resistant Brass rated to 300 psig. Valves shall be multi-turn, provide positive shut off; include: position indication, memory stops, integral pressure tap ports provided with “drip caps”. Quarter turn valves are not acceptable. Balance valves shall be Nibco 1810, Tour and Anderson 786/787, Apollo 59A, Armstrong CBV, Macon Balancing STV/L Series or approved equivalent.

3. 4” – 12”: Body shall be iron body rated to 300psig with 150# flanges. Valves shall be multi-turn, provide positive shut off; include: position indication, memory stops, integral pressure tap ports provided with “drip caps”. Quarter turn valves are not acceptable. Balance valves shall be Nibco F739, Tour & Anderson 788, Apollo 58A, Armstrong CBV, Macon Balancing STV, Watts CSM-91, or approved equivalent.

4. 14” - 24”: Balance valves shall be butterfly valves with memory stop. Where valve is used in conjunction with balancing a specific piece of equipment (and not general throttling in order to assist in balancing) it shall be used in conjunction with a flow-measuring device.

E. Check:

1. Check valves installed at pump discharge size 2 ½ and larger shall be Silent type, size 2” and smaller may be swing type.

2. 2” and smaller: Class 125 (125 psi at 400°F, 200 psi at 150°F), bronze, horizontal swing, vertical up-flow, Y pattern, teflon renewable seat and disc in conformance with MSS SP80. Nibco 413, Grinnell 3300, Watts 5000, Crane 1707, Hammond IB904, Stockham B320, or approved equivalent.

3. 2” - 12”: Class 125 (125 psi at 400°F, 200 psi at 150°F), iron body, flanged, horizontal swing, vertical up-flow, bolted bonnet, renewable seat and disc in conformance with MSS SP71, type 1. Nibco 918, Grinnell 6300A, Watts 511, Crane 373, Hammond IR1124, Jenkins 624C, Stockham G931, or approved equivalent.

4. Silent Check Valve: 2-1/2" - 30", Class 125 (125 psi at 400°F, 200 psi at 150°F), flanged, ASTM A-126 Class B, cast iron body, bronze trim, resilient seat. Nibco F-910, Grinnell Series 500, Milwaukee 125 Class, Mueller 91-AP, or approved equivalent.

6. 2" and smaller: Class 300 (300 psi at 550°F, 600 psi at 150°F), ASTM B61 bronze body, horizontal swing, vertical upflow, regrinding type, Y pattern renewable seat and disk in conformance with MSS SP80. Nibco T-473, Grinnell 3370, Milwaukee 507, Hammond IB949, or approved equivalent.

20 10 14 STRAINERS

A. General:

1. When two or more strainers of the same type are to be used in the same service, all strainers of this type shall be of the same manufacturer.

2. Only general strainer series are specified. Strainers shall have all options, trim, and accessories as specified whether or not listed as a prefix, suffix or the model number.

3. All manufacturers and models listed shall be considered as “acceptable manufacturers” and may be submitted without concern from subsection 150620.

B. “Y” Strainers:


2. 2-1/2" through 12": ANSI 125 lb. (125 psi at 353°F, 200 psi at 150°F), ASTM A126-B cast iron body and cover, ASTM A240 304 stainless steel perforated sheetmetal with .045" openings for steam and 1/4" diameter for water service. Mueller 751, Keckley A, Armstrong A-FL-125, Spirax/Sarco F-125, Watts 77F-D, or approved equivalent.

3. 2" and smaller: ANSI 250 lb. (250 psi at 400°F, 400 psi at 150°F), ASTM B62, bronze body and straight thread cap, ASTM A240 304 stainless steel perforated sheetmetal with .033" openings for steam and 1/8" diameter for water service. Mueller 352M, Keckley F-350, Armstrong F4SC, Spirax/Sarco BT, or approved equivalent.

4. 2-1/2" through 12": ANSI 250 lb. (250 psi at 400°F, 400 psi at 150°F), ASTM A126-B Cast iron body and cover, ASTM A240 304 stainless steel perforated sheetmetal with .045" openings for steam and 1/4" diameter for water service. Mueller 752, Keckley A, Armstrong A-FL-250, Spirax/Sarco F-250, Watts 77F-D-250, or approved equivalent.

5. 2" and smaller: ANSI 250 lb. (250 psi at 400°F, 400 psi at 150°F), ASTM A126-B cast iron body and straight thread cap, ASTM A240 304 stainless steel perforated sheetmetal with .033" openings for steam and 1/8" diameter openings for water service. Mueller 11-M, Keckley B, Armstrong A-SC, Spirax/Sarco IT, or approved equivalent.

20 10 20 MISCELLANEOUS MATERIALS

20 10 21 SLEEVES (NON-WATER PROOF, NON-FIRE RATED)

A. Piping passing through non-fire rated interior walls or floors shall be neatly field cut round holes with hole saws for non-masonry/concrete, and core drill for masonry/concrete. “Beating” an opening in a gypsum or masonry wall shall not be accepted.

B. Install Schedule 40 pipe sleeves where pipes passing through floors of spaces where water could leak to the area below (i.e., mechanical rooms, janitor closets, kitchens, etc.). ID of pipe sleeve shall accommodate pipe insulation. Pipe sleeve shall extend a minimum of 4” above
the finished floor, grout the annual space between the oversized core drill in the floor and the sleeve.

C. In new construction, field formed walls or floors, the contractor shall install appropriate blocking or material or pipe sleeves.

20 10 23 FIRESTOPS AND SMOKESTOPS, FIRE RATED/SMOKE PARTITIONS.

A. All penetrations through rated assemblies, walls, shafts, floors, roofs, etc., shall be firestopped in accordance with Local Building Codes, NFPA, U.L. Fire Resistant Directory, and manufacturer’s instructions.

B. Provide a FIRESTOP PRODUCT SCHEDULE consisting of the following minimum information:

1. Type – indicate the type of materials, or system.
2. Manufacturer – manufacturer’s name, product name and product number.
3. Mechanical System – indicate which Divisions 20 - 25 items the product is utilized for.
4. Rating – indicate the fire rating and UL detail numbers.

C. Submit the following with the above FIRESTOP PRODUCT SCHEDULE:

1. Manufacturer’s specifications and technical data including installation instructions.
2. Details of each proposed assembly.
3. Manufacturer’s representative who shall provide qualified engineering judgments and drawings for non-standard applications.
4. Contractor’s qualifications and related experience.

D. Materials shall be stored per the manufacturer’s recommendations and as specified for General Project storage in Division 20.

20 10 24 SEALS, NON-FIRE RATED

A. All penetrations through non-rated walls, floors, etc., shall be sealed for draft stopping with caulk, putty, etc., designed for this use.

20 10 25 ESCUTCHEONS

A. Wall, floor, and ceiling plates shall be spun brass, plain pattern, chrome plated, spring type or setscrew fastening. Provide escutcheons for all exposed piping in finished spaces.

20 10 28 ACCESS DOORS

A. Access to mechanical equipment and ductwork of Divisions 20 - 29 required for testing, adjusting, inspection, maintenance or servicing shall be the responsibility of the Contractor. Doors for manufactured equipment shall be an integral feature included with the respective equipment. Access openings in ductwork shall be included with the fabrication in accordance with SMACNA practices.

B. Openings in building components for access to concealed mechanical work shall be furnished by the Contractor and installed with the building construction work. Access doors shall be located as indicated on the Plans or as strategically required for inspection, maintenance, and service. The model and style shall fit the building construction, fire rating requirements and provide adequate size and function.
C. Access doors shall be sized as shown on the drawings or shall be a minimum size of 18" x 18" and otherwise shall be large enough for purpose intended and shall be fabricated of heavy gauge steel frames and door panels with double action concealed spring hinges, 1/4 turn flush screwdriver operated cam locks and prime coat paint finish. Access doors for various applications shall be as follows:

- **building construction:**
  - flush door in dry wall construction (walls and ceilings) style DW
  - flush door in masonry or tile walls with exposed frame flange
  - flush door in plaster construction (walls and ceilings) style K
  - recessed door in acoustical plaster ceiling style AP
  - recessed door in suspended drywall ceiling style CT (aluminum - wet locations)
  - flush door in suspended drywall ceiling style CF (aluminum - wet locations)
  - door in suspended drywall ceiling style ATR (fire resistive door)

- **Milcor access door:**
  - style M (steel), Style MS (stainless)
  - fire rated separation (walls and ceilings) - fire rated door

D. Access doors are not required for Work above lay-in panel ceilings.

E. Submittals shall indicate schedule of locations, sizes, types, adjacent building construction, finish, fire rating including thickness and type of insulation, conformance to UL requirements and associated labeling, metal and gauge of fabrication. Access door shall be as manufactured by Karp Associates, Milcor, or Higgins MfCO.

### 20 10 29 RESTRICTIONS, GENERAL FOR ALL PIPING SYSTEMS

A. Do not use gaskets or packing containing asbestos.

B. Selections of material and equipment and options for substitution shall conform to the requirements of Sub-section 20 00 60, MATERIAL and EQUIPMENT.

C. “Bull head” tee connections are not permitted, unless approved by the Engineer.

D. Close nipples and bushing reducers are not permitted.

E. Slip joints are permitted in sanitary drainage systems only, on the fixture side of traps.

F. Mitered elbows are not permitted in welded pipe construction.

G. Solder for use in joints of copper piping for domestic (sanitary) cold water, hot water, hot water recirculating and softened water shall not contain lead.

H. Unprotected, non-smoke rated plastic piping material is not permitted in above-the-ceiling spaces used as return air plenums, or exposed in any occupied space.

I. Black and galvanized pipe, fittings, nipples and specialties are not permitted in water piping systems where copper and/or brass are the basic materials.

J. Cast iron fittings are not permitted for gaseous distribution applications.

K. Cast brass/copper fittings are not permitted for gaseous applications including refrigerant lines.

L. Short radius 90-degree elbows and 180-degree returns are not permitted, unless specified and/or specifically noted.

M. The use of pipe hooks, chain and perforated band iron are not permitted for hanging or supporting piping.
N. Power driven inserts and attachments are not permitted unless approved by the Architect/Engineer on express request by the Contractor.

O. Welded attachments to the structural steel of the building are not permitted unless otherwise noted or approved by the Architect/Engineer on specific request of the Contractor.

P. Plastic pipe, fittings, valves and specialties are not permitted for gaseous distribution applications.

20 10 30 JOINTS AND CONNECTION METHODS

20 10 31 THREADED

A. Threads for all screwed pipe systems shall be American National Standard taper threads in accordance with ANSI B-1.201.

B. Threads shall be full, sharp, clean and free of fins and burrs. Pipe ends shall be reamed to remove internal burrs.

C. Threaded connections shall be joined using teflon sealing tape applied to the male threads only.

D. This sub-section does not apply to threads for compression, flare and sanitary drainage slip type drainage fittings.

20 10 32 WELDED

A. Welded joints shall be “V” type butt welds in accordance with ANSI B31.1.

B. The Contractor shall only use welders regularly engaged in the piping trades and certified by the National Certified Welding Bureau, using procedures set forth in ASME Boiler Construction Code, Section IX, “Welding Qualifications”.

C. Contractor shall keep a copy of welder's certification on file at Contractor's office. Upon request the Architect/Engineer may request Contractor to produce certifications. Any pipe installed by a non-certified welder shall be removed if requested by Architect/Engineer.

D. All steel piping shall be cleaned of mill scale and rust before assembly. Welds shall be chipped and hammered after each pass and joints shall be built up to at least the same thickness as that of the pipe wall. All welding shall be done in accordance with the welding procedures of the National Certified Pipe Welding Bureau conforming to the requirements of the ASA Code for Pressure Piping.

E. Architect/Engineer shall have the authority to accept or reject the welds and require random samples of installed welds to be removed, tested and inspected.

20 10 33 GROOVED

A. Grooved joints for grooved couplings and fittings shall be in accordance with accepted manufacturer's specifications and practices.

B. Grooves may be cut or rolled in accordance with manufacturer's recommendations for type of pipe, sizes and thicknesses specified for respective systems.
C. Gaskets shall be suitable for the temperature, pressure and compatibility with the fluid contained therein. Unless specifically specified otherwise or incompatibility with the system, gaskets shall be EPDM grade E.

D. Grooved couplings shall be ASTM-A47 grooved malleable iron clamp type couplings as manufactured by Victaulic or equivalent.

E. Grooved couplings for vibration isolation or as unions at equipment connections shall be similar to Victaulic Style 77; all others shall be similar to Victaulic Style 07.

20 10 34 SOLDERED AND BRAZED

A. Soldered and brazed connections shall be made in accordance with recommendations of the current edition of the Copper Tube Handbook of the Copper Development Association or as hereinafter specified.

B. General criteria for soldered and brazed joints shall be as follows:

1. Copper tubing shall be square-end cut by varied methods at the Contractor's option. The ends of the tubing shall be reamed to remove both internal and external burrs.

2. Joints for copper piping for medical vacuum, hydronic systems, domestic water, temperature controls, DWV systems and other applications of fluids below 250 degrees F. shall be soldered with 95-5 Tin Antimony. 50-50 Tin Lead solder shall not be used.

3. Joints in copper piping for gases, medical gases, medical vacuum, refrigerant lines and other applications operating above 250 degrees F., or where otherwise specified shall be brazed with Copper Phosphorus (BCuP Series), Silver solder (BAg Series), or other approved high temperature brazing alloy.

4. Cleaning of tubing and fittings, application of flux and heat, purging and cooling shall be in accordance with recommendations of solder and brazing alloy manufacturers for the joint type and material specified in the respective “PIPING MATERIAL SCHEDULE”.

C. Copper connections for medical gas, medical vacuum, refrigerant systems shall be made per the following criteria:

1. Work shall be performed in accordance with NFPA and CGA Medical Gas Piping Standards and Practices. At the end of each installation workday, medical gas piping shall be capped and tagged; piping shall not be left open.

2. Fittings and valves shall be purchased for "oxygen" service. Material shall be factory washed, degreased and packaged separately. When material is contaminated, tubing, fittings and valves shall be washed in a hot solution of one pound of trisodium phosphate to three gallons of water and rinsed thereafter with clean hot water. Do not use hydrocarbon-based solvents. Temporarily cap to prevent recontamination before use.

3. Brazed joints in medical gas systems using copper tubing shall be made with a nitrogen purge to prevent formation of copper oxide on the inside of the pipe. Do not use any flux or thread compound containing oil or an oil derivative.

4. Screwed joints shall be made with teflon tape applied to the male threads.

20 10 35 FLANGED

A. Flanges shall be flat faced or raised faced as required for mating flanges of valves, specialties, equipment connections, etc.

B. Carbon steel hex head machine bolts, ASTM A307, grade 2, with heavy hex nuts shall be used for joining 125 and 150# flanged joints, unless otherwise specified.
C. Alloy steel machine bolts, studs and heavy hex nuts shall be used for joining of 250 and 300# flanged joints, unless otherwise specified.

D. Lubricate the threads of bolts and studs with an acceptable commercial product. Include data with submittal for approval for piping material.

E. Gaskets shall be 1/16” thick non-metallic type conforming to ANSI B16.21 and shall be suitable for the pressure and temperature of the fluid contained therein, shall be provided at all flange joints. Full-faced gaskets shall be used for flat face flanges; ring gaskets shall be used for raised face flanges.

20 10 36 CAST IRON PIPE AND FITTINGS

A. Joints for hub and spigot and no-hub cast iron soil pipe and fittings shall be installed in accordance with recommendations of the CISPI, unless noted otherwise.

B. Do not use joint material which has deteriorated or which does not spread easily or smoothly.

C. No-hub couplings shall be NSF Listed and conform to the requirements of CISPI 310, ASTM C1277, FM1680, IAPMO 35-89 and gaskets shall comply with ASTM C564.
   1. Band, screw housing, screw, and shield shall all be stainless steel.
   2. 1-1/2" through 4" couplings shall have a minimum of two clamps. 5" through 10" couplings shall have a minimum of four clamps. 12" through 15" coupling shall have a minimum of six clamps.
   3. Couplings (60 in./lbs) shall be by Anaco/Husky, Ideal Clamps, Tyler Pipe, Mission Rubber Company, Thermafit Industries POC, or approved equivalent.

20 10 37 MECHANICAL JOINTS

A. Mechanical joints and joining material shall meet the requirements of ANSI/AWWA C111/A21.11.

B. Clean bell and plain end, and lubricate gasket as recommended by manufacturer. The joint area must be free of dirt.

C. All bolts and tie rods shall be galvanized. Tighten bolt to 75-90 ft.-lbs. torque alternating from top to bottom maintaining equal distance between face and gland during tightening.

D. Where flanged joints are used to interface with equipment or other piping materials they shall be flanged joints in accordance with ANSI B16.1. The gaskets shall be full forced, made of rubber and shall meet the requirements of ANSI B16.21.

20 10 38 PLASTIC

A. Solvent cement: Joints in PVC piping shall be made in accordance with manufacturer's guidelines and instructions for CPVC handling, joint preparation, type of primer and solvent/cement, curing time, temperature and testing.
   1. PVC pressure piping and DWV - solvent cement shall conform to ASTM D-2564 and primer shall conform to ASTM F-656.
   2. CPVC pressure piping - solvent cement shall conform to ASTM F-493.
   3. SDR sewer pipe - ASTM D-2855.

B. Gasket: Elastomeric seals (gaskets) for joining plastic piping shall conform to the following:
1. PVC water distribution piping - AWWA C-900, ASTM D-2774 and ASTM D-3139.
2. SDR sewer piping - ASTM D-2321 and ASTM D-3034.

20 10 40 HANGERS, SHIELDS, SUPPORTS AND ANCHORS

A. General:
1. All hanger devices (e.g. - concrete inserts, expansion anchors, clamps, pipe hangers, strut, etc.) shall be UL approved for the intended service. Material shall be applied within the load limitations prescribed by the respective manufacturer. Loads transmitted to the building shall be within the limitations of the structure.
3. This section shall not apply to Division 21 Fire Protection.

20 10 41 HANGERS

A. Piping shall be supported from the building structure, walls, and floors. Piping shall not be supported from other piping, ductwork, conduits, etc. Loads shall be within the allowable load of building component that is connected to. Piping loads shall include, but not limited to, the weight of the piping, valves, specialties, insulation, pipe covering, pipe content, pressure test media content, wind, snow, seismic, etc.

B. Where piping is indicated on common trapeze hangers, racks, stanchions or brackets, the various trade contractors involved shall agree to a mutually acceptable arrangement among themselves, but each shall be responsible for the correctness and compliance of their work.

C. Pipe hangers, supports, etc. for “cold” piping systems shall have hangers sized for the outside diameter of the insulation in order to maintain a continuous vapor barrier.

D. Pipe hangers for all “ambient” and “hot” piping systems shall be the same size as the pipe, except at roller hangers or supports where the treatment shall be the same as for “cold” piping systems.

E. Hangers, and other supports, anchors, guides, etc. in direct contact with copper piping material shall be copper plated. All others shall be electro-plated for indoor use.

F. The use of pipe hooks, chain, perforated band iron, wire, or cable are not permitted for hanging or supporting piping.

G. Singular, horizontal, suspended piping above grade shall be hung with pipe hangers per the following schedule, unless noted otherwise:

<table>
<thead>
<tr>
<th>pipe sizes</th>
<th>piping application</th>
<th>Anvil International type and figure number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3” and smaller</td>
<td>not subject to expansion/contraction</td>
<td>adjustable ring, #69</td>
</tr>
<tr>
<td>4” and larger</td>
<td>not subject to expansion/contraction</td>
<td>adjustable clevis, #260</td>
</tr>
<tr>
<td>4” and smaller</td>
<td>copper pipe/tubing</td>
<td>adjustable ring, #CT-99</td>
</tr>
<tr>
<td>5” and larger</td>
<td>copper pipe</td>
<td>adjustable clevis, #260 (1)</td>
</tr>
</tbody>
</table>
all vertical risers riser clamps
    steel #261
copper #CT-121

1. hanger to be sized for outside diameter of insulation and to be used with insulation protection shield, figure 167.

H. Hangers, supports, etc. shall position the piping properly in the work, and provide for expansion and contraction.

I. Vertical piping shall be supported at each floor level with riser clamps bearing on the building structure or pipe sleeve.

J. Pipe stands shall be field fabricated to meet the anticipated loads. The base plate shall be spaced 1” minimum above the finished floor with concrete or grout.

K. Wall brackets shall be field fabricated to meet the anticipated loads. The minimum brace angle shall be 45° from the horizontal.

20 10 42 HANGER RODS AND HANGER SPACING

A. Where “All-thread” rod is used it shall be galvanized, cadmium or zinc electro-plated. Where plain rod is used the threads shall be a minimum of 2” in length on each end.

B. Hangers and hanger rod spacing for metallic piping shall be provided and installed in accordance with the Building Codes or the following schedule, whichever is more stringent:

<table>
<thead>
<tr>
<th>pipe size</th>
<th>rod diameter</th>
<th>max. hanger spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4” &amp; smaller</td>
<td>3/8” diameter</td>
<td>8’ on centers</td>
</tr>
<tr>
<td>1-1/2” &amp; 2”</td>
<td>3/8” “</td>
<td>10’ oc</td>
</tr>
<tr>
<td>2-1/2” &amp; 3”</td>
<td>½” “</td>
<td>10’ oc</td>
</tr>
<tr>
<td>4” &amp; 5”</td>
<td>5/8” “</td>
<td>12’ oc*</td>
</tr>
<tr>
<td>6” &amp; 8”</td>
<td>¾” “</td>
<td>12’ oc*</td>
</tr>
<tr>
<td>10” and 12”</td>
<td>7/8” “</td>
<td>12’ oc*</td>
</tr>
<tr>
<td>14”,16”, 18”</td>
<td>1” “</td>
<td>12’ oc*</td>
</tr>
</tbody>
</table>

* cast iron pipe shall have a maximum spacing of 10’ oc center with the hangers located near the joint.

C. Hangers for non-metallic piping shall be spaced in accordance with the Building Codes or the following schedule, whichever is more stringent:

<table>
<thead>
<tr>
<th>pipe size</th>
<th>rod diameter</th>
<th>max. hanger spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1” &amp; smaller</td>
<td>3/8” diameter</td>
<td>4’ oc</td>
</tr>
<tr>
<td>1-1/4” - 2”</td>
<td>3/8” “</td>
<td>5’ oc</td>
</tr>
<tr>
<td>3”</td>
<td>½” “</td>
<td>6’ oc</td>
</tr>
<tr>
<td>4”</td>
<td>5/8” “</td>
<td>7’ oc</td>
</tr>
<tr>
<td>6” &amp; larger</td>
<td>¾” “</td>
<td>8’ oc</td>
</tr>
</tbody>
</table>

20 10 43 ANCHORING

A. Anchors for piping, ductwork, or equipment in new concrete construction may be suspended at the Contractor’s option, or as shown on the plans, from inserts placed in the concrete as it is poured-in-place. Mechanical equipment rooms shall have inserts placed at a maximum of 4 ft. centers.

<table>
<thead>
<tr>
<th>hanger rod size</th>
<th>Grinnell insert figure number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8” or smaller</td>
<td>single - CB universal, figure #282</td>
</tr>
</tbody>
</table>
B. Anchors for piping, ductwork, or equipment in existing concrete construction shall be suspended from epoxy resin set anchors, installed per the manufacturer's recommendations set into holes drilled into the concrete. Anchors shall be UL and/or FM approved, and applied within the allowable working load ratings for the respective size. Cataloged load values shall be derated by one third for seismic allowances. Minimum embedment depth shall be 2/3 of concrete thickness. Field pullout test shall be performed when requested by the Engineer. Anchors shall be Hilti type HVA.

C. Anchors for piping, ductwork, or equipment in steel structured buildings shall be attached to the steel by bolting directly through the void in the bar joist chord or by using the appropriate cataloged type C-clamp or beam clamp. The roof deck shall not be used for supporting the piping or ductwork.

D. Welded attachments to the structural steel of the building are not permitted unless otherwise noted on the Construction Documents or where approved by the Architect/Engineer on specific request of the Contractor.

E. Power driven inserts and attachments are not permitted unless approved by the Architect/Engineer on express request by the Contractor.

F. In all cases, anchor loading shall be based on hanger spacing, weight of the pipe to be supported when full and insulated, weight of any additional loads imposed upon the anchor, wind loading, seismic loading, quality of the material that the anchor is being installed in, etc. The Contractor shall verify in the field that the anchors used and the materials that they are being installed in are suitable for the load imposed and shall bring any problems to the attention of the Owner's Representative in writing immediately.

G. Where anchors are loaded in shear in existing concrete structure, suitably sized and installed wedge type anchors may be used. Wedge type anchors shall be Hilti Kwik Bolt II.

20 10 44 SEISMIC RESTRAINT

A. All materials and workmanship shall specifically comply with the above listed Building Code with respect to seismic requirements for the support and anchorage of all mechanical systems and equipment as installed on this project. Lateral forces to be restrained shall be as required by ASCE 7 Section 11 and 13 Architectural, Mechanical, and Electrical Components and Systems. Refer to structural drawings and/or Geotechnical Report for design values.

- Seismic Use Group IV
- Seismic Design Category C

B. All piping support and restraint details and practices shall conform to the publication “Seismic Restraint Manual Guidelines for Mechanical Systems” by SMACNA, 2008 Edition, and/or “Seismic Restraints” by B-Line systems, Inc.

C. DELEGATED DESIGN: Design hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, herein referred to as Seismic engineer. Prepare drawings, calculations and details for any anchorage, bracing and/or sway bracing for seismic restraint as required by the local codes and Authority Having Jurisdiction. Seismic engineer shall inspect the final installation for compliance with the approved Seismic shop drawings. Seismic engineer to identify items that need to be corrected or changed and provide contractor additional/revised drawings as required.

D. SUBMITTALS:
1. SHOP DRAWINGS: Submit drawings, calculations and details shall be signed and sealed by a Professional Engineer licensed in the State of the Project's location.

2. CLOSEOUT: As-built seismic drawings with Letter from Seismic engineer stating that the completed installation meets the design.

E. INSTALLATION: Contractor shall only use those materials submitted and approved. Contractor shall notify Seismic Engineer when actual installation differs from the approved Seismic shop drawing.

**20 10 50 BASIC MECHANICAL METHODS - GENERAL**

**20 10 51 INTENT OF PROJECT DOCUMENTS**

A. Install the Work in accordance with the Project Documentation and considerations enumerated in Subsection 20 00 01, GENERAL (Project Documents).

**20 10 52 ARRANGEMENT OF WORK**

A. All Work shall be arranged so that hangers and supports for the mechanical equipment and materials shall be within the load limitations of the structure and the respective hanger and/or support.

B. Contractor shall not scale from drawings to determine the exact locations for devices, piping, ductwork, etc., but shall follow the architectural drawings, the structural drawings and the actual building conditions, in establishing dimensions and lines of run. The work shall be adjusted to accommodate interferences anticipated and encountered. The Contractor shall verify the exact material quantities and lengths required.

C. Piping that is required to pitch shall have priority over piping that does not pitch. Work which cannot be changed in elevation shall have priority over that which can be moved. Offsets, transitions and changes in direction shall be made in piping and ductwork to maintain headroom and pitch whether or not indicated on the Plans. The Contractor shall provide air vents, traps, dirt legs, drains, lifts, sanitary vents, mechanical vent lines, etc. as required to install the mechanical systems for proper operation and maintenance.

D. Do not install work in the immediate proximity of electrical components (e.g. - panels, switches, controls, boxes, etc.) in equipment rooms. Drip pans above and/or around electrical equipment are not permitted.

E. Aluminum and copper products shall not be encased in concrete.

F. Work in “finished spaces” shall be concealed within walls, chases or above the ceiling unless specifically indicated otherwise. Install the Work to coordinate with other trades and to conform to the architectural reflected ceiling plan.

G. The work shall be installed parallel with the building lines unless specifically shown or noted otherwise.

**20 10 53 COORDINATION**

A. Each Contractor shall prepare and submit coordination drawings (at a scale equal to or larger than the project documents) to the Architect/Engineer for review prior to any fabrication or installation.

B. It shall be the Contractor's responsibility to coordinate their work with the work of other trades, and with the architectural and structural drawings. Where physical interferences cannot be
resolved between the trades, or when encountered in the field, the Contractor shall prepare composite drawings at a scale of not less than 3/8" = 1'-0" clearly showing the Work of Divisions 20 - 29 in relation to the Work of others to identify the conflict. Submit a proposed resolution to the Architect/Engineer for approval in accordance with Sub-sections 20 00 01, GENERAL (Project Documents) and 20 10 06, SUBMITTALS.

1. Do not proceed with Work in question until the matter is mutually resolved among the involved parties, and adequate information has been submitted to the Architect/Engineer for review. No additional compensation shall be granted for modifications and execution of the resolution(s). Modifications are to be incorporated in the “as-built” drawings.

C. Contractor shall review the Project Documents, site conditions, and the requirements of other disciplines, and shall report any discrepancies between them to the Architect/Engineer and obtain from him written permission for changes necessary in the Mechanical Work. Subsequent clarification(s) by the Architect/Engineer will not be a change in scope of the Work. The Contractor at no addition in the contract price shall perform any such modifications required.

D. Contractor shall verify tie-in locations to verify sizes, direction of flow (via pressure or physical tracing, not labels), materials, elevations, etc. prior to commencing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

E. The drawings shall not be scaled; obtain detailed information, shop drawings, installation and maintenance bulletins, etc. to determine exact requirements and to satisfactorily achieve the intent of the Project Documents.

F. The Contractor shall furnish and properly install all sleeves, slots, chases, openings, recesses, supports, anchors and anchor bolts required for his Work in coordination with the other trades as the building is erected.

G. The expenses for changes required by neglect in executing, coordinating or scheduling the Work properly or avoiding conflicts shall be borne by the Contractor precipitating the issue requiring the changes.

20 10 54 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of equipment and material are the Contractor's responsibilities. The Contractor shall perform the Work in accordance with the following criteria:

1. Delivery shall be arranged by the Contractor (including Owner furnished items) for the expeditious and economical pursuit of the Work and to meet the scheduling requirements of the Contract.

2. The Contractor will be assigned a “lay-down” area at the job site and shall confine temporary storage to this area.

3. The Contractor may take delivery of equipment and material at his “shop” or an off-site location as suits the performance and schedule of the Work.

4. Regardless of where and how equipment and material are temporarily stored prior to installation, or if installed at the job site prior to acceptance, the Contractor is responsible for the following:
   a. All equipment and material shall be accessible to the Architect/Engineer for inspection.
   b. All equipment and material shall be protected adequately and properly from the weather, dirt and water, chemical, mechanical or comprehensive damages.
   c. The Contractor shall be liable for the repair and/or replacement (including labor) of any equipment and material lost, damaged or defective prior to acceptance.
5. The Contractor shall arrange all labor, tools, services and scheduling to perform the handling of equipment and material for his Work.

20 10 55 GENERAL CLEANING

A. Each Contractor and Subcontractor shall be responsible for progress and final clean-up of his respective Work in accordance with the Contract Documents, requisite ordinances and regulations. Clean-up and legal disposal of debris from the Work, excess refuse and presence at the job site shall be performed in a timely and satisfactory manner. If not, the Contractor shall be notified of the unsatisfactory condition. If the matter persists, the Contractor will be back charged for the clean-up performed by others.

B. Clean exposed exteriors and limited access interior surfaces of all equipment, piping and ductwork of foreign matter to provide an “as new” condition.

20 10 56 CLEANING OF PIPING SYSTEMS

A. The Contractor shall clean the respective piping system(s) that are included in his scope of work. All systems shall be flushed with water or air (depending on ultimate use) to relieve any congestion and internally cleanse the respective piping system. The Contractor shall provide all flushing media in sufficient quantity, inlet connections, discharge or drainage outlets and any temporary provisions to protect components, or remove it, to facilitate the flushing. Clean and replace all strainer screens and filters. Flush clean and drain all low points in the piping.

B. Owner's representative shall be present for flushing, cleaning, and rinsing. Water treatment representative must check water after rinsing to insure all chemical cleaner has been removed and the Alkalinity of the rinse water is equal to that of the make-up water.

C. All pipe systems for hydronic applications shall be flushed continuously with 100% city water make-up until the water runs clean from all drain locations. Each piping system shall be subsequently cleaned with recommended dosage of an approved pre-cleaning chemical designed to remove deposition such as pipe dope, oils, loose rust, mill scale and other extraneous materials for a minimum period of twenty-four (24) hours then drained, refilled, and rinsed clean. Flushing before and rinsing after cleaning shall be supplying constant make-up water while draining at all system low points and drains.

D. New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or, in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652.

20 10 57 PRESSURE TESTING

A. The Contractor shall submit a schedule at the beginning of the Work of the piping systems that are to be pressure tested, and indicate whether tests will be for an entire or partial system. Entire piping systems shall be pressure tested at one time unless it is not possible or practical.

B. All piping to be insulated or concealed shall be pressure tested prior to the application of the insulation or concealment.

C. A representative of the Architect/Engineer shall witness all pressure testing. The Contractor shall notify the Architect/Engineer at least three (3) days prior to the test date.

D. Each piping system shall be tested per the method, test pressure, and test duration as specified in the Piping Material Schedules.
E. The Contractor shall provide all test media, measuring devices, inlet connections, test measurement connections, and disposal of test media. The Contractor shall protect, isolate and/or remove piping system components that can not be subjected to test pressures.

F. Hammer each joint in welded or soldered piping while under test. Leaks shall be repaired and the test(s) repeated until the respective piping system is tight.

20 10 60 BASIC MECHANICAL METHODS - INSTALLATION

20 10 61 GENERAL

A. The Contractor shall install all equipment and material as specified in the Project Documents. The Contractor shall review the installation requirements, and provide all of the appurtenances and accessories required for complete systems and a functioning installation. The Contractor shall be prepared to submit installation details and procedures where specified or requested for approval by the Architect/Engineer.

B. The Contractor shall follow the manufacturer's instructions for the handling, temporary storage, protection and installation of the respective equipment and material. The Contractor shall promptly notify the Architect/Engineer in writing of any discrepancy or conflict between the Project Documents and the manufacturer's instructions, and request clarification. Unless there is a specific change in the scope of work, no additional compensation shall be granted for modification(s) and execution of the clarification.

C. Work performed that does not comply with the manufacturer's instructions, any approval or instructions from the Architect/Engineer, or that causes a significant and/or unapproved deviation from the intent of the Project Documents shall not be grounds for additional compensation for costs to modify the Work in a manner directed by and to the satisfaction of the Architect/Engineer.

D. All Work shall be installed to permit access and/or removal of components that require periodic maintenance, servicing, repair and/or replacement. Equipment, piping, ductwork, conduit and raceways shall be arranged to permit access to valves, motors, motor and temperature controls, and to clear the opening of doors and access panels.

E. Welded attachments to the building structure are not permitted.

20 10 62 PIPING

A. All piping shall be properly installed and supported with adequate provisions for clearance from other work, for expansion, contraction, slope, anchorage and prevention of transmission of vibration.

B. Piping shall be generally installed parallel to building lines in the most expeditious and economical manner and to facilitate servicing. Piping shall be positioned and installed to provide noiseless circulation, and pitched to provide drainage and avoid air pockets. Valves and specialties shall be located to provide proper function and be readily accessible for servicing and maintenance.

C. All piping connecting to equipment shall be installed without springing and any strain at final connections. The Contractor may be requested to disconnect piping to demonstrate that the piping has been so installed.

D. Changes in direction in the piping shall be made with manufactured fittings only. All elbows shall be long radius (1.5 x diameter) unless specifically noted otherwise. Bending may be permitted on submittal for approval of a satisfactory procedure to the Architect/Engineer for
approval. Bending is to be accomplished with hydraulic type equipment producing no mal-
formations in the piping.

E. Full size branch connections and branch connections one size smaller in steel piping shall be 
made with manufactured fittings only. Branch connections two sizes and smaller than the main 
run may, in special cases with the Engineer's written permission, be made with manufactured 
fittings, weld-o-let or thread-o-let type fittings for welded piping construction, saddle type fittings 
for grooved piping construction or a pipe-to-pipe nozzle weld. Small branch connections for 
thermometers, pressure gauges, controls, etc. may be made with nozzle welded 3000# forged 
steel threaded couplings, thread-o-lets or saddle fittings. For insulated piping, provide branch 
connections with sufficient “neck” length to extend beyond the thickness of the insulation.

F. Changes in direction in piping systems using hard temper copper tubing shall be made with 
manufactured and cataloged elbow fittings. Branch connections and reductions in all copper 
tubing systems shall be made with tee and reducer fittings. At the Contractor's option, utilizing 
a "Tee Turner" tool and corresponding procedure may provide branch connections. These 
joints shall be brazed and not soldered.

G. Minimum slope for piping shall be provided in accordance with the following schedule, unless 
otherwise specified, noted or shown:

<table>
<thead>
<tr>
<th>Type of Piping</th>
<th>System</th>
<th>Component</th>
<th>Pitch</th>
<th>Direction of Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer, sanitary</td>
<td>main/branch</td>
<td>1/8&quot;/Ft.</td>
<td>w/flow</td>
<td></td>
</tr>
<tr>
<td>Sewer, storm</td>
<td>main/branch</td>
<td>1&quot;/40/Ft.</td>
<td>w/flow</td>
<td></td>
</tr>
<tr>
<td>Chilled/heating water</td>
<td>supply/return main</td>
<td>1&quot;/40Ft.</td>
<td>from vent</td>
<td></td>
</tr>
<tr>
<td>Chilled/heating water</td>
<td>runouts to risers</td>
<td>1/8&quot;/Ft.</td>
<td>back to mains</td>
<td></td>
</tr>
<tr>
<td>Condensate drain</td>
<td></td>
<td>1&quot;/20Ft.</td>
<td>w/flow</td>
<td></td>
</tr>
<tr>
<td>Refrigerant piping</td>
<td></td>
<td>1&quot;/20Ft.</td>
<td>w/flow</td>
<td></td>
</tr>
<tr>
<td>Domestic water</td>
<td></td>
<td>1&quot;/40Ft.</td>
<td>to drain</td>
<td></td>
</tr>
</tbody>
</table>

H. All piping materials shall be physically cleaned internally and externally of mill scale, oxidation, 
grease, oil, dirt, mud, loose and foreign matter before fabrication and installation.

I. All open ends of piping and equipment shall be closed during fabrication and installation to 
keep dirt and foreign matter out of the Work.

20 10 63 VALVES

A. Shut-off valves shall be provided at all inlet and outlet connections to equipment, at major 
branch connections to mains, where required for normal service, and where shown on the 
drawings, flow diagrams or details.

B. Valves shall be the same size as the adjacent piping, except for control valves furnished in 
Division 25.

C. Valves shall be accessible and free from interference when operated. Valves shall be installed 
with the stem on or above horizontal.

D. Valves shall be packed and glands adjusted before final acceptance.

20 10 64 EQUIPMENT

A. The Contractor shall furnish and install the necessary frames, stands, brackets, stiff-legs, 
hangers, etc. to support or suspend the equipment and material that require this installation 
arrangement. The Contractor shall be responsible for the size, quantity, location and design of
the supports and suspensions. The design shall permit no deflection of the support, the suspension arrangement or related building members, nor impart any vibration into the building structure. Loads transmitted to the building shall be within the limitations of and distributed satisfactorily to the structure. Designs for supports and suspensions shall be submitted for approval to the Architect/Engineer. Any attachment to the floor shall be provided with a minimum of 1” thick concrete or grout between the base and the floor. All associated ferrous metal parts shall be painted or galvanized. Painting shall consist of one (1) coat of base primer on properly prepared surfaces and one (1) coat of rust inhibiting enamel, color selected by the Architect/Engineer.

B. Each exposed mechanical drive and rotating shaft shall be provided with a protective guard. The guards may be provided with the respective equipment or may be field fabricated. The guard shall be constructed to comply with the appropriate safety requirements of the National Institute of Safety and Health and OSHA. Provide adequate and proper access for speed measurements for all rotating shafts. Guards shall not interfere with the lubrication of equipment nor restrict the airflow into fan inlets. The design for field fabricated guards shall be submitted for approval to the Architect/Engineer.

C. All equipment except pumps, having rotating or reciprocating components shall be provided with captive spring type vibration isolation mounts for seismic and restrained service. Mounts shall be selected at a maximum transmissibility of 0.03 (isolation efficiency of 97%) at the lowest anticipated operating speed of the equipment.

D. Grease fittings for bearings shall be extended to accessible locations.

E. Installation Instruction

1. Equipment shall be set level, plumb, properly oriented, aligned and secured in the location shown on the drawings.
2. Shims used for leveling shall be of size sufficient to cover the entire bearing surface except where shims are used to level preparatory to grouting. Shims used in conjunction with grouting shall be located to properly support equipment at load points to prevent any distortion.
3. Assembly and installation of the equipment shall be in strict compliance with the equipment vendor's instructions.
4. Where specified, equipment shall be assembled, installed, inspected and adjusted under the supervision of the Vendor's representative.
5. Lugs, saddles, supports, covers or similar components which have been shipped separately or loose shall be located and attached by the Contractor by means of welds or bolting.
6. Holes in structural steel required for installation of equipment shall be drilled as required.
7. Contractor shall supply and install self-anchoring anchors.
8. The Contractor shall grout under the equipment to effect a firm permanent setting as required.
9. Upon completion of installation the Contractor shall remove all staging, blocking and construction debris from the equipment.
10. The Contractor shall check all packaged or pre-assembled equipment to make sure that all packing shims and blocking is removed before rotating, running or testing the equipment.

F. Equipment Alignment

1. The Contractor shall do a cold final alignment of all rotating equipment shafts and coupling assemblies even when they were factory aligned. The reverse dial indicator method of alignment is preferred whenever possible. The following requirements apply to alignment:
a. **Initial Alignment** shall be checked with all piping larger than NPS 1” disconnected from the equipment. Maximum misalignment readings shall be 0.05-in. total indicator reading (TIR) on the rim and on the face of the coupling hub for all equipment unless otherwise noted in the Equipment Data Sheet instructions. Equipment shall rotate freely, all bolts shall be tight, all bearings and couplings shall be lubricated, and all safety guards shall be in place.

b. **Soft Foot.** Equipment will be checked for “soft foot”. If the dial indicator indicates more than 0.05 in. (TIR) when any equipment to baseplate bolt is loosened, the equipment will be reshimed.

c. **Final Alignment.** The Architect/Engineer will witness the final alignment check on each piece of rotating equipment. Connecting pipe shall fit up to the equipment without the use of mechanical force. Connecting piping greater than NPS 1” will be bolted to the equipment one at a time, with the dial indicator attached. If the alignment changes by more than 0.05 inches (TIR), the piping will be revised until the alignment change is acceptable.

2. Shims used for aligning the equipment shall be stainless steel and shall be stamped with the shim thickness. The shim shall be large enough to cover the complete load bearing area and the total height shall be a maximum of 1/8 inch and shall be installed between the equipment's foot and the equipment's baseplate.

20 10 65 **MISCELLANEOUS**

A. **Sleeves, inserts, etc.**

1. The Contractor shall furnish and properly install sleeves, inserts, supports, anchors and anchor bolts required for his Work. The size, quantity and location of chases, openings and recesses in the building structure shall be the responsibility of the Contractor performing the Work that requires these considerations. Patching of oversized openings and finishing thereof shall be the responsibility of the trade or Contractor requiring the opening. Material and labor for openings in [new construction] requiring structural framing including lintels and angles shall be furnished by the trade requiring the opening and installed by the General Contractor. Lintels shall be structural steel angles, channels, or tees of proper size and sections for the load supported.

2. Sleeves shall be provided for all penetrations through the building structure. Sleeves through floors shall extend 1” above the finished floor except where otherwise noted; sleeves through walls, partitions or structural members shall be flush with the exterior surface on both sides. Sleeves shall sized to include the pipe/duct insulation.

3. The space between the sleeve (or opening in the structure) and the pipe/duct or outside of the insulation of penetrations through fire rated components of the building shall be fire stopped, see Section 20 10 20 Miscellaneous Piping Materials. Penetrations through non-rated components of the building shall be draft stopped, see Section 20 10 20 Miscellaneous Piping Materials.

B. **Unions and flanges:**

1. A ground joint type union shall be provided in threaded and sweat joint piping, 2” and smaller pipe or tube size, down-stream of each branch shut-off valve, control valve and specialty item, the inlet and outlet connections of each piece of equipment, and where shown on the drawings.

2. Flanged connections shall be provided in piping 2-1/2” and larger at each manual valve, control valve, specialty item and the inlet and outlet of each piece of equipment.

C. **Interconnections between dissimilar piping material systems shall be made with fittings manufactured for the specific application.**
20 10 71 DEMOLITION

A. Work Included:

1. The Contractor shall legally dispose of the designated equipment, apparatus and/or piping. Any cost of removal or salvage value shall be credited to the Contractor's account and shall be considered accordingly in the Contractor's bid.

2. Disconnect only, make inoperative, remove any internal substances and abandon-in-place designated mechanical equipment, apparatus and/or piping for removal by others. Do not include any electrical power and/or control considerations.

3. Remove externally applied insulation only as required to facilitate dismantling and ultimate removal of the designated mechanical equipment and material. Do not include removal of any asbestos-based insulation.

B. Work Not Included:

1. The removal and disposal of asbestos based insulation or other hazardous materials applied to, or contained in, the mechanical equipment, material and piping designated to be demolished shall not be included in the scope of the work regardless if known ahead of time or discovered in the course of performing the Work. In the latter case, the Contractor shall notify the Architect/Engineer and shall not pursue that portion of the Work until others have removed the asbestos-based material. The removal and disposal of asbestos-based material shall be arranged by and to the account of the Owner, and conducted separately from the demolition work.

C. Miscellaneous:

1. Loose ends of mechanical systems shall be capped and/or sealed in a safe and secure manner approved by the Architect/Engineer.

2. Dead legs of branch piping are not permitted unless a cap is specifically shown on the drawings. Where a cap is not shown and the drawings indicate to cap piping, the Contractor shall remove branch piping back to the main and cap at that point.

20 10 72 CUTTING AND PATCHING

A. The basic premise of this Sub-section is that the cutting and patching (where required) are performed in existing building components. In “new” construction, the premise is that the building component is already in place.

B. The Contractor requiring the penetration of or the access way in the building structure to fulfill the intent of the Project Documents for his Work shall be responsible for the cutting and the subsequent patching in accordance with the following criteria:

1. No structural component of the building shall be cut or violated without express approval of the Architect/Engineer.

2. The Contractor shall verify the presence of any concealed utility or service within the structure (walls, roof, floor, etc.) in question, and shall be responsible for maintaining continuity and/or replacing it.

C. Cutting of work-in-place in “new” construction because of error, neglect or damage inflicted shall be the responsibility of the Contractor precipitating the issue.

D. “Patching” shall be construed as the repairing or replacing of the building structure to return it to an original or new condition, in the opinion of the Owner and/or Architect/Engineer, as existed prior to the cutting.
E. Patching and finishing work shall be the responsibility of the Contractor requiring the cutting. The patching shall match all the substantive and visual aspects of the structure and adjacent surfaces. Restoration and finishes shall be as specified and executed in the respective sections, schedules and/or details of the Project Documents for the general construction work. Completed work and any special requirements shall be subject to approval by and satisfaction of the Architect/Engineer.

20 10 76 LUBRICATION

A. Provide all oil and grease for the operation of all equipment until acceptance. The Mechanical Contractor and Subcontractors shall be held responsible for all damage to bearing while the equipment is being operated by them up to the date of acceptance of the equipment. Protect all bearings during installation and thoroughly grease steel shafts and other unpainted steel surfaces to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. For equipment that is received void (dry) of lubrication the Contractor shall lubricate the equipment before storing to prevent internal damage to the equipment.

20 10 77 DRAINING, FILLING AND VENTING SYSTEMS

A. The Contractor shall provide all required labor for draining, filling and venting of new or modified systems as many times as required during construction and for all phasing activities.

B. Where draining and filling systems affects other systems or the Owner’s normal operations, then they shall be scheduled at least two weeks in advance with the Owner and shall be carried out to minimize such disruptions.

20 10 80 TESTING, ADJUSTING AND BALANCING

20 10 81 GENERAL

A. This scope of services specifies the requirements and procedures for mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner’s personnel. It is the Contractor’s responsibility to assist as outlined below.

B. Test, adjust and balance the following mechanical systems which are shown in the construction documents:

1. Supply air systems, all pressure ranges, including variable volume and constant volume systems.

2. Return air systems.

3. Exhaust air systems.

4. Hydronic systems.

5. Verify temperature control system operation.

C. Testing and balancing performed by the Owner shall not relieve the Contractor of obligations to perform Work in accordance with the Project Documents.
20 10 82  CONTRACTOR’S RESPONSIBILITIES

A. Notify the Owner’s Representative fourteen (14) days prior to the schedule date for balancing the system.

B. Schedule a two (2) week allowance for the testing and balancing firm to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.

C. Cooperate with the testing and balancing firm and make all necessary preparations for the TAB efforts.

D. Complete the following work prior to requesting the TAB effort.
   1. Clean and flush all piping systems.
   2. Leak test and make tight all piping systems.
   3. Fill all piping systems with clean water.
   4. Clean and seal all ductwork systems.
   5. Service and tag all equipment.
   6. Set and align all motors and drives.
   7. Start up and prove all equipment and systems.
   8. Make preliminary settings on all control devices and have all systems operational.
   9. Operate all systems successfully for twenty-four (24) hours minimum.

E. Lubricate all motors and bearings.

F. Patch insulation, ductwork and housing, using materials identical to those removed.

G. Seal ducts and piping, and test for and repair leaks.

H. Seal insulation to re-establish integrity of the vapor barrier.

I. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.

J. Provide a complete set of as-built drawings prior to the TAB effort.

K. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.

L. Change out fan sheaves when and if required by the TAB firm.

M. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.

N. If a significant rebalance (Owner’s determination) of the HVAC system is required due to the Contractor’s failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

20 10 83  PRE-BALANCING CONFERENCE

A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner’s representative, Engineer and the Test and Balance Agency’s representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.
A. Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.

B. Testing and adjusting each new or modified VAV box to achieve design minimum and maximum airflows, water flows, and heating capacity as scheduled.

C. Testing and adjusting each existing-to-remain VAV box serving the cath lab suite and immediately adjacent areas. Tests shall include pre-reads of each box at max and min airflow setpoints prior to any renovation work taking place. At the completion of the work, existing boxes shall be tested and balanced to ensure initial airflows are maintained.

D. Testing and adjusting each terminal unit water flow rate and/or airflow rate to achieve design flows and capacities.

E. Testing and adjusting each new exhaust branch connection to achieve design airflow rate as scheduled.

F. Testing and adjusting each air device to achieve design airflow rate as indicated on the plans.

G. Testing and adjusting the systems to maintain pressure relationships as required per ASHRAE 170. Note this will require repeated balancing of all system to obtain the pressure relationships.
   1. Cath Lab: positive to all adjacent spaces (+0.01 in. wc)
   2. Clean Supply: positive to adjacent spaces
   3. Soiled Utility: negative to adjacent spaces

H. Test and survey of all applicable central air handling units (AHU-4, AHU-5, AHU-6 & AHU-7) at the time of balancing to document operating conditions. This testing shall include, but shall not be limited to:
   1. pressure profile across all components/sections of the AHU
   2. VFD speed command and Hz for all fans (supply and return)
   3. Duct static pressures in suply and return mains at both the entrance to the shaft (in 8th floor mechanical room) and at the shaft connections at the 4th floor
   4. Chilled water and heating water coil flows and control valve positions

I. Test and survey of central exhaust fans (EF-15A & EF-15B) at the time of balancing to document operating conditions. This testing shall include, but shall not be limited to:
   1. Total static pressure at exhaust fans
   2. Total exhaust system airflow
   3. Fan speed (rpm) for each fan
20 10 90 BASIC MECHANICAL METHODS - IDENTIFICATION

20 10 91 GENERAL

A. This Sub-section specifies basic materials and methods for identification that shall apply to systems specified in other sections of Divisions 20 - 29 of the Specifications.

B. The Contractor shall submit schedules and listings of Work to be identified indicating color code, material, name plate information and method of application for approval prior to performing the Work.

20 10 92 REFERENCES

A. All provisions and conditions cited in this Sub-section shall apply to Work of all other sections of Divisions 20 - 29 of these Specifications, where and when relevant.

B. Applicable requirements of the current and accepted edition of the following codes and standards shall apply to the Work of this Sub-section:
   1. ANSI/ASME A 13.1 - "Scheme for the Identification of Piping Systems".
   2. NFPA 99 – Health Care Facilities
   3. CGA Pamphlet C-9 - “Standard Color-Marking of Compressed Gas Cylinders Intended for Medical Use in the U.S.A”.

20 10 93 WORK INCLUDED

A. Each respective Contractor and Subcontractor shall identify the applicable components of his Work in accordance with specifications hereinafter enumerated or where required by other sections of Divisions 20 - 29 of the Specifications.
   1. All equipment items (i.e., VAV boxes, etc.)
   2. All heating water, plumbing, and fire protection valves both new and existing.
   3. All piping systems identifying the system type and direction of flow.
   4. All control devices and panels.

20 10 94 SUBMITTALS

A. Contractor shall submit shop drawings for approval in accordance with Section 20 00 43 submittals.

B. Provide an Identification Product Schedule consisting of the following minimum information:
   - Material - type of identification product.
   - System - indicate which system or equipment materials will be used for.
   - Manufacturer - Manufacturer's name, product name and model numbers.
   - Accessories - Miscellaneous materials used in affixing identification.

C. Provide manufacturer's technical product sheet and recommended installation instructions.

D. Provide color list/schedule and lettering sizes for pipe markers, valve tags, and equipment nameplates.

E. Provide a valve tag list for approval prior to ordering or making valve tags.
20 10 95 GENERAL METHODS FOR IDENTIFICATION

A. All surfaces to receive identification nameplates or markers shall be clean, degreased, dry, free of oxidation and prepared per manufacturer's recommendations.

B. Plastic nameplates shall be installed with corrosion-resistant mechanical fasteners. Do not use adhesives.

C. Tags shall be installed with corrosion-resistant chain and end fasteners.

D. Pipe and duct markers shall be installed in accordance with the manufacturer's recommendations.

E. Valve tag list for each separate trade in electronic format.

F. Valve tag information is required on “as-built” drawing submittals.

G. Acceptable Manufacturers:

Products of the following manufacturers may be considered

1. Seton Nameplate Corp.
2. Brady Signmark Division
3. Craftmark Identification Systems
4. D & G Sign and Label

20 10 96 PIPING IDENTIFICATION

A. All piping, bare pipe or insulated, exposed or concealed, shall be identified by one of the methods specified herein.

B. Markers shall be installed in clear view; aligned with axis of pipe; located at not more than twenty-five foot (25') intervals on straight runs, risers and drops; located adjacent to each valve, control device and tee fitting; and located on each side of penetrations of the building structure and non-accessible enclosures.

C. The following schedule shall govern label types for each application:

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Rooms II</td>
<td>II</td>
</tr>
<tr>
<td>Above Lay-in Ceilings I</td>
<td>I</td>
</tr>
</tbody>
</table>

1. Pressure Sensitive Tape (Type I): Vinyl pressure sensitive tape color coded and lettered in accordance with ANSI A13.1 for label of service. Flow direction shall be separately labeled with 2” wide pressure sensitive tape. The flow arrow band shall overlap the service label to secure it in place and shall not be less than two complete wraps around the pipe.

2. Plastic Pipe Markers (Type II): Manufactured in accordance with ANSI A13.1 requirements, semi-rigid plastic, pre-formed to fit curvature of pipe or pipe insulation, color coded and imprinted with media identification and flow direction. Available in varied sizes for pipe diameter, wording and inclusion of arrow.

3. Stencil Lettering (Type IV):

<table>
<thead>
<tr>
<th>Outside diameter of bare pipe or insulated pipe</th>
<th>Size of letters</th>
<th>Length of color field</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾”- 1-1/4”</td>
<td>½”</td>
<td>8”</td>
</tr>
<tr>
<td>1-1/2” - 2”</td>
<td>¾”</td>
<td>8”</td>
</tr>
<tr>
<td>2-1/2” - 6”</td>
<td>1-1/4”</td>
<td>12”</td>
</tr>
</tbody>
</table>
D. Medical gases shall be identified in addition at least once in each room, at zone station valves and at each story traversed by the piping systems.

E. The following legend, color, and lettering shall be used:

<table>
<thead>
<tr>
<th>Service and Legend</th>
<th>Color of Field</th>
<th>Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials Inherently Hazardous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot Water Supply</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Hot Water Return</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Domestic Hot Water Return</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Waste</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Vent</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Materials of Inherently Low Hazard:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Water</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Drain</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Roof Drain</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Fire Quenching Materials:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprinkler – Fire</td>
<td>Red</td>
<td>White</td>
</tr>
<tr>
<td>Health Care:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Air</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Nitrous Oxide</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Medical Vacuum</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>WAGD (Waste Anaesthetic Gas Disposal)</td>
<td>Yellow</td>
<td>Black</td>
</tr>
</tbody>
</table>

20 10 97 VALVE IDENTIFICATION

A. All valves exposed or concealed shall be identified with brass valve tags indicating the service of system the valve is in and the number of the valve.

B. Valve tags shall be minimum 1-1/2” diameter brass stock with ¼” legend identifying and ¼” valve number both shall be black enamel filled. Legends shall be HVAC, PLBG, SPR, and GAS.

C. Valve tags shall be secured in place with a No. 6 brass bead chain or No. 16 brass jack chain. Chains shall be attached to the valve lever handle or around the valve stem.

D. An additional 10 consecutively numbered tags for each service shall be provided to the Owner for future use.

E. Existing system valve tag lists shall be obtained from the Owner. Additions to the existing systems shall start numbering at a multiple of (10) plus (1) leaving a minimum of 10 valve numbers between the existing system and the new (i.e., if the existing numbering stops at 66, the new number shall be at 81). The existing numbering convention shall be followed as closely as possible.
F. Balance valves that are not used as a combination balance/service valve are not required to be labeled.

G. Temperature control valves shall be identified with a ¼” “T.C.” legend and shall be numbered consecutively starting with major equipment and then terminal units (i.e., AHU-1 preheat, cooling, reheat control valves shall be numbered 1, 2, 3 respectively).

20 10 98  EQUIPMENT IDENTIFICATION

A. All major equipment items (i.e., chillers, air handling units, fans, terminal units, pumps, boilers, etc.) shall be identified with appropriately sized nameplates permanently attached to the respective equipment.

B. Small equipment items (i.e., in-line pumps, pot feeders, etc.) shall be identified with brass valve tags, see requirements for valve tags and chains.

C. Equipment that is controlled by the Building Automation Control System shall be labeled with a 2” x 5” yellow label with black letters:

   “CAUTION – THIS EQUIPMENT IS UNDER COMPUTER CONTROL AND MAY CYCLE AT ANY TIME.”

D. Interior equipment nameplates shall be 1/16” thick two-ply acrylic plastic 2-1/2” x 1” size minimum with white letters on a black background. Tag size shall be appropriate for equipment name, letters shall be a minimum of ½” high.

E. Nameplates shall be attached with corrosion-resistant No. 3 round head or No. 4 sheetmetal screws.

20 10 99  DUCTWORK IDENTIFICATION

A. Supply, return and exhaust ductwork uninsulated or insulated, exposed or concealed, shall be identified as specified herein, except for exposed ductwork in finished areas.

B. Markers shall be installed in clear view; installed on both sides of the duct; run parallel to the ductwork; located at not more than fifteen foot (15’) intervals on straight runs at all branch locations; and located on each side of penetrations of the building structure and non-accessible enclosures.

C. Markers shall include flow direction and source equipment information (AHU#, EF#, etc.)

D. Markers shall be pressure sensitive vinyl tape labeled for service and direction of airflow. Minimum size shall be 2” high x 8” long.

E. Supply, return, exhaust and outdoor air ductwork labels shall be blue with white letters. Hazardous exhaust air ductwork labels shall be yellow. Outdoor air labels shall have an “air” legend.

20 10 100  CONTROL DEVICES IDENTIFICATION

A. The materials specified herein Section 20 10 90 shall apply to Division 25 Temperature Control Systems. Additional identification work is specified in Division 25.
20 20 10 ELECTRICAL REQUIREMENTS

20 20 11 GENERAL

A. This Subsection specifies the basic requirements for electrical components which are an integral part of “packaged” mechanical equipment. These components include, but are not limited to, factory installed motors, starters, disconnect switches, control panels and related prewiring of power and control wiring for a single external electrical service connection. All material and equipment shall be provided for the application and service intended.

B. Specific electrical requirements (e.g. horsepower, electric characteristics, etc.) for mechanical equipment shall be specified within the respective equipment specifications or shall be scheduled on the Plans.

C. The Contractor shall verify that electrical characteristics of material and equipment furnished for Divisions 20 - 25 equipment are in accordance with the electric service and comply with the specifications and requirements of Division 26 - 29.

D. Unless otherwise specified as an integral part of packaged mechanical equipment, motor control centers, motor starters and disconnect switches and the power wiring from power source to motor starting equipment (including variable frequency drive packages) and wiring from that equipment to the respective motors including final connections shall be performed as Electrical Work of Division 26 - 29.

E. The field installation of electrical components, not included in Division 26 - 29, that are specified to be provided with the mechanical equipment and are shipped separately shall be the responsibility of the Contractor furnishing the base equipment.

F. All electrical components and material shall be UL labeled.

G. Submittals for the applicable electrical equipment shall include the following: identification of the equipment which the electrical material is to serve, application, voltage, phases, full load amperage, wattage and NEMA enclosure. For motors: horsepower, RPM, full load power factor and efficiency, frame size and service factor.

H. Identification of electrical components of mechanical equipment shall be in accordance with Subsection 20 10 90, “Basic Mechanical Methods - Identification”.

20 20 12 REFERENCES

A. Electrical material and equipment provided for Divisions 20 - 29 shall meet the applicable requirements of the latest accepted edition of the following codes and standards:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>EEI</td>
<td>Edison Electrical Institute</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronic Engineers</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electrical Code</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriter’s Laboratories, Inc.</td>
</tr>
</tbody>
</table>

20 20 15 DISCONNECT SWITCHES

A. Fusible: For 3/4 horsepower and larger. Disconnect switch shall be horsepower rated, heavy duty, spring reinforced fuse clips each phase, quick-make/quick-break mechanism with arc quenchers, dead front line side shield, solderless lugs, silver electroplated current carrying parts, lockable hinged door, capacity and electric characteristics as specified.
B. Non-fusible: For 1/2 horsepower motor and smaller. Disconnect switch shall be horsepower rated, toggle switch type, quantity of poles and voltage rating as specified.

END OF SECTION
20 25 00 INSULATION

20 25 01 GENERAL

A. This Section specifies mechanical insulation of piping, equipment and ductwork.

B. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.

C. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

20 25 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:

1. State and local Air Pollution Codes and Regulations.
3. UL 1479/ASTM E-814 Fire Test of Through-Penetration Firestops.

20 25 03 RELATED SECTIONS OF THE SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:
   1. Division 20 - Basic Mechanical Conditions
   2. Division 20 - Basic Mechanical Materials and Methods
   3. Division 22 - Plumbing Work
   4. Division 23 - HVAC Piping and Equipment
   5. Division 24 - Air Distribution

20 25 04 DEFINITIONS

A. The term “fitting” where used in this Section of the Specifications shall be construed as an elbow, tee or reducer. Unions, flanges and valves shall not be considered as fittings.

B. The term “cold” shall be defined as the temperature of a surface that may result in the formation of condensation.

C. The term “accessory” shall include staples, bands, wire, mesh, clips, pins, studs, tape, anchors, corner angles, cements, adhesives, coatings, sealers, mastics, finishes, etc.

D. The term “ASJ” where used in this Section of the Specifications shall mean a reinforced vapor retarding All Service Jacket.

E. The term “SSL” where used in this Section of the Specifications shall mean Self-sealing Lap Joint closure system for longitudinal jacket joints.

F. The term “supply air” where used in this Section of the Specifications shall mean downstream of a coil.

G. The term “outdoor air” where used in this Section of the Specifications shall mean ambient air that has not been conditioned.
H. The term “return air” where used in this Section of the Specifications shall mean conditioned air that is returned from the space.

I. The term “mixed air” where used in this Section of the Specifications shall mean air streams that are a mixture of “outdoor air” and “return air”.

J. The term “relief air” where used in this Section of the Specifications shall mean excess return air that is relieved from the building.

K. The term “exhaust air” where used in this Section of the Specifications shall mean air that is removed due to contaminates, odors, or heat.

20 25 05 WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to the insulation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the Specifications (Subsection 20 25 03) to perform the Work completely.

1. Heating water piping.
2. Reheat coils and return bends of uncased coils, including VAV boxes.
3. Ductwork-sheetmetal systems.
4. Domestic hot, hot recirculating and cold-water piping.
5. Storm water drainage.

B. Providing appropriate size calcium silicate/cellular glass/pipe shield manufactured inserts to the trade contractor for installation between the pipes and oversized hangers as specified in this section.

C. Fire wrapping piping system located in occupied spaces or plenum spaces that do not meet flame spread 25 and smoke development 50.

20 25 06 SUBMITTALS

A. The Contractor shall submit shop drawings for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Provide an INSULATION PRODUCT SCHEDULE consisting of the following minimum information:
   - Material - type of insulation material, jackets, or covers.
   - Manufacturer - manufacturers name, product name, and K-value where applicable.
   - Accessories - tapes, staples, coatings, adhesives including manufacturer's name and product name.
   - Systems - indicate systems where product is used.

C. Provide an INSULATION THICKNESS SCHEDULE consisting of the following minimum information:
   - System - indicate which system insulation is installed.
   - Location - inside, outside, concealed, exposed, etc.
   - Size - indicate size range of pipe, insulation type used.
   - Thickness - indicate insulation thickness in inches.

D. Provide manufacturer's technical product data of each material and accessory item with engineering support information and recommended installation procedure. Indicate product number, "K" value, thickness and required accessories for each application.
E. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

20 25 07 SPECIAL REQUIREMENTS

A. Contractor's Qualifications: Contracting company shall be one specializing in insulation application and have a minimum of three (3) years experience in this work.

20 25 10 INSULATION MATERIALS

20 25 11 GENERAL

A. Materials and accessories furnished for this Section of the Specifications shall be standard cataloged products, new, commercially available and suitable for the service specified.

B. Insulation material and/or accessories containing asbestos are prohibited.

20 25 12 FIRE SAFETY STANDARDS

A. All insulation material shall have composite fire and smoke hazard ratings in accordance with NFPA 255 and UL 723 not exceeding the following values as tested by the latest procedures of ASTM E-84: flame spread of 25; smoke developed of 50.

B. Accessories such as adhesives, mastics, cements, tapes and cloths for seams, joints and fittings shall have the same ratings as hereinbefore listed. All products and their respective shipping cartons shall have indications that flame and smoke ratings meet the aforementioned requirements. Any treatment of jackets or facings to impart acceptable flame and smoke safety values shall be permanent; water-soluble applications are prohibited. The Insulation Contractor shall bear responsibility that all products to be used meet the foregoing criteria.

20 25 13 TYPES OF INSULATION MATERIALS

The following types of insulation material are enumerated in the respective INSULATION MATERIAL SCHEDULE. K values listed are in units of (Btu in/hr ft.2 °F) and are based on specific products and are to be met or exceed. ANSI/ASTM types or class shall not provide relief for any K value specified.

A. Type CS: Hydrous calcium silicate, molded pipe or block form, asbestos free, ANSI/ASTM C533, Type I, "k" value of 0.41 at 200 degrees F for pipe, "k" value of 0.39 at 200 degrees F for block, density of 15#/cubic foot. Owens-Corning Calcium Silicate or equivalent by Knauf, Manville or Pabco.

B. Type GF1: Glass fiber, non-combustible, preformed for pipe and tube application, ANSI/ASTM C547, Class 1, "k" value of 0.23 at 75 degrees F. Owens-Corning type ASJ with SSL-II vapor retarder jacket or equivalent by CertainTeed, Knauf, Manville or Schuller.

C. Type GF2: Glass fiber, non-combustible, rigid board with vapor retarder facing, ANSI/ASTM C612, "k" value of 0.24 at 75 degrees F, density of 3#/cubic foot. Owens-Corning type 703 with ASJ 25 jacket or equivalent by CertainTeed, Knauf, Manville or Schuller.

D. Type GF3: Glass fiber, flexible blanket, laminated to reinforced kraft vapor retarder facing, ANSI/ASTM C553, Type II, "k" value of 0.27 at 75 degrees F, density of 1#/cubic foot. Owens-Corning type 100 All-Service faced duct wrap or equivalent by CertainTeed, Knauf, Manville or Schuller.
**E. Type F1:** Flexible elastomeric foamplastic with smooth exterior surface, preformed for pipe and tube application, ASTM C534, Type I, “k” value of 0.28 at 75 deg. F. Armstrong AP Armaflex pipe insulation, K-Flex LS tube, Aerocel EDPM tube.

**F. Type F2:** Flexible elastomeric foamplastic with smooth exterior surface, sheet material, ASTM C534, type II, “k” value of 0.28 at 75 degrees F. Armstrong AP Armaflex sheet material, K-Flex LS sheet, Aerocel EDPM sheet.

**G. Type FG:** Rigid foamglass preformed for pipe applications ASTM C552, K value of 0.33 at 75°F with all-purpose vapor retarder jacket. Pittsburgh Corning Foamglass.

**H. Type PI:** Polyisocyanurate preformed for pipe applications ASTM C591, aged “k” value of 0.19 at 75 degrees F, density of 2#/cubic foot. Shall be ASTM E84 less than 25/50 rated. Saran 560 vapor barrier.

**I. Type PH:** Phenolic preformed for pipe applications ASTM C1126, Type III, grade 1. ASTM E84 less than 25/50 rated, Saran 560 vapor varrier, 0.15@75°F.

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20 25 14 TYPES OF PIPING JACKET MATERIALS

**A.** 0.016” aluminum or 0.010” stainless steel jackets with moisture barrier shall be cut and fitted to size required. Fold a ½” safety edge on exposed side, roll to diameter required and secure with ½” x 0.020” aluminum or ½” x 0.015” stainless steel bands respectively on 9” centers (4 bands per 3 foot section of jacketing). Provide appropriate seals, and shed water toward low end of pitched piping. Install lap on top quadrant (2 or 10 o’clock position) of outside diameter of insulation and line up bands and seals to present neat and workmanlike appearance. Fitting covers shall be consistent with piping insulation jacketing. Secure in place with SS screws or banding. Seal with approved caulking. Sharp edges shall be turned under or otherwise protected.

**B.** PVC jacketing (0.030” x 48”) for pipe shall be applied with the SSL lap positioned properly to facilitate solvent welding of the seam. PVC fitting covers shall be installed with proper watershed and all joints sealed with solvent welding. Penetrations in the jacketing for hangers, supports and other openings shall be sealed with silicone caulk to be weather, vapor and watertight.

**C.** Finish piping insulation with factory or field application for respective locations as follows:

| Dry, low abuse: | Concealed, not exposed to view. |
| (indoor)       | Mechanical equipment room.     |
|                | Exposed, finish space.         |
| Pipe:          | ASJ jacket.                    |
| Fittings:      | Pre-molded PVC covers.         |

**High abuse area:** Exposed vertical risers in all Storage Rooms, Janitor Closets.

Exposed, unfinished space.

| Pipe:                      | Stainless steel jacket with seam away from abusive force. Apply to height of 8 feet. |
| Fittings:                  | Formed stainless steel covers.                                               |
20 25 15 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The Contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.

C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the Contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance and provide the Architect/Engineer with a copy of manufacturer’s recommendation for approval.

20 25 16 ACCEPTABLE MANUFACTURERS

The following are acceptable manufacturers for products specified in this section of the specification.

A. Metal jackets:
   1. Childers Products Co., Inc.
   2. Insul-Coustics
   3. Pabco Surfit Metal Corp.
   4. RPR Products, Inc.

B. PVC covers:
   1. Proto Corp.
   2. Ceelco Corp.
   3. Speedline PVC Corp.

C. Adhesives and Coatings:
   1. Alpha Associates
   2. Miracle Adhesives
   3. Vimasco Corporation

D. Fasteners
   1. ACS Industries
   2. GEMCO
   3. Midwest Fasteners

E. Fire Stop
   1. 3M
   2. Metacaulk
4. USG Interior, Inc.

20 25 20 INSULATION MATERIAL SCHEDULES: <SEE FOLLOWING PAGES>
<table>
<thead>
<tr>
<th>A.</th>
<th>Service: Hot and cold piping</th>
<th>thickness</th>
<th>insulation material</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.</td>
<td>Hot water (140°F – 200°F) supply and return</td>
<td>1-1/2&quot;</td>
<td>Type GF1, F1</td>
</tr>
<tr>
<td></td>
<td>1-1/4&quot; and smaller</td>
<td>1-1/2&quot;</td>
<td>Type GF1, F1</td>
</tr>
<tr>
<td></td>
<td>1-1/2&quot; and larger</td>
<td>2&quot;</td>
<td>(Contractor's option)</td>
</tr>
<tr>
<td>C.</td>
<td>Domestic water- hot, hot recirc.</td>
<td>1&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td></td>
<td>All pipe sizes</td>
<td>1&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td></td>
<td>2-1/2&quot; and larger</td>
<td>1-1/2&quot;</td>
<td>Type GF1</td>
</tr>
<tr>
<td>D.</td>
<td>Domestic water-cold</td>
<td>3/4&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td>E.</td>
<td>Storm water from the roof drain to the first floor level below the roof. Thereafter, all horizontal piping only and related elbows to vertical. Insulate drain body with ½” sheet Armaflex.</td>
<td>1&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td>F.</td>
<td>Fittings (hot and cold): Molded/preformed fittings, secured in place with twine or tape, seal all “cold” applications prior to installing jacket material.</td>
<td>Type F1</td>
<td>Same thickness as adjacent piping.</td>
</tr>
<tr>
<td>G.</td>
<td>Unions, flanges: Form external collar, minimum 1” overlap on adjacent insulation. Use adhesive to secure in place and maintain vapor barrier.</td>
<td>1&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td></td>
<td>Valves: (cold piping)</td>
<td>1&quot;</td>
<td>Type F1</td>
</tr>
<tr>
<td>H.</td>
<td>Unions, flanges: No insulation.</td>
<td>(hot piping)</td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Valves (hot piping): Insulate valve body only.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J.</td>
<td>Joints: Lines subject to condensation: seal longitudinal laps of jacket with adhesive and wrap butt joints between sections with 2” wide tape.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### INSULATION MATERIAL SCHEDULE I-4

A. Service: Ductwork, 0 to 250 degrees F.

<table>
<thead>
<tr>
<th>Location</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Unconditioned Spaces and Above Ceilings (ducted return)

1. Supply Air  
2. VAV box coil return bends, Duct mounted coils  
3. Return Air  
4. Exhaust Air  
5. Supply air devices not in return air plenums

<table>
<thead>
<tr>
<th>Location</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Air</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>VAV box coil return bends</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Return Air</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Exhaust Air</td>
<td>N/A</td>
</tr>
<tr>
<td>Supply air devices not in return air plenums</td>
<td>1”</td>
</tr>
</tbody>
</table>

C. Insulation Material

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Rectangular ducts  
2. Round and Oval Ducts  
3. Air devices

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular ducts</td>
<td>GF3</td>
</tr>
<tr>
<td>Round and Oval Ducts</td>
<td>GF3</td>
</tr>
<tr>
<td>Air devices</td>
<td>F2</td>
</tr>
</tbody>
</table>
20 25 30 INSULATION APPLICATION

20 25 31 INSULATION APPLICATION - GENERAL

A. Respective piping system, duct system and/or equipment shall be pressure tested, proved tight and accepted, as specified in section for installation of such, before insulation is applied. Sheet metal ductwork joints shall be sealed prior to insulating. Coordination among the respective contractors is essential.

B. Insulation materials and accessories shall be applied in accordance with respective manufacturer's recommendations and recognized industry practice for the insulation to serve its intended purpose. All surfaces to receive insulation shall be clean, dry, free of oxidation and prepared as required.

C. The insulation work shall be subject to inspection during the various applications and construction phases. Material, accessories, finishes, methods and workmanship that are not in compliance with these Specifications and/or approved submittals may lead to rejection of the Work and replacement at the Contractor's expense.

D. Tie-ins to existing systems and all new work shall be insulated to provide a complete and functional system. Finishes shall be compatible wherever possible.

1. When existing insulation thickness is different than the specified thickness herein, the Contractor shall notify the Architect/Engineer. It is the intent that the existing piping would be restored to its original condition (thickness and finish) as if new work had not been performed.

20 25 32 INSULATION APPLICATION - PIPING

A. Insulate each piping section with single thickness full-length units of insulation, with a single cut piece to complete the run where a fitting is encountered. Do not use cut pieces or scraps abutting each other.

B. Extend piping insulation without interruptions through walls, floors, and similar piping penetrations, except where otherwise specified.

C. Insulation on unions, flanges, valves, strainers, expansion joints, pump impeller housings and other equipment requiring accessible servicing shall be removable and reusable without damage. Items requiring periodic attention shall have covers and/or casings to contain the insulation.

D. All “cold” piping systems shall be insulated with type and thickness of material herein specified and shall have a continuous vapor retarder through all fittings, hangers, supports and sleeves.

E. In cold systems flanges, unions, valves, etc., shall be covered with an oversized pipe insulation section sized to provide the same thickness as on the main piping section. An oversized insulation section shall be used to form a collar between two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on main piping system. Rough cut ends shall be coated with suitable weather and/or vapor resistant mastic as required by the system location and service. All valve stems must be sealed with caulking that allows free movement of the stem but provides a seal against moisture incursion.

F. In hot system flanges, unions, valves, etc., shall be left exposed; insulation ends shall be tapered and sealed to allow bolts to be removed or other required access.
G. The installation of cold piping systems shall use oversize (outside the thickness of the insulation) pipe hangers.

1. Piping systems 3" and smaller, the Insulation Contractor shall replace temporary wood blocking with insulation of thickness as scheduled in this section of the specification. Metal pipe shields shall be placed between the pipe hanger and the insulation.

2. Piping systems 4" and larger, the Insulation Contractor shall replace the temporary wood blocking with high density pre-formed insulation (i.e. calcium silicate, cellular glass) inserts with suitable characteristics for the weight, temperature and application and insulation protection shields at each hanger. The specified insulation should stop and start at the insert at the hanger locations. The insert shall be wrapped with vapor barrier jacketing. Circumferential joints shall be taped with vapor barrier tape and coated with vapor barrier sealant. B-Line, or equivalent, figure B-3380 through B-3384, 360 deg. calcium silicate insert/shields and figure B-3153 protection shields may be used or equivalent may be field fabricated per details submitted for approval.

3. If in the event pipe hangers are not oversized, this Contractor shall notify the Engineer and the Contractor(s) who provided and/or installed hangers. Hangers shall be corrected before pipe is insulated.

4. Where size on size hangers have been approved by the Engineer in writing for use in special situations, the insulator shall insulate the hanger and hanger rod with ½" Type F insulation. Pipe insulation shall terminate at each side of the hanger and have vapor barrier end joint butt strips. Hanger insulation shall overlap pipe insulation a minimum of 4" on each side of the hanger and secured to the pipe insulation with contact adhesive. Hanger rods shall be insulated for a minimum of 12" secured to the rod with contact adhesive and the end sealed with a bead of caulk.

5. The Contractor shall adjust hangers after the insulation and pipe shields have been installed to provide an evenly supported piping system. No hanger shall bear the entire weight or not carry any weight of piping system.

H. Special requirements for fiberglass pipe insulation:

1. fiberglass pipe insulation, All Service Jacket/Self Sealing Lap (ASJ w/SSL) type, shall be installed with laps positioned to shed water, position at either 10 o'clock or 2 o'clock and shall not be visible to view. End joint butt strips shall be installed on all piping with ½" adhesive to adhesive overlap.

2. For piping systems using fiberglass insulation, the fittings shall be insulated with: double thickness molded fiberglass fittings, or preformed cellular glass fittings secured with twine or wire; or with flexible elastomeric foamplastic; at the Contractor’s option. The pre-molded PVC fitting covers shall be installed over the fiberglass inserts and secured with SS tacks. Victaulic fittings or couplings shall be insulated with sheet elastomeric foam plastic insulation formed to the fitting and formed “collars” over all couplings encountered.

3. For piping systems using fiberglass insulation, butt joints in hot piping shall be made with 2" wide vapor barrier tape over butt joints. Butt joints in cold piping shall be made with a wet coat of vapor barrier lap cement on butt joints and seal joints with 2" vapor barrier tape. All pipe insulation ends shall be tapered and sealed.

4. On “cold” applications only, the following additional requirements shall apply: the premolded fittings shall be sealed with an approved vapor barrier retardant prior to installing the jacket materials. Premolded PVC fitting covers shall then be installed over the premolded inserts, all joints shall be sealed with vapor barrier cement and 2" vapor barrier tape on lap joints. Premolded stainless steel or aluminum fitting covers shall be installed per the manufacturer’s instructions and a bead of clear silicon caulk applied to all joints. Straight lengths of insulation abutting all fittings shall have both ends sealed with vapor barrier cement to prevent “wicking” or moisture migration. At a maximum of twenty-one foot (21’) intervals, joining ends of the butt joints shall be sealed with vapor barrier cement prior to butting together to prevent “wicking” or moisture migration.
I. For piping systems using elastomeric foamplastic insulation, joints and seams shall be sealed with manufacturer's recommended contact adhesive. Fittings shall be insulated from segments fabricated from pipe insulation or sheet material, secured and sealed with contact adhesive. Termination points and ends shall be sealed to the pipe to prevent backflow of condensation on the inside of the insulation. Any piping outdoors or otherwise exposed to UV or ozone provide two (2) coats of WB Armaflex or Rubatex 374 finish.

20 25 33 INSULATION APPLICATION - EQUIPMENT

A. Manufactured equipment (i.e. air handling equipment, terminal units, air device plenums, etc.) requiring insulation shall be specified in the respective equipment specifications to be factory insulated with internally applied liner or double wall casing.

20 25 34 INSULATION APPLICATION - DUCTWORK

A. Ductwork systems shall be insulated in accordance with the insulation schedules. Insulate each duct section with single thickness full length pieces. Do not use scraps abutting each other.

B. Extend insulation without interruptions through walls, floors, and similar penetration, except where otherwise specified.

C. “Cold” duct systems shall have insulation with a continuous vapor retarder through all fittings, hangers, supports, air devices, fire dampers, duct mounted coils, dampers, and other devices in the ductwork system, etc.

D. In “cold” duct systems, using rigid board or sheet elastomeric foam insulation, support angles, stiffener angles, ductmate flanges, etc. they shall be covered with an oversized insulation strip sized to provide the same insulation thickness as on the duct. Provide a minimum of 2” of overlap on each side of the obstruction.

E. Board insulation shall be properly cut and dry fitted to the surface to be insulated. Edges shall be neat and clean cut. No intermediate cut pieces shall be allowed on the bottom and sides of the ductwork. Insulation board shall be secured in place using mechanical fasteners such as welded pins or speed clips. Locate not less than 3” from each edge or corner and approximately 12” on centers on all sides. There shall be a minimum of two (2) rows of pins on the bottom of the duct and one (1) on the sides. Additional pins may be needed on the bottom to prevent sagging. All seams, joints, penetrations and breaks in the vapor retarder jacket shall be sealed with pressure sensitive tape matching insulation facing. Edges shall be provided with 28 ga. 1” x 1” aluminum corner beading properly secured and shall have the same facing material as the insulation board.

F. Flexible duct wrap insulation shall be cut properly and fitted to “stretchout” dimensions and a 2” piece of insulation removed from the facing at the end of the piece to form an overlapping staple and tape flap. Insulation shall be installed with facing outside so tape flap overlaps facing at the other end. Insulation shall be butted tightly. Seams shall be stapled on 6” centers with outward clinching staples. Adjacent sections of duct wrap insulation shall be butted tightly with the 2” tape flap overlapping and stapled. For horizontal oval ducts over 30” wide, duct wrap insulation shall be secured additionally to the bottom of the duct with mechanical fasteners such as pins and speed clip washers spaced on 18” centers to prevent sagging. All seams, joints, tears, punctures and other penetrations in the vapor retarder jacket shall be sealed with FRK backing pressure sensitive tape.

G. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation.
H. Where a duct run changes from interior lining to exterior application (or vice versa), there shall be a 6" overlap of insulation.

I. In "cold" duct system with internal duct insulation, with 1 1/2 " thickness flexible duct wrap, insulate air devices, fire dampers, duct mounted coils, dampers, and other devices in the ductwork system that are not internally insulated.

**20 25 35 PVC PIPING INSULATION PLENUM FIRE WRAP**

A. Provide 1/2 inch minimum thickness fire resistant blanket wrap consisting of inorganic blanket encapsulated with a scrim-reinforced aluminum foil and overlap seam to provide a flexible, non-combustible enclosure for cables and PVC non-plenum rated pipe in return air plenums as tested to UL 910.

B. Plenum Wrap shall be tested in accordance with the following:
   - ASTM C 411, ASTM C 518, ASTM E 84, ASTM E 136, and UL 910
     - Maximum Flame Spread (Ft.) 0.01
     - Maximum Smoke (Optical Density) 0.01
     - Average Smoke (Optical Density) 0.00
     - Surface Burning Characteristics (ASTM E 84)

C. Cut Fire Barrier Plenum Wrap to a length sufficient to wrap completely around the perimeter of the pipe, plus provide a longitudinal overlap of not less than 1 inch and an overlap of 1 inch, minimum, over the adjacent wrap section. Use aluminum foil tape to seal cut edges of the blanket. Temporarily secure Plenum Wrap in place using 3/4 inch wide filament tape. Install minimum 1/2 inch wide by 0.015 inch (28 gauge) thick stainless steel metal banding with stainless steel metal band clamp or 16 gauge galvanneal tie wire around the Plenum Wrap to hold it in place. Place the bands or tie wires 1/4 inch from each edge of the blanket and at the midpoint of the blanket, 11-3/4 in. on center. Tension the banding or tie wire to hold the Plenum Wrap snugly in place, compressing the foil but not cutting the foil.

D. PVC Piping Insulation Plenum Fire Wrap shall be 3M Fire Barrier Plenum Wrap 5A or approved equivalent.

END OF SECTION
21 00 00 FIRE PROTECTION SYSTEM

21 00 01 GENERAL

A. This section specifies a hydraulically calculated fire protection system designed and installed by the Contractor as described on the drawings and hereinafter.

B. It is the intent that the drawings and specifications shall describe and provide for a working installation complete in every detail and all items necessary for such complete installation shall be furnished whether specifically mentioned or not.

C. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.

D. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

21 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:

1. National Fire Protection Association (NFPA) 13, 2010 & 2016 (whichever is more stringent)
2. National Fire Protection Association (NFPA) 14, 2010 & 2016 (whichever is more stringent)
3. The Local Authority having jurisdiction.
4. FM Global
5. Owner’s Insurance carrier

21 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:

A. Division 20 - Basic Mechanical Conditions.

B. Division 20 - Basic Mechanical Materials and Methods

21 00 04 DEFINITIONS

A. The term “layout” where used in this Section of the Specifications shall mean drawings prepared by the Contractor showing where all piping and heads are located. These drawings should include pipe elevations, need not include pipe sizes and should not include hydraulic calculations.

B. The term “Authority Having Jurisdiction” or “AHJ” where used in this Section of the Specification shall mean the organization, office, or individual responsible for approving equipment, an installation, or a procedure.

C. The term “rhythm” where used in this Section of the Specifications shall mean spaced in a manner which would place the heads at the same location with respect to lights or diffusers (i.e., for a row of lights spaced at 12’ centers heads shall also be on 12’ centers so that the
heads will remain the same number of ceiling tiles or distance away from the lights; where there is an odd number of tiles between lights or diffusers, it is also preferable to have heads located at the tile centered between them).

D. The term “working drawings” where used in this Section of the Specifications shall mean drawing of the quality and containing all information as which would be required for approval by local official and for field construction.

21 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to the installation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications (Subsection 21 00 03 to perform the Work completely.

B. Furnish and install a complete hydraulically engineered extension / modification of the building fire protection system including the relocation of existing heads on existing branch lines.

C. Verify actual water supply with a test, preferably witnessed or performed by the local fire official.

D. Contractor shall coordinate his work with the work of other trades, and with the architectural and structural drawings.

21 00 06 SUBMITTALS

A. The Contractor shall prepare submittals for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Submit “Layout drawings” and equipment cut sheets for review prior to any fabrication or ordering or materials.

C. Contractor shall submit “Working drawings” coordinated with the other trades for review prior to any fabrication or installation.

21 00 07 SPECIAL REQUIREMENTS

A. The Contractor preparing the drawings and calculations shall be NICET Level 3 certified or a Professional Engineer licensed in the State Missouri, whichever is required by the Authority Having Jurisdiction.

B. All equipment shall be U.L. Listed or F.M. approved for use in fire protection systems.

C. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing lines for: sizes, direction of flow (via pressure or physical tracing of piping, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

21 00 08 CLOSE-OUT REQUIREMENTS

A. Reference Section 20 00 48.

B. Where NFPA maintenance information is utilized, it shall be edited to contain only information that is relevant to this project.
21 00 10 DESIGN

21 00 11 WATER SUPPLY

A. The water supply to the system is existing.
B. A new flow test witnessed by the Fire Marshal shall be conducted.
C. This information is provided for general information only.
D. Design water pressure requirements shall include a minimum of [10-psi] safety factor. Where Authority having jurisdiction requires a higher safety factory it shall be used.
E. The zone valve for the existing automatic sprinkler system serving the area is located in Stairwell CS4095Q.

21 00 12 LAYOUT - GENERAL TO ALL SPRINKLER SYSTEMS

A. The “layout” shall be submitted to the Architect prior to performing hydraulic calculation, sizing pipes or seeking approvals from the authority having jurisdiction.
B. The Architect/Engineer will review “layout” for aesthetics, and pipe routings for consistency with the construction documents.
C. Minimum head spacing shall be as per NFPA-13. Additional heads may be required by the Architect/Engineer to create spacing that works with the reflected ceiling plans. Contractor shall layout any areas not shown on the plans with symmetry and “rhythm” in mind.
D. Heads shall be on return bends and centered ± 1” for 2’ x 2’ ceiling tiles, or on quarter points ± 1” for 4’ x 2’ ceiling tiles.
E. Contractor shall not scale the drawing, refer to architectural drawings for dimensions. Where the room dimension is at the maximum size listed for the sprinkler heads, install an additional row of sprinklers.
F. Contractor shall locate heads in the field from the final wall locations. It shall be brought to the Architect’s/Engineer’s attention where the center of tile location exceeds the maximum distance of the sprinkler. Additional heads shall be added and the layout modified as directed by the Architect/Engineer at no additional cost to the Owner.
G. All sets and rises shall be located above ceilings of adjacent spaces of rooms without ceilings as opposed to making the sets and risers in the exposed spaces.
H. Inspector test connections and auxiliary drains shall be piped to spaces not occupied by building occupants, i.e., Mechanical Rooms, Storage Rooms, Janitor’s Closets, etc.

21 00 13 APPROVALS

A. Submittal drawings shall show lights, ducts, and pipes indicating all necessary rises and drops in sprinkler piping required for routing. Drawings shall be of a minimum of the same scale as the contract documents, 1/8” = 1’-0” scale.
B. Any pipe sizing or hydraulic calculations performed prior to the Contractor receiving the “layout” submittal with the ‘approved stamp’ of the Engineer shall be at the Contractor’s own risk. Any design changes resulting in resizing pipe and/or revising hydraulic calculations will be done at no cost to the Owner.
C. The “working drawing” submittals shall include peaking information for each area calculated. The hydraulic calculation used for the system design shall be clearly identified from all other hydraulic calculations and should show the safety factor the designed system has relevant to the available water test pressure.

D. Hydraulic calculations shall include: actual pipe internal diameters and coefficients of materials approved in the “layout” submittal; design density; remote area size; and area per sprinkler.

E. The Contractor shall not pursue any approvals or interpretations of the design documents except through the office of the Architect/Engineer.

F. All work shall meet the requirements of the Owner, authority having jurisdiction, Owner's insurance underwriter, Architect and Engineer. These requirements may be greater than required by NFPA. Work shall not start prior to the Contractor receiving the “working drawing” shop drawings with the 'stamp' of the Engineer and approval from the authority having jurisdiction.

21 00 14 TESTING

A. Preliminary testing witnessed by the Architect/Engineer shall be conducted to assure proper operation before the final test is scheduled. Prior to this testing, pipes shall be flushed, hydrostatically tested, and all valves and devices shall be operated. All requirements of “System Acceptance” of NFPA 13 shall be met in full.

B. The sprinkler system shall be final Acceptance tested in the presence of the Owner's Representative and the governing agencies having jurisdiction for approval.

21 00 15 ACCEPTANCE

A. Acceptance test performed as described above.

B. Contractor shall fill out completely and sign Contractor's Material and Test Certificate provided in NFPA-13 and submit to Engineer for approval and thus system acceptance.

C. Spurious Alarms
   1. If the Owner experiences an unacceptable number of spurious or unexplained false alarms during the installation and guarantee periods, the Contractor shall be responsible for providing the necessary labor, material and technical expertise to correct the problem to the satisfaction of the Owner.
   2. Any spurious alarms associated with workflow devices or valve supervisory switches, range hood and duct fire suppression system monitoring devices, or monitoring of special suppression systems are considered unacceptable.
   3. The Contractor shall coordinate with the fire alarm contractor to resolve spurious or unexplained false alarms.

D. Keys and Special Tools
   1. The Contractor shall supply the Owner with three complete sets of any special tools or keys necessary for normal operation and maintenance of the system. Keys and locks for equipment shall be identical.
A. The most stringent of NFPA-13, local practices, or the following criteria shall be used in the sprinkler system design and hydraulic calculations.

1) Light Hazard:
   - Offices
   - Toilet Rooms
   - Lobby/Commons Area
   - Corridors
   - Meeting Rooms
   - Locker Rooms
   - Multi-Purpose Rooms
   - Hospitals

2) Ordinary Hazard, Group 1:
   - Mechanical Rooms
   - Janitor's Closet

3) Ordinary Hazard, Group 2:
   - Storage

B. The hazard protection level shall be increased as required for areas with hazardous materials, flammable and combustible liquids, or storage that requires additional protection per NFPA 13. The sprinkler design criteria for spaces with hazardous materials and/or flammable and combustible liquids shall be in accordance with NFPA 30 and the requirements for Extra Hazard occupancies of NFPA 13.

C. Reduction in design area shall be permitted for quick response sprinklers in accordance with NFPA 13.

21 00 20 SERVICE ENTRANCE & SYSTEM PIPING

21 00 28 PIPING MATERIAL AND FITTING SCHEDULE

A. Size: 2-1/2" and larger above grade.
   1. Pipe: Schedule 40 steel
   2. Fittings: Butt-welded, groove-end, forged steel flanges, thread-o-let, weld-o-let.
   4. Tests: Hydrostatically at not less than 200 psi for two (2) hours per NFPA 13, Section 8-2.2.

B. Size: 2" and smaller above grade.
   2. Fitting: Cast iron.
4. Tests: Hydrostatically at not less than 200 psi for two (2) hours per NFPA 13, Section 8-2.2.

D. The following types of fittings are prohibited: plain end couplings and fittings, saddle tee, Victaulic flange rings, and Victaulic reducing couplings.

E. Pipe velocities shall not exceed 14 feet per second in any section of the piping system.

21 00 30 WET PIPE SPRINKLER SYSTEM

21 00 31 SPINKLER HEADS

A. All sprinkler heads are to be quick response liquid in glass bulb type, with a minimum of ½ inch orifice, ½ inch NPT, and a K factor of 5.65. Sprinklers have an orifice larger than ½ inch shall be ¾” NPT.

B. In finished spaces with ceilings, concealed sprinklers with an adjustable white coverplate shall be used. Heads shall be equivalent to the Viking model Horizon Mirage, Star model Stealth S110, Central model Royal Flush Concealed, or Reliable model G4QR.

C. In unfinished spaces or in concealed locations, upright and pendent sprinkler heads with a natural bronze finish shall be used.

D. In finished spaces without ceilings the heads shall be the same as above with the addition of a white factory finish.

E. Sidewall sprinklers where utilized in Unobstructed Construction shall be horizontal recessed type with a white factory finish.

F. Temperature range and response time shall be suitable for the location and the expected heat release. Within a space all sprinklers should be the same Temperature Range and Response Time to avoid “skipping”.

G. All sprinklers shall be FM Global listed.

H. All sprinklers shall be standard coverage.

END OF SECTION
A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 22 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 22 of these Specifications.

C. Each plumbing fixture, accessory, equipment item and specialty shall be installed in accordance with the respective manufacturer's recommendations.

D. Plumbing fixtures, equipment and specialties shall be protected against damage in the period between installation and acceptance. Any item damaged shall be removed, repaired and/or replaced at no additional compensation.

E. All operable devices and features of plumbing fixtures, accessories, equipment and specialties provided for in the Scope of Work of this Section shall be operated and proved to function satisfactorily for a period of eight (8) hours. Adjust, balance, lubricate as required, and instruct the Owner in the proper operation and maintenance of each device.

F. The plumbing system shall comply with the 2011 Reduction of Lead in Drinking Water Act. Components shall be “lead free” equivalent of model number specified regardless if manufacturer’s prefix and suffix have been included.

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20.
5. Draining, filling, and venting of all modified systems as required for the above work. This includes scheduling shutdowns with the Owner. (Refer to Section 20 10 70).

6. Smoke stopping of all penetrations of pipes and firestopping of the same through fire rated partitions as shown on the architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits. (Refer to Section 20 10 20).

7. Cleaning and pressure testing equipment, piping, and accessories installed under this section of the specification. (Refer to Section 20 10 50).

8. All seismic restraints for the above work. (Refer to Section 20 10 40).

9. Installing accessories specified under other sections of the specification referenced in subsection 20 00 05.

22 00 06 SUBMITTALS (SEE SUBSECTION 20 00 43)

A. The Contractor shall submit the following shop drawings for approval in accordance with Subsection 20 00 43 - Submittals.

1. Piping materials and valves as specified in Piping Material Schedule(s) in subsection 22 20 00.
2. All specified drains and overflows in subsection 22 30 00.
3. All specified plumbing fixtures in subsection 22 40 00.
4. All specified plumbing equipment in subsection 22 60 00.
5. All specified plumbing specialties in subsection 22 80 00.
6. All general items specified under Division 20 utilized in the installation of work required by this section of the specification.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information and recommended installation procedure. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

C. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

D. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation. (Refer to Section 20 10 50).

22 00 07 SPECIAL REQUIREMENTS

A. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing for: sizes, direction of flow (via pressure or physical tracing of piping, or camera work, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

B. Where lines installed under this section of the specification tie-in to existing lines Contractor shall verify all existing lines, their elevations and directions of flow before running any new lines.

1. Contractor shall notify Architect/Engineer upon discovery if the new line cannot tie-in to the existing line due to location, elevation, or direction of flow.
PART 1     GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify the Contractor’s responsibilities and participation in the commissioning process relative to Division 22.

B. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Commissioning is primarily the responsibility of the Commissioning Authority, with start-up, testing and support for commissioning the responsibility of the Contractors. The commissioning process does not relieve the Contractor from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.

C. Work of Division 22 includes:

1. Testing and start-up of the plumbing equipment.
3. Providing qualified personnel to assist in commissioning tests, including seasonal testing.
4. Completion and endorsement of Pre-functional Construction Checklists provided by the Commissioning Authority to assure that Division 22 equipment and systems are fully operational and ready for functional testing.
5. Providing equipment, materials and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
6. Providing operation and maintenance information and as-built drawings to the Commissioning Authority for review, verification and organization, prior to distribution.
7. Provide a detailed start up plan for CxA’s review, comment and recommendation.
8. Provide at the end of the job the following items for inclusion in the systems manual.
   a. Control drawings, sequences of control
   b. A table of all set points
   c. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown
   d. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems.
9. Use Burns & McDonnell (BMcD)’s on-line and window based Commissioning application to fill out Construction Checklist and to track issues resolutions. Attendance a one BMcD training class is
required for all contractors. This training will take place at the construction Cx kick off.

10. Providing assistance to the Commissioning Authority to develop, edit and document system operation descriptions.
11. Providing training for the systems specified in this Division with coordination of Owner by the Commissioning Authority.

1.2 RELATED WORK

A. All installation, testing and start-up procedures and documentation requirements specified within Division 22.

B. Section 019113 – Commissioning

C. Commissioning Functional Test Procedures that required participation of the Division 22 Contractors.

D. Cooperate with the Commissioning Authority in the following manner:

1. All testing and start-up procedures and documentation requirements specified within Division 1 and Division 22 and related portions of this project.
2. Allow sufficient time before final completion dates so mechanical systems start-up, test and balance, and commissioning can be accomplished.
3. Provide labor and material to make corrections when required without undue delay.
4. Put all plumbing equipment into full operation and continue the operation of the same during each working day of the testing, balancing and commissioning.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Standard test equipment for commissioning will be provided by the Contractor.

B. Division 22 Contractor shall provide standard and specialized test equipment as necessary to test and start up the plumbing systems.

C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test
equipment, demonstrate its use and assist the Commissioning Authority in the commissioning process.

D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/facility management system. This equipment and software shall be provided for use by the test, adjust and balance contractor and the Commissioning Authority.

PART 3 EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Complete all phases of work so the systems can be energized, started, tested and otherwise commissioned. Division 22 has primary start-up responsibilities with obligations to complete systems, including all sub-systems, so they are functional. This includes the complete installation of all equipment materials, raceways, wire, terminations, controls, etc., per the Contract Documents and related directives, clarifications, change orders, etc.

B. A Commissioning Plan will be developed by the Commissioning Authority. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect and the Contractor may be obligated to compensate the Commissioning Authority to test the revised product or confirm the suitability/unsuitability of the substitution or revision.

C. Specific pre-commissioning responsibilities of Division 22 are as follows:

1. Normal start-up services required bringing each system into a fully operational state. This includes motor rotational check cleaning, lug tightening, control sequences of operation, etc. The Commissioning Authority will not begin the commissioning process until each system is complete, including normal contractor start-up and debugging.

2. The Contractor shall perform pre-functional construction checklists on the systems to be commissioned to verify that all aspects of the work are complete in compliance with the plans and Specifications. Contractor start-up forms may be substituted for the
SECTION 22 0800 – PLUMBING SYSTEMS COMMISSIONING

pre-functional test forms with prior approval by the Commissioning Authority.

3. Factory start-up services will be provided for key equipment and systems specified in Division 22. Factory start-up activities to be documented and submitted. The Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

4. Notify Construction Manager and Commissioning Authority when systems are ready for functional testing.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING

A. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Provide skilled technicians to start up and debug all systems within this division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and/or reconstruction of systems and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purpose of this work.
D. The test, adjust and balance subcontractor shall provide a draft report with final test measurements to the Commissioning Authority and shall provide qualified technicians and instruments needed for balancing to demonstrate a sample up to 100% of measurements until specified results are achieved.

3.3 WORK TO RESOLVE DEFICIENCIES

A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed under direction of the Architect, with input from the Contractor, equipment supplier and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance.

3.4 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers and Commissioning Authority shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

B. The cost of compensation of the Commissioning Authority for repeat testing or troubleshooting due to systems that do not meet specified performance shall be borne by the Contactor.

C. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely to the commissioning process, the Commissioning Authority will notify the Architect/Engineer of Record indicating the nature of the problem, expected steps to be taken and the deadline for completion of activities. If the deadline passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor’s responsibility.

3.5 SYSTEMS TO BE COMMISSIONED

A. Refer to specification section 019113:
3.6 TRAINING

A. This Contractor will be required to participate in the training of the Owner’s engineering and maintenance staff for each system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner’s option.

B. The Contractor will be responsible for the generic training as well as instructing the Owner’s staff on the system peculiarities specific to this project.

3.7 SYSTEMS DOCUMENTATION

A. Maintain as-built red-lines on the job site as required in Division 1. Given the size and complexity of this project, red-lining of the drawings at completion of construction based on memory of key personnel is not satisfactory. Continuous and regular red-lining and/or posting of drawings is considered essential and mandatory.

B. In addition to the stated requirements for operation and maintenance data, provide one (1) copy of equipment technical literature, operation and maintenance literature and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner’s final use.

C. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown

D. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems.

E.
22 20 00 PLUMBING PIPING SYSTEMS

A. General

1. Furnish and install the piping systems shown on the Plans and as hereinafter specified in the respective PIPING MATERIAL SCHEDULE. Include all necessary considerations in the related sections of the Specifications (subsection 22 00 05) to provide for complete systems.

B. All drainage lines shall be flushed clean at the completion of the Work. Rod out any obstructions encountered.

C. All domestic water lines shall be flushed clean at the completion of the Work. Refer to Section 20 10 56 – Cleaning of Piping Systems.

D. Pressure test each respective piping system for tightness to the test pressure indicated without loss. Repair any leaks and retest, as required. If test pressure is not indicated, hydrostatically test to 1.5 times the system operating pressure.

E. The Plans indicate the approximate location and arrangement of roughing-in for waste, vent and domestic water piping to serve the respective plumbing fixture, equipment and specialties. Final locations and arrangements shall be determined from approved shop drawings of the respective item.

F. Provide approved backflow preventers in all branch lines in the domestic water system for connections to non-domestic applications.

G. Main vents shall be the same size as waste lines and shall extend 12” minimum above the roof. Minimum vent thru the roof (VTR) shall be 3” size.

H. Install all piping with pitch to vent or drain. Provide drain valves at low points and air vents at high points. Drain valves and air vents shall be ¼” bronze, 2 piece body ball valves with ¾” hose end adapter, cap, and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain.

I. The plumbing system shall comply with the 2011 Reduction of Lead in Drinking Water Act.

22 20 02 PIPING MATERIAL SCHEDULE P-2

A. Service: Storm water drainage (ST), above grade.
Sanitary waste (SAN) and Vent (V), above grade.
Piping within the building perimeter.

B. Design: Pressure: gravity vented.
Temperature: 140 degrees F.

C. Pipe: Cast iron soil pipe, no-hub.

D. Fittings: Cast iron, no-hub.

E. Joints: No-hub stainless steel coupling assembly, with neoprene rubber gasket.

F. Test: Pressure test at not less than 15 feet static head of water for two (2) hours minimum.
22 20 08 PIPING MATERIAL SCHEDULE P-8

A. Service: Domestic water, above grade.  
   Includes cold water (CW), hot water (HW), hot water recirculating (HWR)

B. Design:  
   Pressure: 100 psig.  
   Temperature: 180 degrees F. max. for hot water only.

C. Pipe: Copper, hard drawn, seamless, type L.  
   1. Fittings: Wrought copper, solder ends.  
   2. Dielectric Isolation union/union flanges between Fittings: water piping and non-copper connections and at all equipment connections.

D. Flanges: Cast bronze, 125 psi.

E. Joints:  
   All 95/5 Solder

F. Valves: All valves shall be lead free.  
   1. Shut-off/Service:  
      3” and smaller Ball valve, bronze body, two piece, full port, stainless steel ball and trim.  
      4” and larger Gate valve, Class 125 cast iron body, bolted bonnet, non-rising stem, resilient wedge.
   2. Balancing/Throttling:  
      3” and smaller “Circuit Setter”
   3. Check Valve:  
      3” and smaller Class 125 bronze, horizontal swing, Y-pattern, regrinding type, renewable seat and disc, solder ends.  
      4” and larger Class 125-iron body, bolted bonnet, horizontal swing, renewable seat and disc, bronze mounted, flanged ends.
   4. Hose End Valve: Interior: ¾” hose thread outlet x copper sweat inlet with integral vacuum breaker. Nibco figure 63-VB.
   5. Hose End Valve: Interior: ¾” hose thread outlet x copper sweat inlet with integral vacuum breaker. Nibco figure 63-VB.
   6. Test: Hydrostatically pressure test at 150 psi for four (4) hours

22 30 00 DRAINS AND CLEANOUTS

A. General  
   1. Furnish and install the following drains and cleanouts where shown on the Plans and as hereinafter specified. Drains and cleanouts shall have all options, body material, top size,
top style, top material, and accessories as specified whether or not listed as a prefix, suffix, or catalog number.

B. Drain and cleanout outlets shall be compatible with respective piping material and size. Outlets below grade shall be push type. Outlets above grade may be no-hub or push type at the Contractor’s option. Tops shall be compatible with the flooring system.

C. Provide deep seal P-traps for all floor drains.

D. Do not install cleanouts in electrical equipment rooms. Extend the cleanout to outside the room limits.

E. Where cleanout is located in open ground, extend the cleanout to finished grade elevation and install a 16" x 16" x 8" deep concrete pad at grade to secure the cleanout.

F. Submit with products, a room by room schedule indicating floor drains and cleanouts to be used including top size, shape, floor finish material, and setting height with respect to concrete slabs. Any drain body set prior to approval shall be performed with block-outs to allow correct tops and finished heights to be adjusted.

22 30 01 FLOOR DRAINS

A. Floor Drain: toilet room (FD-A):
   Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, 6" x 6" square adjustable satin nickel bronze, strainer top with vandal proof fasteners and be 3” outlet. Wade W-1103-G6-1-176, Zurn ZN-415-6S-VP, J.R. Smith 2000-B06NB-U-L, MIFAB F1100C-S6-1, or approved equivalent.

B. Floor Drain: mechanical equipment room (FD-B):
   Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, 7" cast iron loose set tractor strainer and 3” outlet. Wade W-1103-TS7, Zurn Z-415-7N, J.R. Smith 2000-D-CI, MIFAB F1100C-N-1, or approved equivalent.

22 30 07 CLEANOUTS

A. Cleanout: interior finished floor (FCO):
   Cast iron body, threaded adjustable housing, flanged ferrule with straight thread gasketed plug and square secured satin nickel bronze scoriated top, vandal proof, tops shall be for tile, carpet, ceramic tile, terrazzo tile as required. Wade W-6000-1-TS7, Zurn Z-1400-T-BP-VP, J.R. Smith 4052-U, MIFAB C1100-S-1-6, or approved equivalent.

B. Cleanout: interior unfinished floor (FCO):
   Cast iron body, threaded adjustable housing, flanged ferrule with straight thread gasketed plug and round secured satin nickel bronze scoriated top, vandal proof. Wade W-6000-1-179-118, Zurn Z-1400-BP-VP, J.R. Smith 4032-U, MIFAB C1100-R-1-6, or approved equivalent.

C. Cleanout: wall type for concealed riser in finished spaces (WCO):
   Provide cleanout fitting with screwed plug opening and countersunk plug. Provide 8” x 8” square access covers with polished nickel bronze beveled edge frame with anchor lugs for over the wall installation, smooth stainless steel cover, and vandalproof screws. Wade 8480ST-179, Zurn ZANB-1462-8-VP, J.R. Smith 4730-U-NB, MIFAB C1460-S-3-6, or approved equivalent.

D. Cleanout: wall type for concealed riser in unfinished spaces (WCO):
Provide cleanout fitting with screwed plug opening and countersunk plug. Provide round access covers with smooth stainless steel cover, and vandalproof center screw. Wade, Zurn, J.R. Smith, MIFAB, or approved equivalent.

22 40 00 PLUMBING FIXTURES

A. General

1. Furnish and install the following plumbing fixtures where shown on the Plans and as hereinafter specified. Plumbing fixtures and accessories shall have all options, body material, water consumption, and accessories as specified where or not listed as a prefix, suffix, or catalog number. Include all necessary work in the related sections of the Specifications (subsection 22 00 03) and accessories to provide for complete installation and operation of the respective fixture.

2. All plumbing fixtures and non-metal accessories shall be white color, except where shown or specified otherwise.

3. Vitreous china fixtures, where specified, shall be best quality, non-absorbent. Warped or imperfect fixtures shall not be accepted. Enameled cast iron fixtures, where specified, shall be thoroughly fused and bonded to body without discoloration, chips, flaws or cracks. Finish all exposed surfaces.

4. Fixture trim shall be cast brass with polished chrome-plated finish on exposed surfaces, except where shown or specified otherwise.

5. Fixture traps shall be tubular wall type, minimum 17 gauge with integral cleanout plugs, polished chrome plated finish, except where shown or specified otherwise. Size to suit fixture tailpiece. Comply with local plumbing code.

6. All water closets, urinals, and lavatories shall be from the same manufacturer. All faucets, for lavatories, janitor sinks, sinks shall be from the same manufacturer. All supplies and stops for lavatories and sinks shall be from the same manufacturer.

7. Furnish accessories for fixtures requiring trim, carriers, brackets, back-up plates, specialties, etc. for respective complete installation.


9. Provide stops (valves) in all water supplies to all fixtures.

10. Provide escutcheon plates for all wall penetrations for exposed connections to fixtures.

11. Division 22 shall provide templates of openings required for countertop mounted fixtures to the General Contractor.

12. Connections between plumbing fixture outlets and respective waste piping shall be gas and watertight. Use suitable and approved setting compound or gasket; rubber gaskets or putty are not acceptable.

13. Acceptable manufacturers:
   a. Fixtures - American Standard, Kohler, Crane
   b. Carrier - Wade, Zurn, J.R. Smith, Watts
   c. Flush Valve – Sloan, Zurn
   e. Faucets: Chicago, Zurn

22 40 06 WATER CLOSET: FLOOR MOUNTED HANDICAPPED (W-A):

A. Toilet:
Vitreous china elongated bowl, 1.28-1.6 gal/flush, siphon-jet, floor mounted, back outlet, 17” rim height, with 1-1/2” top inlet spud, High Efficiency Toilet (HET). Conforms to ANSI Standard A112.19.2M, ADA, and ANSI 117-1 fixture dimensions. American Standard “Huron” model 3312.001, or equivalent.

B. Seat:
Solid plastic, open front less cover for elongated bowl, integral bumpers and external check hinges with stainless steel bolts. Church #9500C. Bemis #1655C.

C. Flush Valve (Automatic Flush Valve):
Quiet, exposed diaphragm type, closet flushometer, infrared sensor, non-hold-open, integral 24 VAC solenoid operator, 1” IPS screw driver angle stop with protective cap, adjustable tail piece, vacuum breaker flush connection and spud coupling for 1-1/2” top spud, wall and spud flanges. Sloan G2 8111 or Zurn ZER6200.

22 42 03 LAVATORY: WALL-HUNG, AUTOMATIC SENSOR FAUCET (L-A):

A. Lavatory:

B. Faucet:
Infrared sensor operated automatic lavatory faucet, adjustable run-time, adjustable sensor range, serviceable strainer, single 24 VAC solenoid valve, ½ gpm, antimicrobial, laminar flow outlet. All wires shall be metal jacketed. Chicago 116.648.AB.1 or equivalent from Zurn.

C. Strainer:
1-1/4” x 17 gauge cast brass grid strainer, integral spud and tailpiece. McQuire Mfg. catalog no. 155-A. Dearborn Brass catalog no. 760.

D. Supplies:
Loose keyed angle stops with lock shield caps and ½” (nominal) copper solder (5/8” ODS) inlet and 1/2” OD outlet x 12” long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon.

E. Trap:
1-1/2” x 1-1/4” x 17 gauge tubular P-trap with cleanout, plug and wall escutcheon. McQuire Mfg. catalog no. 8902. Dearborn Brass catalog no. 510.

F. Carrier:

22 43 03 SINK: COUNTERTOP WITH SWING SPOUT (S-B):

A. Sink:
Sink bowl to be provided integral to countertop. Refer to architectural plans/specifications.

B. Faucet:
8" centers, 8" swing spout, 4" wrist blade handles, antimicrobial, laminar flow outlet. Chicago Faucet no. 201-AGN8AE29-317AB or equivalent from Zurn.

C. Strainer:
Stainless steel crumb basket with rubber stop for 3-1/2" drain opening and 1-1/2" OD brass tailpiece. Elkay model No. LK-35, Just J-35.

D. Supplies:
Loose keyed angle stops with lock shield caps and ½" (nominal) copper solder (5/8" ODS) inlet x 1/2" OD outlet x 12" long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon.

E. Trap:
1-1/2" x 17 gauge tubular P-trap with cleanout plug and wall escutcheon. McGuire Mfg. catalog no. 8912.

22 43 04 SINK: STAINLESS STEEL, SINGLE COMPARTMENT, COUNTERTOP WITH SWING SPOUT (S-C):

A. Sink:
18 gauge, type 304 stainless steel, self-rim single bowl sink. Sink dimensions: 19" x 19" x 10", Inside bowl dimensions: 16" x 14" x 8". Faucet deck with (3) holes on 4" centers. Elkay model #LR191910.

B. Faucet:
8" centers, 8" swing spout, 4" wrist blade handles, antimicrobial, laminar flow outlet. Chicago Faucet no. 201-AGN8AE29-317AB or equivalent from Zurn.

C. Strainer:
Stainless steel crumb basket with rubber stop for 3-1/2" drain opening and 1-1/2" OD brass tailpiece. Elkay model no. LK-35, Just J-35.

D. Supplies:
Loose keyed angle stops with lock shield caps and ½" (nominal) copper solder (5/8" ODS) inlet x 1/2" OD outlet x 12" long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon.

E. Trap:
1-1/2" x 17 gauge tubular P-trap with cleanout plug and wall escutcheon. McGuire Mfg. catalog no. 8902.

22 43 06 SINK: WALL-HUNG, AUTOMATIC SENSOR FAUCET (S-A):

A. Lavatory:

B. Faucet:
Infrared sensor operated automatic lavatory faucet, adjustable run-time, adjustable sensor range, serviceable strainer, single 24 VAC solenoid valve, ½ gpm, antimicrobial, laminar flow outlet. All wires shall be metal jacketed. Chicago 116.648.AB.1 or equivalent from Zurn.
C. **Strainer:**

1-1/4” x 17 gauge cast brass grid strainer, integral spud and tailpiece. McQuire Mfg. catalog no. 155-A. Dearborn Brass catalog no. 760.

D. **Supplies:**

Loose keyed angle stops with lock shield caps and ½” (nominal) copper solder (5/8” ODS) inlet and 1/2” OD outlet x 12” long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon.

E. **Trap:**

1-1/2” x 1-1/4” x 17 gauge tubular P-trap with cleanout, plug and wall escutcheon. McGuire Mfg. catalog no. 8902. Dearborn Brass catalog no. 510.

F. **Carrier:**


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**22 44 02 CLINICAL SERVICE SINK (CSS-A):**

A. **Sink:**

Vitreous china bowl, blow-out flushing action (6.5gpf), wall mount, back outlet, and 1-1/2” top inlet spud. Conforms to ANSI Standard A112.19.2M fixture dimensions American Standard “Clinic Service Sink”, model 9512999.020 or approved equivalent.

B. **Carrier:**

Adjustable anchor foot type for above the floor no-hub piping connection for wall hung sink (4” connection). Case iron factory-painted adjustable faceplate with corrosion-resistant adjustable waste coupling with neoprene seal and integral test cap. Zinc plated steel fixture studs with vandal-proof chrome-plated fixture cap nuts and fiber fixture washers. JR Smith model 0914, Zurn Z1218-B, or equivalent by Wade.

C. **Flush Valve:**

Quiet, exposed diaphragm type, service sink flushometer, 6.5 gpf, metal oscillating non hold open handle, 1” IPS screwdriver angle stop with protective cap, adjustable tailpiece, vacuum breaker flush connection and spud coupling for 1-1/2” top spud, wall and spud flanges. Sloan Royal model 117 or equivalent by Zurn.

D. **Faucet:**

Service sink faucet designed for wall-mounting, 2-3/8” lever handles, integral vacuum breaker. Provide extensions from wall to mount faucet in front of flush valve piping. Chicago model 814-VBCP.

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**22 80 00 PLUMBING SPECIALTIES**

**A. General**

1. Furnish and install the following plumbing specialties where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the specifications (subsection 22 00 02) and accessories to provide for complete installation and operation of the respective item.
2. Specialties shall comply with the 2011 Reduction of Lead in Drinking Water Act. Components shall be “lead free” equivalent of model number specified regardless if manufacturer’s prefix and suffix have been included.

**22 80 18 THERMOSTATIC MIXING VALVES**

A. Furnish and install thermostatic tempering valves with integral check valves, removable cartridge strainers, stainless steel pistons, and thermal bellows – rough bronze finish.

B. Mixing valves serving tempered water, individual fixtures or small groups of fixtures shall be Symmons Maxline, Leonard 270-LF or approved equivalent.

**22 80 19 WATER HAMMER ARRESTORS**

A. Furnish and install all stainless steel shock absorbers at all solenoid, remote operated or quick closing valves such as restroom devices for each battery of fixtures. Install on both domestic hot and cold water branch lines in an upright position. Install in ADA water closet stall with wall access panel. JR Smith 5005 to 5050 depending on manufacturer’s recommended sizing.

END OF SECTION
23 00 00 HVAC PIPING AND EQUIPMENT

23 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 20 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 20 of these Specifications.

23 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 20.

23 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:

1. Division 20 - Basic Mechanical Conditions and Basic Mechanical Materials and Methods
2. Division 24 – Air Distribution
3. Division 25 - Temperature Controls

23 00 04 DEFINITIONS

(none)

23 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications (Sub-section 23 00 03 to provide for complete systems.

1. Air handling equipment including, but not limited to, terminal units.
2. Draining, filling, and venting of all modified systems as required for the above work. This includes scheduling shutdowns with the Owner (Refer to Section 20 10 70).
3. All seismic restraints for the above work (Refer to Section 20 10 40).
4. Smoke stopping of all penetrations of pipes and ductwork, and firestopping of the same through fire rated partitions as shown on the Architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits (Refer to Section 20 10 20).
5. Cleaning and pressure testing equipment, piping, and accessories installed under this section of the specification. (Refer to Section 20 10 50).
6. Provide sufficient labor and resources required for the testing and balancing (Refer to Section 20 10 80) and for the commissioning process.
7. Installing accessories specified under other sections of the specification referenced in Sub-section 23 00 05, including but not limited to, control valves, thermowells, and taps for pressure sensors.
23 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of the Contractor - Submittals.

1. Piping materials, valves, and accessories as specified in Piping Materials Schedule(s) in this section of the specification.
2. All specialties including, but not limited to, thermometers, gauges, relief valves, pressure regulators, backflow preventers, flow switches, and vacuum breakers.
3. All HVAC equipment specified in this Division 23 including, but not limited to, terminal units.
4. All general items specified under Division 20 utilized in the installation of work required by this section of the specification.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

C. At the point where the mechanical system has been installed and checked by the Contractor and the systems are ready for testing and adjusting, submit a letter to the Architect/Engineer stating such. Refer to Section 20 10 85.

D. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

E. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation (Refer to Section 20 10 50).
SECTION 23 0800 – COMMISSIONING OF MECHANICAL SYSTEMS

PART 1     GENERAL

1.1     DESCRIPTION

A. The purpose of this section is to specify the Contractor’s responsibilities and participation in the commissioning process relative to Division 23.

B. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Commissioning is primarily the responsibility of the Commissioning Authority, with start-up, testing and support for commissioning the responsibility of the Contractors. The commissioning process does not relieve the Contractor from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.

C. Work of Division 23 includes:

1. Testing and start-up of the HVAC equipment.
3. Providing qualified personnel to assist in commissioning tests, including seasonal testing.
4. Completion and endorsement of Pre-functional Construction Checklists provided by the Commissioning Authority to assure that Division 23 equipment and systems are fully operational and ready for functional testing.
5. Providing equipment, materials and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
6. Provide a detailed start up plan for Burns & McDonnell (BMcD)'s review, comment and recommendation.
7. Provide at the end of the job the following items for inclusion in the systems manual.
   a. Control drawings, sequences of control
   b. A table of all set points
   c. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown
   d. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems.
8. Use (BMcD)'s on-line and window based Commissioning application to fill out Construction Checklist and to track issues resolutions. Attendance a one BMcD training class is required for all
contractors. This training will take place at the construction Cx kick off.

9. Providing operation and maintenance information and as-built drawings to the Commissioning Authority for review, verification and organization, prior to distribution.
10. Providing assistance to the Commissioning Authority to develop, edit and document system operation descriptions.
11. Providing training for the systems specified in this Division with coordination of Owner by the Commissioning Authority.

1.2 RELATED WORK

A. All installation, testing and start-up procedures and documentation requirements specified within Division 23.

B. Section 019113 – Commissioning

C. Commissioning Functional Test Procedures that required participation of the Division 23 Contractors.

D. Cooperate with the Commissioning Authority in the following manner:
   1. All testing and start-up procedures and documentation requirements specified within Division 1 and Division 23 and related portions of this project.
   2. Allow sufficient time before final completion dates so mechanical systems start-up, test and balance and commissioning can be accomplished.
   3. Provide labor and material to make corrections when required without undue delay.
   4. Put all heating, ventilation and air conditioning systems and equipment into full operation and continue the operation of the same during each working day of the testing, balancing and commissioning.
   5. Include the costs of the dampers, replacement sheaves and belts, as required, to obtain satisfactory system performance as requested by the test and balance contractor or the Commissioning Authority.
   6. Provide test holes in ducts and plenums where directed or necessary for pitot tubes for taking air measurements and to balance the air systems. Test holes shall be provided with an approved removable plug or seal. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.
   7. Provide pressure/temperature taps where directed or necessary for taking measurements to test and balance hydronic systems.
PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Standard test equipment for commissioning will be provided by the Contractor.

B. Division 23 Contractor shall provide standard and specialized test equipment as necessary to test and start up the HVAC systems.

C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test equipment, demonstrate its use and assist the Commissioning Authority in the commissioning process.

D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/facility management system. This equipment and software shall be provided for use by both the test and balance contractor and the Commissioning Authority.

PART 3 EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Complete all phases of work so the systems can be energized, started, tested and otherwise commissioned. Division 23 has primary start-up responsibilities with obligations to complete systems, including all sub-systems, so they are functional. This includes the complete installation of all equipment materials, raceways, wire, terminations, controls, etc., per the Contract Documents and related directives, clarifications, change orders, etc.

B. A Commissioning Plan will be developed by the Commissioning Authority. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect and the Contractor may be obligated to compensate the Commissioning Authority to test the revised product or confirm the suitability/unsuitability of the substitution or revision.

C. Specific pre-commissioning responsibilities of Division 23 are as follows:
SECTION 23 0800 – COMMISSIONING OF MECHANICAL SYSTEMS

1. Normal start-up services required bringing each system into a fully operational state. This includes motor rotational check cleaning, lug tightening, control sequences of operation, etc. The Commissioning Authority will not begin the commissioning process until each system is complete, including normal contractor start-up and debugging.

2. The Contractor shall perform pre-functional construction checklists on the systems to be commissioned to verify that all aspects of the work are complete in compliance with the plans and Specifications. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Authority.

3. Factory start-up services will be provided for key equipment and systems specified in Division 23. Factory start-up activities to be documented and submitted. The Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

4. Notify Construction Manager and Commissioning Authority when systems are ready for functional testing.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING

A. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Provide skilled technicians to start up and debug all systems within this division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and/or reconstruction of systems and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
SECTION 23 0800 – COMMISSIONING OF MECHANICAL SYSTEMS

C. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purpose of this work.

D. The test, adjust and balance subcontractor shall provide a draft report with final test measurements to the Commissioning Authority and shall provide qualified technicians and instruments needed for balancing to demonstrate a sample of up to 100% of measurements until specified results are achieved.

3.3 WORK TO RESOLVE DEFICIENCIES

A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed under direction of the Architect, with input from the Contractor, equipment supplier and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance.

3.4 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers and Commissioning Authority shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

B. The cost of compensation of the Commissioning Authority for repeat testing or troubleshooting due to systems that do not meet specified performance shall be borne by the Contractor.

C. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely to the commissioning process, the Commissioning Authority will notify the Architect/Engineer of Record indicating the nature of the problem, expected steps to be taken and the deadline for completion of activities. If the deadline passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and equipment to
resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor’s responsibility.

3.5 SYSTEMS TO BE COMMISSIONED

A. Refer to specification section 019113:

3.6 TRAINING

A. This Contractor will be required to participate in the training of the Owner’s engineering and maintenance staff for each system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner’s option.

3.7 SYSTEMS DOCUMENTATION

A. Maintain as-built red-lines on the job site as required in Division 1. Given the size and complexity of this project, red-lining of the drawings at completion of construction based on memory of key personnel is not satisfactory. Continuous and regular red-lining and/or posting of drawings is considered essential and mandatory.

B. In addition to the stated requirements for operation and maintenance data, provide one (1) copy of equipment technical literature, operation and maintenance literature and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner’s final use.

C. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown

D. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems.

E.

3.8 SOFTWARE

A. The Controls Contractor shall supply the Commissioning Authority with an unprotected electronic controls submittal with all flow diagrams, sequence of operation, bill of materials and point database in Microsoft Visio or AutoCAD format in time for use in preparing the functional test procedures and integrated one-line diagrams.
SECTION 23 0800 – COMMISSIONING OF MECHANICAL SYSTEMS

B. The Controls Contractor shall supply the Commissioning Authority with two (2) debugged printouts of all facility management systems software, including all user’s programming and engineering manuals required to interpret the software. Included in the printouts, though not limited to, shall be the following:

1. Point data base
2. All custom control programs written in the BAS control language
3. All parameters required for proper operation of BAS control and utility firmware such as start/stop routines, etc.
4. System graphics

C. The software printout shall be fully documented for ease of interpretation by the Commissioning Authority and Owner without assistance from the Contractor. English language descriptions shall be either integrated with or attached to the BAS printout. The following shall be specifically documented:

1. All point names, I/O and virtual.
2. All BAS programming language commands, functions, syntax, operators and reserved variables.
3. Use of all BAS firmware.
4. The intended actions, decisions and calculations of each line or logical group of lines in the custom control program(s). Sequences of operation alone are not sufficient.
5. Complete descriptions of and theories explaining all software and firmware algorithms. The algorithms to be described include, but are not limited to, PID, optimum start/stop, demand limiting and chiller and boiler optimization.
6. A table of contents to the documentation that locates the sections of the documentation and describes which programs or program sections are for each piece of controlled/monitored equipment.
7. Flow charts using IEEE symbol nomenclature that demonstrates the software’s algorithms and flow logic.

END OF SECTION
23 10 00 HYDRONIC PIPING

A. Itemization of the piping materials for specific system application are enumerated in the following sub-sections for the respective PIPING MATERIAL SCHEDULE. Specific requirements for materials shall be as listed in Division 20 Basic Materials and Methods.

B. Manufacturer’s mill reports and applicable documents to certify the validity of the procured piping materials shall be on file at the Contractor’s office.

C. Install all piping with pitch to vent or drain. Provide drain valves at low points and air vents at high points. Drain valves and air vents shall be ¾’ bronze 2 piece body ball valves with ¾” hose end adapter, cap and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain. Use eccentric reducing fittings (installed top level) as required to avoid air pockets.

D. Gaskets and packings containing asbestos are not acceptable.

E. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing for: sizes, direction of flow (via pressure or physical tracing of piping, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

23 10 01 PIPING MATERIAL SCHEDULE, M-1

A. Service: Hot water (heating) supply and return for HVAC.

B. Rating: 125 psig at 350°F

C. Pipe: (Refer to Section 20 10 11)
   1. 3” and smaller Copper, type L.
   2. 10” and smaller Black carbon steel, schedule 40, ASTM-A53, ERW.
   3. Contractor has the option on piping 3” and smaller to use either copper or black carbon steel. Fittings shall be as scheduled below for the piping material chosen.

D. Fittings: (Refer to Division 20 10 10)
   1. 3” and smaller Wrought copper, solder ends.
   2. 2-1/2” and smaller Cast iron, screwed.
   3. 3” and larger Black carbon steel, buttweld. Elbow fittings shall be long radius. See Division 20 10 00 for acceptable branch arrangement in lieu of tee fitting. Wall thickness consistent with connecting pipe.

E. Joints in Steel Piping: (Refer to Division 20 10 30)
   1. 2-1/2” and smaller Screwed
2. 3” and larger  Welded, except at connections to rotating equipment where (2) Style 77 couplings shall be used at each inlet and outlet connection.

3. All sizes where concealed in chases or walls, or above gyp/plaster ceilings  Welded

F. Joints in Copper Piping (Refer to Division 20 10 30):

1. All 95/5 solder

G. Valves: (Refer to Division 20 10 10)

1. Shut-off/service:
   1.1 3” and smaller  Ball valve: two piece, bronze body, stainless steel ball and trim.
   1.2 3” and larger  Butterfly valve, cast iron body.

2. Balancing/Throttling:
   2.1 12” and smaller  “Circuit Setter”

3. Check valve – General Duty:
   3.1 All Class 125, swing check.

4. Unions:
   4.1 3” and smaller  Wrought copper, solder ends.

5. Flanges:
   5.1 4” and smaller  Cast copper companion type, solder end, class 125 ASME standard or class 150.
   5.2 2-1/2” and larger  150 lb., Black forged carbon steel, weld neck pattern.

7. Pressure Test: Hydrostatic test at 200 psi for two (2) hours minimum.

23 23 00 MISCELLANEOUS PIPING

A. Itemization of the piping materials for specific system application are enumerated in the following sub-sections for the respective PIPING MATERIAL SCHEDULE. Specific requirements for materials shall be as listed in Division 20 10 00 Basic Materials and Methods.
B. Manufacturer's mill reports and applicable documents to certify the validity of the procured piping materials shall be on file at the Contractor's office.

C. Gaskets and packings containing asbestos are not acceptable.

23 23 07 PIPING MATERIAL SCHEDULE M-2

A. Service: Medical Gas, above ground

B. Design: Pressure: 200 psig
Maximum temperature: 150°F

C. Pipe: Oxygen service, Type L Copper Pipe

D. Fittings: Wrought copper, brazed

23 23 08 PIPING MATERIAL SCHEDULE M-3

A. Service: Medical Vacuum, above ground

B. Design: Pressure: 150 psig
Temperature: 150°F

C. Pipe: Type L Copper Pipe

D. Fittings: Wrought copper, long radius 90° elbows, ‘Y’ type tees provided with cap for unconnected straight run.

23 23 09 MEDICAL GAS AND MEDICAL VACUUM TESTING

A. Medical gas and medical vacuum testing shall be performed per NFPA 99, System Verification. The technical aspects associated with this contract will be furnished by the Owner. This contractor shall provide labor for the adjustment of valves, and shall provide nitrogen for testing. The Contractor shall notify the Owner in writing when all medical gas and medical vacuum systems are prepared for testing. Prior to Owner furnished testing, the Contractor shall perform Installer Performance Testing per NFPA 99. Installer performance testing includes the following:

B. Blowdown: Prior to installing system outlets, pressure switches, etc., the contractor shall blowdown piping with dry nitrogen.

C. Initial Pressure Test: Prior to installing pressure switches and system outlets, Contractor shall pressure test piping at 150 psig for oxygen, nitrous oxide and medical vacuum. Joints shall be tested with soapy water. Piping shall be tested until all leaks are repaired.

D. Cross Connection Test: Contractor shall test all piping to verify that no cross connection between services exists. Each service shall be pressurized with nitrogen individually, and all services shall be tested to verify no cross connections exist. Pipe labeling shall also be verified.

E. Piping Purge Test: At each station outlet, the Contractor shall purge the line until the purge produces no discoloration in a white cloth. Nitrogen shall be used for purging.
F. Standing Pressure Test: After initial pressure test is performed, and all outlets and accessories are installed, the Contractor shall pressure test all services for 24 hours. Medical vacuum, oxygen, and nitrous oxide shall be tested at 60 psig. The only allowable pressure change during a 24-hour test shall be due to ambient temperature variation. If leaks occur, the leads shall be repaired, and the pipe retested.

23 23 10 MEDICAL GAS AND MEDICAL VACUUM VALVES AND SPECIALTIES

A. Medical Gas and Medical Vacuum Valves:

B. Shut-off/service: Medical gas ball valve per 20 10 13. Valves in concealed spaces shall be provided with pad-lockable handles.

C. Medical Gas and Medical Vacuum Pressure Gauge: Provide and install pressure gauge as indicated on plans. Pressure gauge shall comply with ANSI/ASME B-40.1 gauges< pressure indicating dial type, elastic elements, and 1-1/2” diameter face. Additional requirements are as follows:

D. Oxygen, clinical air and nitrous oxide: Gauge shall have 0-100 psig pressure range, ±1 psig accuracy and shall be cleaned for oxygen service. Allied Healthcare Products #77-90-0571 or approved equal.

E. Medical Vacuum: Gauges shall have a 0-30 inch mercury vacuum range, ±1/3 inch mercury accuracy.

F. Medical Valve Box (MVB): Valve box shall be constructed of 18 gauge sheet steel with anodized aluminum cover frame. The frame assembly shall be capable of adjusting for variances in wall thickness. Box shall be provided with cover window and pull ring, color coded gas service labels, pressure gauges for each service per 23 23 04-B., valves per 23 23 04-A., valves shall be mounted so handles in closed position do not allow reinstallation of cover. Allied Healthcare Products Multiple Zone Valve Box or approved equal. Medical valve boxes shall be provided with a label stating what zone is fed by the valve box. Submit labels for approval.

G. Medical Gas Outlets:

Boom outlets to be DISS compatible, manufactured by Ohmeda, Amico or approved equivalent.

H. Medical Alarm Panel: Panel shall be a UL 1069 device with four (4) module spaces per panel. Power shall be double fused 110-250 VAC 50/60 hertz with a built-in transformer to convert to 24 VAC. Panel shall be Beacon Medaes Model MEGA2 “6-M2-L-OAVB” OR Chemetron Impact Model 74-15-XXX. Provide pressure transducers with quick disconnect.

23 82 00 TERMINAL UNITS

23 82 04 VARIABLE VOLUME UNIT WITH HOT WATER HEAT

A. Unit casing shall be welded, galvanized steel. Leak rate shall be not more than 1% of rated capacity at 4” wg. Interior surface of unit casing shall be acoustically and thermally lined with 1/2 inch thick, minimum of 1.5 lb./cu. ft. density glass fiber with foil face. Insulation shall be UL listed and meets NFPA-90A and UL 181. Factory mounted, removable panel on bottom of unit providing access to air valve and entering airside of coil. Straight flange or slip and drive rectangular discharge duct connection.
B. Factory mounted one or two row coil with maximum of 12 fins per inch. Full fin collars for accurate fin spacing and maximum tube-fin contact, 5/8 inch O.D. seamless copper tubes mechanically expanded into the fin collars, leak tested at 300 psig.

C. Air valve shall be a 90° rotational damper flow control device with direct digital controls (DDC). Manufacturer shall provide multiple point averaging flow sensing ring with high and low pressure pneumatic tubes compatible with DDC velocity pressure sensor. A calibration chart shall be provided on each unit.

D. Unit controllers will be provided and installed by the Owner.

E. Units shall be as manufactured by Titus, Trane, or Price.

23 82 08 TERMINAL UNIT COIL HOOK UP

A. Contractor to provide valves and specialties specified herein and in section 20 10 13 Valves (not valves from a HVAC hose kit manufacturer). Two service valves and a pressure independent balance valve are required.

B. One of the following piping and specialty configurations is acceptable (piping components installed in the order listed):

1. Supply service valve, balance valve, tee with integral drain, hard pipe or hose to coil, hard pipe or hose from the coil, tee with integral vent, control valve, service valve.

2. Supply service valve with integral drain (on coil side), balance valve, hard pipe or hose to coil, hard pipe or hose from the coil, control valve, service valve with integral vent (on coil side).

C. When hoses are used at the contractors option they shall meet the following:

1. Internal diameter of the hose shall be not less than 90% of the ID of copper pipe, for the pipe size on the drawings feeding the unit. Hose inner liner shall be EDPM rubber and shall be covered with stainless steel braid. Pressure rating shall not be less than 200 psig.

2. Hoses shall have one fixed end male NPT connection and one swivel end. The swivel shall be a gasket-less JIC 37°F flared female connection, with companion flare x NPT fitting. Connections shall be stainless steel or brass. Hose kits shall be 24” long. Hoses using gaskets or o-rings are not acceptable. Hoses shall be Twin City Hose, ACE Hose, Hosecraft USA, Chamflex, or approved equivalent meeting the above specifications.

D. Specialty Valves incorporating auxiliary ports for p/t, drain, vent, etc. may be utilized provided the arrangement meets the flow diagram and the products do not contain unions, gaskets, or o-rings. Valves shall be dezincification resistant brass and shall be rated for 200psig minimum at 200°F.

1. Service valve with integral drain /vent – Webstone Ball Drain, Cimberio Valve model 630B less strainer basket, or approved equivalent.

2. Service valve with NPT tapping, plus separate drain cocks – Apollo 7B-100, Cimberio 200MC, or approved equivalent.

3. Tee with integral drain /vent – Webstone T-drain, or approved equivalent.

END OF SECTION
24 00 00 AIR DISTRIBUTION

24 00 01 GENERAL

1. This Section specifies air distribution systems.
2. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.
3. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

24 00 02 REFERENCES, REGULATORY REQUIREMENTS:

A. Work for this section of the specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:
   4. ASTM A525-91b, “Spec for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process”.
   5. ASTM A527/A527M-90, “Spec for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality”.
   9. UL 555, “Fire Dampers and Ceiling Dampers.”
   10. UL 181, “Factory Made Air Ducts and Connectors.”

24 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:
   A. Division 20 - Basic Mechanical Conditions and Basic Mechanical Materials & Methods
   B. Division 23 – HVAC Piping and Equipment
   C. Division 25 - Temperature Control

24 00 04 DEFINITIONS

A. The size of the ducts shown on the drawings and in this Section of the Specifications shall be the outside dimension of the ductwork which will take into account any internal acoustical lining thickness specified for duct system or sub-system.
B. The term “supply air” where used in this Section of the Specifications shall mean downstream of a coil.
C. The term “outdoor air” where used in this Section of the Specifications shall mean ambient air that has not been conditioned.
D. The term “return air” where used in this Section of the Specifications shall mean conditioned air that is returned from the space.

E. The term “mixed air” where used in this Section of the Specifications shall mean air streams that are a mixture of “outdoor air” and “return air”.

F. The term “relief air” where used in this Section of the Specifications shall mean excess return air that relieved from the building.

G. The term “exhaust air” where used in this Section of the Specifications shall mean air that is removed due to contaminates, odors, or heat.

24 00 05 WORK INCLUDED

Furnish material, labor and services necessary for and incidental to the installation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the Specifications (Sub-section 20 30 03) to perform the Work completely.

A. Sheet metal ducts, sheet metal plenums, duct linings, flexible ductwork, dampers and accessories.

B. Air devices including adjusting the pattern controllers.

C. Louvers, louvered penthouses.

D. Installing accessories specified in referenced sections above.

E. Smoke stopping of all penetrations of ductwork, and firestopping of the same through fire rated partitions as shown on the Architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits (Refer to Section 20 10 20).

F. Contractor shall coordinate his work with the work of other trades, and with the architectural and structural drawings.

24 00 06 SUBMITTALS

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation (Refer to Section 20 10 50).

C. Submittals shall include drawings showing joining methods, location of duct transverse joints, and duct support locations.

D. Submittals shall be required for all shop fabricated balancing dampers.

E. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

24 00 07 SPECIAL REQUIREMENTS

A. Contractor shall inspect each component of the heating and air conditioning system to eliminate rattles, air whistles, vibration, and mechanical system sound transmission. Rough edges in ducts, insecure dampers, turning vanes, fire dampers, etc., shall be corrected to
assure no recurrence of the noise source. Each vibration isolator and flexible connector shall be adjusted to limit transmission of sound to the occupied space.

B. Where Ductwork and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing for: sizes, direction of flow (via pressure or physical tracing of ductwork, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

24 00 08 AIR DISTRIBUTION CLEANLINESS

A. Contractor shall implement procedures to maintain an “Advanced Level” of ductwork cleanliness per the latest addition of the SMACNA Duct Cleanliness for New Construction Guidelines.

1. Production and Site Delivery:
   a. Self-adhesive labels for part of identification are to be applied to the external surfaces only.
   b. During transportation, ductwork and air distribution components shall be sealed either by blanketing or capping the duct ends, bagging small fittings, surface wrapping or shrink wrapping.

2. Site Storage:
   a. Temporary storage shall be located away from high dust generating processes such as masonry, tile cutters, saws, drywall sanding, mortar and plaster mixers, roof pitch kettles, portable electric generators, and main walkways that will be constantly broom swept.
   b. Temporary storage shall include pallets or blocking to keep ductwork and air distribution components above floor surface to prevent water damage.
   c. Coverage should be used to protect stored materials at all times.
   d. Duct open ends and air side of air distribution components shall be securely sealed at all times.
   e. Seals shall be visually examined and if damaged, resealed with an appropriate material.

3. Installation:
   a. Before installation of individual duct sections and air distribution components, they are to be inspected to ensure that they are free from debris and shall be wiped clean if debris exists.
   b. The working area shall be clean, dry, and the airside of ductwork and air distribution components protected from dust and moisture.
   c. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.
   d. Open ends on completed ductwork shall be sealed immediately if left for an extended period of time (work breaks, overnight, etc.).

24 31 00 SHEETMETAL DUCTWORK

24 31 01 MATERIAL

A. All ducts unless specified otherwise shall be constructed from sheets or rolls of G-90 or better-galvanized steel, LFQ, Chemtreat. Fiberglass ductboard is prohibited.
B. All supply ductwork, unless specified otherwise, shall be constructed of gauges and reinforcement to 4” w.g. static pressure in SMACNA Duct Construction Standard – Latest Edition.

C. All return, exhaust, outdoor air, relief, and supply ductwork downstream of terminal units shall be constructed of gauges and reinforcement to 2” w.g. static pressure in SMACNA Duct Construction Standard – Latest Edition. Panels in all ducts 12” and larger shall be cross-broken or beaded on 12” centers.

D. Where local code requires gauges heavier than required by SMACNA then the local code shall govern.

24 31 02 CONSTRUCTION

A. All ductwork shall be neatly constructed, stiffened, on the outside surfaces where necessary to prevent perceptible vibration or buckling. All ducts, housings, etc., shall be fabricated as detailed on the drawings and in the SMACNA Duct Construction Manual –Latest Edition.

B. All rectangular ducts unless specified otherwise shall be “Pittsburgh Lock” longitudinal joints. Snaplock is not acceptable.

C. All round ducts and flat oval ducts shall have spiral seams or continuously welded longitudinal seams.

D. All transverse joints in rectangular ductwork 24” and larger shall be Ductmate, SMACNA T-25, or approved equivalent. All flanged ductwork, regardless of pressure class, shall use gaskets, corner closures, and be TEK screwed or riveted on 10” centers with a minimum of two (2) per side. Transverse joints in rectangular ductwork smaller than 24” shall be made in accordance with SMACNA suitable with the pressure class.

E. All transverse joints in round and oval ductwork 24” and larger shall be Ductmate, or approved equivalent. Transverse joints in round and overall ductwork smaller than 24” shall be beaded sleeve joints.

F. Ducts shall be securely supported in accordance with SMACNA Duct Construction Manual – Latest Edition and in no case less than double thickness 1” x #24 gauge galvanized metal. Cable hangers are not allowed.

G. Ducts that are to be externally insulated shall not be supported on unistrut channel unless it required based upon loading. Hanger rods for trapeze bars shall be spaced to allow for insulation installation.

24 31 03 SEALING

A. Duct sealant shall be flexible, water-based, adhesive sealant designed for use in 4” static pressure systems. Sealer shall be UL listed and conform to ASTM E84. Sealer shall be equal to Ductmate PROseal, United McGill Uni-Mastic, Duro-Dyne DSW, or equivalent.

B. All supply ductwork unless specified otherwise shall be SMACNA’s seal class A.

C. All return, exhaust, outdoor air, relief and supply ductwork downstream of terminal units shall be SMACNA’s seal class B.

24 31 04 DUCTWORK LEAKAGE TESTING

A. New installed ductwork shall be tested prior to installation of access door, take-offs, or other specialties.
B. New portions of supply main ducts shall be tested in whole or up to 100’ in length, whichever is lesser.

C. New portions of return main ducts shall be tested in whole or up to 50’ in length, whichever is lesser.

D. Ductwork shall be tested as follows:
   1. Ductwork shall be tested in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
   2. Use a certified orifice tube for measuring the leakage.
   3. Define section of system to be tested and blank off.
   4. Determine the design airflow for the portion of the duct to be tested.
   5. Determine the allowable leakage (cfm) for the section being tested.
   6. Pressurize to operating pressure and repair any significant or audible leaks.
   7. Repressurize and measure leakage.
   8. Repeat steps 6. and 7. until the leakage measured is less than the allowable defined in step 5.

E. The following Leak Class and Duct Pressure Class shall be used to determine the Leakage Factor in cfm/100 S.F. Duct. Ducts shall be tested at the design pressure class. Max. leakage = Leak Class × (design pressure)\(^{0.65}\)

   1. Rectangular Duct Pressure Class
      Leak Class
      All
      6
      (i.e. 4” duct systems shall be tested at 4” and the leakage shall not exceed 14.8 cfm/100 S.F. duct and 2” duct systems shall be tested at 2” and the leakage shall not exceed 9.4 cfm/100 S.F. duct).

   2. Round Duct Pressure Class
      Leak Class
      All
      3
      (i.e. 4” duct systems shall be tested at 4” and the leakage shall not exceed 7.4 cfm/100 S.F. duct and 2” duct systems shall be tested at 2” and the leakage shall not exceed 4.7

24 31 06 FITTINGS

A. Rectangular duct branch take-offs, or rectangular to round, shall be 45°-boot fittings, spin in fittings are not acceptable.

B. Rectangular duct proportional splits shall be made the sizes as shown on the drawings. Where duct sizes are changed from the original design, Contractor shall proportion split equal to the split in airflow.

B. Rectangular duct changes in direction:
   1. 90 degree elbows, refer to plans, shall be mitered with turning vanes; or radiused with centerline radius to width ratio of 0.75 (inside radius/width ratio 0.25 with curve ratio 0.585) with 2 splitter vanes.
   2. 45 degree and less elbows shall be mitered without vanes.
   3. Elbows other than above shall be radiused with centerline radius to width ratio of 1 without splitter vanes.

C. Round or Oval elbows and changes in direction shall have a minimum centerline radius of 1-1/2 that of duct size. Round or oval branch take-off shall be 45 degree booted style similar to McGill Airflow Lo-Loss Tee.
D. When approved by the Engineer ducts may be notched at structural steel. The converging angle shall be no greater than 30°, the diverging angle shall be no greater than 15°.

E. When approved by the Engineer objects may penetrate a duct. An airfoil shape shall be placed around the object to minimize turbulence.

24 31 07 PLENUMS

A. Sheetmetal plenums shall be constructed of a minimum of 18 ga. or greater as determined by the pressure class of the plenum. Sheetmetal and shall be braced and reinforced to support the weight of a 200-lb. person. Tie rods shall not be used.

B. Plenums shall be constructed without air turning vanes.

C. Plenums shall have access doors as sized on drawings, where no size is shown provide a minimum size of 18” x 36”.

24 31 08 AIR THERMOMETERS

A. Air thermometers shall be provided as shown on the plans.

B. Airstream thermometers shall be bimetal type, with an accuracy of ±1°F throughout the range with 5” dial size, 12” stem length, ½” N.P.T. back side connector with plain slip ring case of 304 stainless steel, and recalibrator. Thermometer shall be Trerice Model No. B85212 or approved equal as manufactured by Weksler, Marsh, or Marshalltown Instruments. Thermometers for use in the mixed air shall have flexible averaging elements strung with the mixed air temperature sensor and freezezstat sensor elements. Mixed air thermometers shall be Trerice No. V80445 with bulb number 4-3-1.

C. Range shall be as follows:

- Outdoor air: -40-160°F
- Mixed air: 0-100°F
- Supply air: 25-125°F
- Return air: 25-125°F
- Preheat coil discharge: 25-125°F
- Reheat coil discharge: 25-125°F
- Chilled water coil discharge: 25-125°F

24 33 00 AIR DISTRIBUTION ACCESSORIES

24 33 01 BALANCING DAMPER

A. Furnish and install volume dampers at each main branch take-off and in such other locations where required to properly balance the air distribution systems.

B. All dampers, except those located downstream from terminal units used to adjust individual grilles, shall have frames and bearings and shall have quadrant lock regulators with thread screw to allow damper to be securely locked into place.

C. Balancing dampers downstream from terminal units that are contractor fabricated or apart of manufactured branch fitting shall be a minimum of 18-ga. plate, 3/8” continuous shaft with locking quadrant handle equal to Duro Dyne model Quadline.

D. Rectangular dampers up to size 24” x 12” shall be Ruskin MD25, Nailor 1870, Arrow, Air Balance, NCA, or shop fabricated equal, approved by the Engineer.
E. Round dampers up to size 20” diameter shall be Ruskin MDRS25, Nailor 1890, Arrow, Air Balance, NCA or shop fabricated equal, approved by the Engineer.

F. Rectangular dampers larger than 24” x 12” shall be Ruskin MD35, Nailor 1820 or equivalent manufactured damper by NCA.

G. Where volume dampers are to be adjusted through walls or ceilings, such dampers shall be operated by regulators designed for recessed installation and provided with a cover plate which shall be flush to the surface of the wall or ceiling. Concealed regulators, as manufactured by Duro Dyne Corporation or Elgen shall be of the indicator type. Regulator shall be provided with a spring washer for non-binding adjustment and hex lock nut in addition to wedge pin which shall be installed to prevent damper rattle. Cast alloy regulator housing, with “open to shut” range positioning markers, shall be secured with removable cover to expose regulator for adjustments.

H. All automatic dampers and control dampers shall be as specified in Division 25, “Temperature Control”. Dampers shall be furnished under Division 25 for installation under Division 23 30 00.

I. Control Damper Installation
   1. Dampers installed in walls shall be installed with wall sleeves to allow direct coupled actuator installation.
   2. Large damper installations with multiple actuators shall be installed with 8” sheetmetal blank-off/spacers between them to allow direct coupled actuator installation. Provide structural supports as required for a straight, true, level and square installation.
   3. Dampers shall be attached with fasteners on 6” centers with a minimum of 2 per side.

24 33 02 FIRE DAMPERS

A. Fire dampers shall be provided as indicated on the plans. Dampers shall be U.L. 555 listed under N.F.P.A. Pamphlet #90-A. Dampers for rectangular ductwork shall be Style B, round or oval ductwork shall be Style C. In both cases the curtain shall be located outside of the airstream. Factory wall sleeves are not permitted. Closure springs shall be furnished for both horizontal and vertical installations.

B. Dampers rated for installation in up to 2-hour fire resistive construction shall be Ruskin Type IBD2, Nailor model 0120/0130, Air Balance model 119, Greenheck model FD-150, or approved equivalent. Fire dampers rated for installation in greater than 2-hour fire resistant construction shall be Ruskin Type IBD23, Nailor model 520/530, Air Balance model 319, Greenheck model FD-350, or approved equivalent.

C. Dampers are to be witness tested by the Owner. The Contractor shall remove the fusible link and demonstrate that the damper closes freely. After acceptance by the Owner, the Contractor shall reset the damper and replace the fusible link.

24 33 03 FIRE-SMOKE DAMPERS

A. Fire-smoke dampers shall be provided as indicated on the plans.

B. Combination fire-smoke dampers with steel airfoil blades meeting requirements of the latest edition of UL Standard 555 and UL Standard 555S. Each combination fire-smoke damper shall be equipped with a factory installed electrically-resettable heat responsive device rated to close the damper when the temperature at the damper reaches 165°F. Dampers shall have a UL555S leakage rating of Leakage Class I for airflow in either direction and shall have a minimum UL 555S differential pressure rating of 4 in. wg. Dampers shall have a minimum UL 555S velocity rating of 2000 fpm.
C. Damper frame shall be 16 ga. galvanized steel formed into a 5” structural hat channel. Top and bottom frame members on dampers less than 17” high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 1/2” (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.

D. Damper blades shall be 16 ga. galvanized steel with full length structural reinforcement and a double skin true airfoil shape. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Blade seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb seals shall be flexible stainless steel compression type. Linkage shall be concealed in the jamb. Axle bearings shall be permanently lubricated stainless steel or sintered bronze sleeve type rotating in polished extruded holes in the damper frame.

E. Dampers sized as scheduled. If not scheduled, dampers shall be the full size of the duct they are associated with unless noted otherwise.

F. Actuators shall be listed with the damper assembly and be electrically operated, 120 VAC, power supply. Actuators shall be 2-position and shall fail in a closed direction.

G. Damper options

1. Damper assembly shall come with a factory-mounted permanent momentary test switch to operate the damper for inspection.

H. Dampers shall have a UL 555 fire resistance rating of 1½ hours shall be Ruskin FSD60, Greenheck FSD-311 or approved equivalent.

I. Dampers are to be witness tested by the Owner.

24 33 04 SMOKE DAMPERS

A. Smoke dampers shall be provided as indicated on the plans.

B. Smoke dampers with steel airfoil blades meeting requirements of UL Standard 555S, latest edition. Dampers shall have a UL555S leakage rating of Leakage Class I for airflow in either direction and shall have a minimum UL 555S differential pressure rating of 4 in. wg. Dampers shall have a minimum UL 555S velocity rating of 2000 fpm.

C. Damper frame shall be 16 ga. galvanized steel formed into a 5” structural hat channel. Top and bottom frame members on dampers less than 17” high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 1/2” (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.

D. Damper blades shall be 16 ga. galvanized steel with full length structural reinforcement and a double skin airfoil shape. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Blade seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb seals shall be flexible stainless steel compression type. Linkage shall be concealed in the jamb. Axle bearings shall be permanently lubricated stainless steel or sintered bronze sleeve type rotating in polished extruded holes in the damper frame.

E. Dampers sized as scheduled. If not scheduled, dampers shall be the full size of the duct they are associated with unless noted otherwise.
F. Actuators shall be listed with the damper assembly and be electrically operated, 120 VAC, power supply. Actuators shall be 2-position and shall fail in a closed direction.

G. Damper options
   1. Damper assembly shall come with a factory-mounted momentary permanent test switch to operate the damper for inspection.

H. Dampers shall be Ruskin SD60, Greenheck SMD-301, or approved equivalent.

I. Dampers are to be tested by the Contractor and witnessed by the Owner.

24 33 05   AIR TURNING VANES

A. Furnish and install directional air turning vanes in ductwork at all 90 degree mitered elbows and 90 degree radiused elbows.

B. Mitered 90 degree elbows vanes shall be:
   1. Single rolled type with a radius of 2" with 1.5" spacing.
   2. Single rolled type with a radius of 4-1/2" with 3.25" spacing.
   3. Double thickness type with a radius of 4-1/2" with 3.25" spacing. Double thickness 2" radius is not allowed.
   4. Tie rods shall be used to limit the maximum unsupported width per the type of vane used per SMACNA.
   5. Vanes shall be solidly installed and rattle-free locked into each slot of preformed vane guide rails as manufactured by Duro Dyne Corporation or Elgen. Rails shall be constructed of 24 gauge galvanized steel, specially embossed for extra strength and sturdiness.

C. Radiused 90 degree elbows shall have 2 vanes. Vanes shall be single thickness, Splitter Vanes for radius elbows shall be fabricated based on the "SMACNA HVAC Systems Duct Design Manual" using the appropriate curve ratio.

24 33 06   FLEXIBLE CONNECTORS

A. Furnish and install flexible connections at the connections to air handling equipment as indicated on the plans. Flexible connections shall be U.L. listed fabric that meets NFPA 90A. It shall weigh not less than 24 oz per sq. yd and have a tensile strength of not less than 500 psi. Flexible connections shall be preassembled “Super Metal-Fab” with 6” fabric attached to 3” metal on either side by means of “Grip-Loc” seam. At least one inch of slack shall be allowed when making connection to insure that no vibration is transmitted from fan to ductwork. The flexible connectors shall be fastened to ductwork and equipment by screws, rivets or spot welding. Flexible connectors shall be No. MF6N as manufactured by Duro Dyne Corporation, or equivalent by Vent-Fabrics or Elgen.

24 33 07   ACCESS DOORS AND PANELS

A. Access panels shall be provided at all duct mounted automatic control dampers, fire dampers, smoke dampers and as shown on drawings.
   1. 2” Pressure Class: Door shall be SMACNA Standard, 18” x 18”, double skin, 1” fiberglass insulation, with underside duct to frame gasket for reduced leakage.

   Solid without window Ruskin ADH22, Nailor 08SH, Greenheck HAD-10, Ductmate FDH, or equivalent.
2. 4” and Higher Pressure Class: Oval shape, ultra low leakage at 8” w.c. Solid without window Nailor 0800, Greenheck RAD, Ductmate Sandwich, or equivalent.

B. Access doors in casings and housings shall be fabricated double skin doors with 1” thick insulation between inner and outer surface as detailed in the SMACNA Duct Manual. Provide two compression latches equal to Ventlok #260 on each door. Where access doors provide for personnel entry into the system, they must be provided with inside/outside latch hardware. Provide access doors at all locations indicated on the drawings and into the mixing chamber of all air handling units. Size shall be 18 x 36, unless indicated otherwise on the drawings. Ruskin GPAD or equivalent.

C. For access panels required in ceiling, walls, etc. of the building construction, see Section 20 10 10.

24 33 08 FLEXIBLE DUCTWORK

A. Flexible duct shall be factory-fabricated units constructed of galvanized steel formed and mechanically locked to fabric covering. The units shall have an inside bending radius of 3/4 of the inside dimension of the pipe, and the entire installed unit, using manufacturer's apparatus and installation methods shall be flexible duct assemblies shall be rated for working pressures of 6” w.g. positive and 1” w.g. negative. Flexible duct assemblies shall be U.L. 181, Class I air duct listed and shall meet fire resistive standards of NFPA 90A. Flexible ducts shall be factory insulated with 1-1/2” thick glass fiber insulation with flame resistant, metallic vapor barrier finish. R-4.2 in Return Air Plenum, R-6 otherwise.

B. Flexible duct length shall not exceed 5’ for diffusers.

C. Flexible duct shall not be installed upstream of terminal units.

D. Flexible duct shall not be used in ducted return or exhaust systems.

E. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 2 inches per 48 inches.

F. Avoid contact with metal fixtures, water lines, pipes, or conduits.

G. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Flexible duct shall be Flexmaster Type 1M, or equivalent.

24 37 00 AIR DEVICES

24 37 01 GENERAL

A. Furnish and install diffusers, grilles, and registers as shown on the drawings and specified herein.

B. Air devices shall be installed in the orientation and the pattern controllers adjusted as indicated on the plans, as indicated on the shop drawing, or through supplemental information.

C. Submittal data for all distribution devices shall contain the following information:
   1) Room Number
2) Model Number
3) Flow Rate
4) Size: Neck and where applicable
5) Throw in feet: Based on 50-fpm velocity
6) Air patterns: Such as one-way, two-way opposite, corner, four-way, etc.
7) Pressure drop in inches of water
8) Sound rating
9) Airflow factor: Such as K factor or as required for airflow rate measurements.
10) Accessories: Such as volume dampers, deflectors, etc.
11) Three-color charts and balance instructions shall be furnished with submittal data.

D. Devices described below and indicated on the drawings are based on the manufacturers listed in the air device schedule. Similar design characteristics as manufactured by Titus, Price, Carnes, Metal Aire, Nailor, or Tuttle & Bailey will also be acceptable. Performance data such as pressure drop and NC level shall be equivalent or better for any proposed substitutions. Return or exhaust devices shall not be smaller than sizes shown.

E. Ceiling diffusers shall be of the type, service, size, and finish as scheduled on the drawings. Border types shall be coordinated by the Contractor to be suitable for ceiling types in which diffusers will be installed.

24 37 02 LOUVERED CEILING DIFFUSERS

A. In dry areas diffusers shall be steel construction, Titus TDCA or equivalent. In wet areas diffusers shall be aluminum construction, Titus TDCA-AA or equivalent.

B. Return or exhaust diffusers shall be similar to the supply air diffusers less the adjustable pattern controllers. In dry areas diffusers shall be steel construction, Titus TDC or equivalent. In wet areas diffusers shall be aluminum construction, Titus TDC-AA or equivalent.

24 37 03 SIDEWALL GRILLES - REMOVABLE CORE

A. Sidewall supply air grilles (SAG) shall be adjustable double deflection type with removable core with a separate mounting frame with a gasketed one-inch wide flange as scheduled. Sidewall grilles shall be similar to Titus Model 1700 with optional 07 directional blades. Sidewall return or exhaust grilles shall be single deflection to match sidewalk supply grilles in appearance. Where registers are required (SAR or RAR), include a key operated opposed blade volume control.

24 37 04 SIDEWALL GRILLES

A. Sidewall return/transfer grilles shall have fixed fins set at 38°/0° angle, separate one inch wide gasketed mounting flange frame. Returns/transfers shall be similar to Titus Model 350RL.

24 37 05 SPECIALTY TYPE – LAMINAR FLOW PANELS

A. Laminar flow ceiling diffusers shall be constructed using a maximum 6 inches tall backpan. The backpan shall have integral hanger tabs for securing the unit to the overhead structure. The non-aspirating laminar flow panels shall utilize a dual chamber plenum design consisting of an upper chamber with a top, round inlet collar, lower chamber, and a perforated face, to establish a unidirectional flow of air. Air shall be distributed from the upper to lower chamber through multiple “V” shaped air diffusion baskets located along the length of the assembly to generate a uniform air flow across the entire face. The plenum assembly shall include integral hanging tabs for supporting unit overhead. The removable face shall be attached to the assembly with 1/4 turn fasteners and shall include closed cell gaskets. Stainless steel safety cables shall prevent accidental dropping of the panel. The face shall include hinges, in
addition to the safety cables, to allow the face to swing down 90 degrees for cleaning. Anemostat MV-2 or approved equivalent.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. University of Missouri Controls Specification.

B. This section contains requirements for pneumatic, electric and digital control systems as indicated on the contract drawings.

C. Contractor is responsible for providing, installing and connecting all sensors, pneumatic actuators, control valves, control dampers, electrical components and all interconnecting pneumatic tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).

D. DDC controllers consist of Johnson Controls METASYS controllers, type NAE, DX, FEC, IOM, AHU, VAV, VMA, or UNT controllers. Owner will provide Johnson Controls METASYS controllers for the contractor to install.

E. After all equipment has been installed, wired and piped, Owner will be responsible for all termination connections at the DDC controller’s and for checking, testing, programming and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.

F. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.02 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.03 QUALITY ASSURANCE

A. Contractor’s Qualifications:
   1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years’ experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Conditions section 3.4.1 and 3.4.4.

B. Codes and Standards:
   1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled and comply with NEMA standards.
   2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.


1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings for each control system, containing the following information:

B. Product data for each damper, valve, and control device.

C. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.

D. Label each control device with setting or adjustable range of control.

E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

F. Provide details of faces on control panels, including controls, instruments, and labeling.

G. Include written description of sequence of operation.

H. Provide wiring diagrams of contractor provided interface and I/O panels.

I. Provide field routing of proposed network bus diagram listing all devices on bus.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Air Piping:

1. Copper Tubing: Seamless copper tubing, Type M or L, ASTM B 88; wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment.

2. Flex Tubing: Virgin Polyethylene non-metallic tubing, ASTM D 2737, with flame retardant harness for multiple tubing. Use compression or push-on polyethylene fittings. Tubing used above suspended ceilings to be plenum rated per NFPA 90A. See section 3.1.b for locations where flex tubing can be used.

3. Copper to polyethylene connections shall be compression barbed fittings or solder barbed fittings.

B. Conduit and Raceway:

1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.

2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.

3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.

4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.
C. Control Valves: Provide factory fabricated electric control valves of type, body material, and pressure class as indicated on the drawings. Butterfly style control valves are not acceptable except for two position applications. Equip control valves with heavy-duty actuators, with proper shutoff rating for each individual application.
   a) Hydronic Chilled Water and Heating Water
      i) Hydronic control valves for VAV box reheat coils shall be proportional non-spring return valves (0-10V, 3-15 psi).
      ii) The valve bodies shall be of cast iron, steel or bronze and rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass, or bronze.
      iii) Ball valves shall be Belimo or approved equivalent. Ball valves shall be threaded bronze body, chrome plated ball, blowout proof stem, teflon seat, rated at 600-psi W-O-G working pressure, and 35-psi differential pressure.
      iv) The valves shall have pressure taps across the valve for measuring the pressure drop across the valve. The pressure taps shall have ½-inch extensions for accessibility.
      v) Control valves shall be installed with unions or flanges as necessary for easy removal and replacement.
      vi) Valve Tag shall include the model number, AHU being served, design flow, and maximum flow for that valve.

D. Control Dampers: Ruskin CD-50 or approved equal.
   1. Provide dampers with parallel blades for 2-position control.
   2. Provide opposed blades for modulating control.
   3. Dampers shall be low leakage design with blade and edge seals.
   4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.

E. Electric Actuators: Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable. For VAV reheat valves, actuators shall have a manual override capability to aid in system flushing, startup, and balancing.

F. Air and Hot Water Electronic Temperature Sensors:
   1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
   2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner's Representative.
   3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.

G. Electronic Temperature Sensors and Transmitters:
      a) General: The RTD/Temperature Transmitter/Thermowell assembly shall come as a complete assembly from a single manufacturer. The Assembly shall be suitable for use
in the accurate measurement of Chilled/Tower/Hot Water and steam temperatures in a mechanical room environment.

b) Calibration: Each RTD must be match calibrated to the Transmitter via NIST traceable calibration standards. Results are to be programmed into the transmitter. Results are to be presented on report as after condition at the specified calibration points. Assembly shall not be approved for installation until Owner has received all factory calibration reports.

c) RTD:
   (1) RTD type: 2-wire or 3-wire 100 ohm platinum class A
   (2) Outside Diameter: 0.25 inch
   (3) Tolerance: +/- 0.06% Type A
   (4) Stability: +/- 0.1 % over one year.
   (5) TCR: 0.00385 (ohm/ohm/oC).
   (6) RTD shall be tip sensitive.
   (7) Resistance vs. Temperature table for the RTD must be provided to the Owner.

d) Transmitter:
   (1) Transmitter shall be match calibrated to the RTD and assembled as a matched pair.
   (2) Type: 2 wire (loop powered)
   (3) Input: 2 or 3 wire 100 ohm platinum class A or class B RTD
   (4) Output: Output shall be a 4-20 mA signal linear to temperature
   (5) Calibrated Span:
      (a) Chilled Water: 30 °F to 130 °F.
      (b) Tower Water: 30 °F to 130 °F.
      (c) Hot Water: 100 °F to 250 °F.
      (d) Steam: 150 °F to 450 °F
   (6) Calibration Accuracy, including total of all errors, of the Transmitter & RTD matched pair over the entire span shall be within +/- 0.2% of the calibrated span or +/- 0.18 °F, whichever is greater.
   (7) Supply Voltage: 24 VDC.
   (8) Ambient Operating Temp.: 32 to 122 °F
   (9) Epoxy potted for moisture resistance.
   (10) Mounting: Transmitter shall be mounted in the RTD connection head.

e) Thermowell
   (1) Thermowell shall be suitable for immersion in chilled/hot water and steam.
   (2) Thermowell shall be reduced tip.
   (3) Thermowell shall be one piece stainless steel machined from solid bar stock.
   (4) Thermowell shall have 1/2" NPT process connection to pipe thred-o-let.
   (5) Thermowell Insertion depth shall be ½ the inside pipe diameter but not to exceed 10".

f) Assembly:
   (1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.
   (2) Connection head shall be cast aluminum with chain connecting cap to body, have 1/2" NPT process and 3/4" NPT conduit connections, and a sealing gasket between cap and body.

g) RTD/Temperature Transmitter/Thermowell assembly shall be the following or approved equal:
   (1) Manufacturer: Pyromation, Inc.
   (2) Chilled Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(30130)F with calibration SMC(40,60)F
H. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.

I. Humidistats: Humidistats must be contamination resistant, capable of ±2% RH accuracy, have field adjustable calibration and provide a linear proportional signal.
   1. HD20K-T91 or equivalent.

J. Humidity High Limit
   1. Multi-function device that can function as a high limit or proportional override humidity controller, as stand-alone proportional controller, or a stand-alone two-position controller.
      a) Johnson Controls TRUERH HL-67N5-8N00P or approved equal.

K. Carbon Dioxide Sensor:
   1. Wall Mount: ACI Model ESENSE-R.
   2. Duct Mount: ACI Model ESENSE-D.

L. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
   1. Kele, DCPA-1.2 or approved equal.

M. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
   1. Water: Units shall be wet/wet differential pressure capable of a bi-directional pressure range of +/- 50 psid. Accuracy shall be +/- 0.25% full scale with a compensated temperature range of 30 to 150 deg F and a maximum working pressure of 250 psig. Install transmitter in a pre-manufactured bypass valve assembly with shut-off valves, vent valves and a bypass valve, all enclosed in a NEMA 1 enclosure.
      a) Setra model 230 with Kele model BVA-5 bypass valve assembly, or approved equal.
   2. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig. a) Setra model 267, or approved equal.
      b) Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.

N. AIRFLOW/TEMPERATURE MEASUREMENT DEVICES
   1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
   2. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings calculated for each sensor housing shall be equally weighted and
averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.

3. All Sensor Probe Assemblies
   a) Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
   b) Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use “chip” or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
   c) Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
      (1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
   d) The operating temperature range for the sensor probe assembly shall be -20°F to 160°F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
   e) Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15°F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
   f) Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
   g) Each sensor assembly shall not require matching to the transmitter in the field.
   h) A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.

4. Duct and Plenum Sensor Probe Assemblies
   a) Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly. Thermistor probes shall be mounted in sensor housings using a waterproof marine grade epoxy resin. All wires within the aluminum tube shall be Kynar coated.
   b) The number of sensor housings provided for each location shall be as follows: (1)

<table>
<thead>
<tr>
<th>Area (sq.ft.)</th>
<th>Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2</td>
<td>4</td>
</tr>
<tr>
<td>2 to &lt;4</td>
<td>6</td>
</tr>
<tr>
<td>4 to &lt;8</td>
<td>8</td>
</tr>
<tr>
<td>8 to &lt;16</td>
<td>12</td>
</tr>
<tr>
<td>&gt;=16</td>
<td>16</td>
</tr>
</tbody>
</table>
   c) Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
      (1) Insertion mounted through the side or top of the duct.
      (2) Internally mounted inside the duct or plenum.
      (3) Standoff mounted inside the plenum.
   d) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5. Fan Inlet Sensor Probe Assemblies
   a) Sensor housings shall be mounted on 304 stainless steel blocks.
b) Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
c) Mounting feet shall be constructed of 304 stainless steel.
d) The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.

6. Transmitters
a) The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
b) The transmitter shall be capable of independently monitoring and averaging up to 16 individual airflow and temperature readings. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.
c) The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.
d) All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
e) The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
f) The transmitter shall be capable of communicating with the host controls using one of the following interface options:
   (1) Linear analog output signal: Field selectable, fuse protected and isolated, 010VDC and 4-20mA (4-wire).
   (2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus.
   (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBusTCP and TCP/IP.
   (4) LonWorks Free Topology.
g) The transmitter shall have an infra-red interface capable of downloading individual sensor airflow and temperature data or uploading transmitter configuration data to a handheld PDA (Palm or Microsoft Pocket PC operating systems).

7. The measuring device shall be UL listed as an entire assembly.

8. The manufacturer’s authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer’s placement requirements.

9. Manufacturer
a) Primary flow elements, sensors, meters and transducers shall be EBTRON, Inc. Model GTx116-P and GTx116-F or approved equal.
b) The naming of any manufacturer does not automatically constitute acceptance of this standard product nor waive their responsibility to comply totally with all requirements of the proceeding specification.

O. Electrical Requirements: Provide electric-pneumatic switches, electrical devices, and relays that are UL-listed and of type which meet current and voltage characteristics of the project. All devices shall be of industrial/commercial grade or better. Residential types will be rejected.

1. EP Switches: Landis & Gyr Powers, Inc. Series 265 - Junction Box Type or approved equal.
2. Relays: Relays shall have an LED status indicator, voltage transient suppression, Closed-Open-Auto switch, plastic enclosure, and color coded wires. Kele model RIBU1C or approved equal.
PART 3 EXECUTION

3.01 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer’s instructions, roughing-in drawings and details shown on drawings.

B. Control Air Piping:
   1. All control air piping shall be copper. Exception: Flexible Tubing may be used for a maximum of two (2) feet at connections to equipment [except for steam control valves] and inside control cabinets.
   2. Provide copper tubing with a maximum unsupported length of 3'-0".
   3. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
   4. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
   5. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
   6. All control tubing at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel.
   7. Provide pressure gages on each output device.
   8. Paint all exposed control tubing to match existing.

C. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.

D. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
   1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
   2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
   3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
      a) Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
   4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
      a) Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
   5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.

E. All low voltage electrical wiring shall be run as follows:
   1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
   2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated and properly supported to building structure.

4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.

F. All devices shall be mounted appropriately for the intended service and location.
   1. Adjustable thermostats shall be provided with base and covers in occupied areas and mounted 48" above finished floor to the top of the device. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owners Representative. Wall mounted sensors such as CO2, RH, and non-adjustable temperature sensors shall be mounted 54" above finished floor. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
   2. All control devices shall be tagged and labeled for future identification and servicing of control system.
   3. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
   4. All field devices must be accessible or access panels must be installed.

G. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.

3.02 ADJUSTING AND START-UP

A. Start-Up: Temporary control of Air Handling Units shall be allowed only if approved by the owner’s representative to protect finishes, etc., AHUs may be run using caution with temporary controls installed by contractor early in the startup process. All safeties including a smoke detector for shut down must be operational. Some means of discharge air control shall be utilized and provided by the contractor such as a temporary temperature sensor and controller located and installed by the Contractor.

B. The start-up, testing, and adjusting of pneumatic and digital control systems will be conducted by owner. Once all items are completed by the Contractor for each system, Contractor shall allow time in the construction schedule for owner to complete commissioning of controls before project substantial completion. This task should be included in the original schedule and updated to include the allotted time necessary to complete it. As a minimum, the following items are required to be completed by the Contractor for Owner to begin controls commissioning.
   1. Process Control Network
      a) The control boards and enclosures need to be installed in the mechanical rooms.
      b) The fiber optic conduit and box for the process control network needs to be installed. Once in place, Owner needs to be contacted so the length of the owner provided fiber cable can be determined and ordered, if required. Coordinate with Owner to schedule the pull in and termination of the fiber cable. Power should be in place at that time. (Fiber for the process control network is required to allow metering of utilities prior to turn on.)
   2. VAVs-First Pass
      a) Power, (FC or N2 bus), and control wire installed before owner can make first commissioning pass. First pass includes installation of VAV controller, termination of power, control and network communication wiring.
3. VAVs-Second Pass
   a) After the air handlers are running and under static pressure control and the heating water system is operating, a second pass can be made on the VAVs to download the control program and commission controllers to verify the VAV dampers, thermostat, and reheat control valves are working properly.

4. Some balance work can be done alongside the control work as long as areas are mostly complete, and all diffusers are in place.

3.03 CLOSEOUT PROCEDURES

A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.

B. Contractor shall provide as built diagram of network bus routing listing all devices on bus, once wiring is complete prior to scope completion.

END OF SECTION
DIVISION 26 - ELECTRICAL

26 00 00 ELECTRICAL

26 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 26 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 26 of these Specifications.

C. The organization of the Specifications into Divisions, Sections and Subsections, and the arrangement of the Plans shall not in and of itself divide the Work among the Contractors and Subcontractors nor establish the Work to be performed by any trade. The “Scope of Work” and “Work Included” under each respective sectional heading, nevertheless, attempts to segregate the Work by known contracting activities. In the final analysis, the General Contractor shall be responsible for scoping the work for each trade based on local practice to include all the Work of a given type in the related proposal, regardless of where and how identified in the Bid Documents.

26 00 02 SCOPE OF WORK

A. This project is for a renovation on the 4th floor of the Critical Care Addition at the MU Healthcare's University Hospital. The design, defined by the Project Documents, provides for a new cath lab and renovated office space.

B. The Electrical Work for this project shall include all material, labor and services necessary for and incidental to providing the following systems (respective Sections of the Specifications are noted in the right hand column):

1. Basic Electrical Requirements 26 00 00
2. Common Work Results for Electrical 26 05 00
3. Low Voltage Electrical Transmission 26 20 00
4. Electrical Protection 26 40 00
5. Lighting 26 50 00
6. Communications and Systems 27 00 00
7. Electronic Safety and Security 28 00 00

26 00 03 REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. The Plans, the general provisions of the of the Contract, including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 26 of the Specifications.

B. All provisions and conditions cited in this Section shall apply to Work for all other sections of Division 26 of these Specifications.

C. Requirements of the following Sections of the Specifications apply to Work for this Section:

1. Division 27 – Communications
2. Division 28 – Electronic Safety and Security
26 00 04  REFERENCES, REGULATORY REQUIREMENTS

A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where relevant standards have been established (see also Paragraph 26 00 60). Material and equipment, which are not covered by UL Standards, will be acceptable provided they meet safety requirements of a nationally recognized testing laboratory. Products which no nationally recognized testing laboratory accepts, lists, labels, certifies or determines to be safe will be considered if inspected or tested in accordance with national industrial standards such as NEMA or ANSI. Evidence of compliance shall include test reports and definitive submittals.

B. Definitions:

1. “Listed”: A product is “listed” if of a kind mentioned in a list which: Is published by a nationally recognized laboratory which makes periodic inspections of such production. States that such product meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. “Labeled”: The product is “labeled” if: It embodies a valid label or other identifying mark of a nationally recognized testing laboratory such as UL, Inc. Production is inspected periodically by a nationally recognized testing laboratory. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

3. “Certified”: The product is “certified” if: The product has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in specific manner. Production is inspected periodically by a nationally recognized testing laboratory. The product bears a label, tag or other record of certification.

26 00 05  DEFINITIONS

A. The term “Work” used in this Division shall be the furnishing of material, labor and/or services necessary for and reasonably incidental to providing specific component(s), consideration(s) and/or system(s) of the design for the mechanical facilities for this Project as hereinafter defined by the Project Documents.

B. The term “Project Documents” used in this Division shall be the compilation of the Specifications, the Plans and any Attachment and Addendum which collectively define the design and the intent of the Work to construct the Project.

C. The terms “Architect” and “Engineer” as used in this Division of the Specifications shall be the professional individual and/or company developing the respective portion(s) of the Project Documents and administering the responsibility for the adherence to the intent of these documents. The “Architect/Engineer” is the agent of the “Owner” and shall represent and discharge authority on all matters unless the matter is referred to the Owner or the Owner elects to perform in their own behalf.

D. The term “General Contractor, Construction Manager, or Prime Contractor” as used in Division 26 shall mean the Contractor who has the prime contract with the Owner and who is responsible for general conditions of the project and is responsible for seeking experienced and qualified Trade Subcontractors to perform the Work.

E. The terms “Contractor” and “Subcontractor” where used in this Division shall mean any Company, regularly in business, to perform the type of work for which the Contract was sought, who has contracted with the Owner or General Contractor to perform the work included in and defined by this section and any other section or sections of this Division.
F. The term “submittal” as used in this Section of the Specifications shall be construed to be information in various forms compiled by the Contractor to transmit to the Architect/Engineer for review, comment and/or approval and return same to the Contractor with notice to react. The information shall support and/or substantiate that the given product complies with the intent of the Project Documents, should be incorporated in the Work and therefore, warrants approval to permit proceeding with that Work. The information may be any form or accepted practice of shop drawings, data, published catalogs, etc. that sufficiently provide the Architect/Engineer with basis of making a determination.

G. The term “unfinished space” as used in Division 26 - 28 of the Specifications shall be a mechanical or electrical equipment room. These are rooms that are generally unpainted and accessible only to building maintenance personnel.

H. The term “finished space” as used in Division 26 - 28 of the Specifications shall mean any space not defined as “unfinished space” (i.e. occupied rooms, corridors, stairways, closets, etc.).

I. The term “exterior” or “outdoors” as used in Division 26 - 28 of the Specifications shall mean exposed to atmospheric weather conditions.

J. The term “interior” or “indoors” as used in Division 26 - 28 of the Specifications shall mean not exposed to atmospheric weather conditions.

K. The term “concealed” as used in Division 26 - 28 of the Specifications shall mean anything that is not visible in a “finished space”.

L. The term “inaccessible” as used in Division 26 - 28 of the Specifications shall mean located within walls or above non-lay-in ceiling (i.e., drywall, plaster).

M. The term “packaged” as used in Division 26 - 28 of the Specifications shall be construed to be a factory manufactured piece of equipment for which all components are totally assembled, pre-piped and prewired within its own structure and ready to operate when connected to proper external mechanical and electrical services.

### 26 00 06 CODES, STANDARDS, etc.

A. The material, workmanship and systems for Work of this Division shall comply with all applicable codes, standards, regulations and laws of the legal governmental jurisdiction at the project site.

B. Should the Contractor perform any work that does not comply with the requirements of the applicable codes, standards, regulations, statutes, laws, acts, or which does not receive the approval of the responsible inspection authority, Contractor shall bear all costs arising in correcting the deficiencies.

C. Applicable requirements of the current and accepted edition of the following codes shall apply to the Work for Divisions 26 - 28:

- International Building Code 2018
- International Existing Building Code 2018
- International Mechanical Code 2018
- International Plumbing Code 2018
- International Fire Code 2018
- International Fuel Gas Code 2018
- National Electrical Code, 2011 & 2017
- NFPA 110 - 2016
D. Applicable requirements of the current and accepted edition of the following industry standards, codes and specifications shall apply to the Work for Division 26-28:

- ANSI American National Standards Institute
- ASTM American Society of Testing and Materials
- IEEE Institute of Electrical & Electronic Engineers
- IPCEA Insulated Power Cable Engineers Association
- NIST Institute of Science and Technology
- NEC National Electric Code, including amendments by local authority having jurisdiction
- NEMA National Electrical Manufacturers Association
- NIOSH National Institute of Occupational Safety and Health
- OSHA Occupational Safety and Health Act
- UL Underwriters Laboratory, Inc.

E. Applicable requirements of all the relevant Federal laws including current and accepted edition of the Americans with Disabilities Act (ADA).

26 00 10 CONDITIONS, BID

26 00 11 REQUEST for PROPOSAL

A. The terms for Contractor's proposal shall be as described in the General Conditions, Supplementary and/or Special Conditions and Specification Sections of Division 1.

26 00 12 TAXES

A. The respective Contractor or Subcontractor shall pay all sales and/or use taxes or other applicable charges coincidental with the purchase of material and equipment for the fulfillment of their respective Work, unless otherwise described in the General Conditions, Supplementary and/or Special Conditions and Specifications Sections of Division 1.

26 00 13 FREIGHT

A. The respective Contractor or Subcontractor shall pay all shipping and/or freight charges coincidental with the purchase of material and equipment for the fulfillment of their respective Work.
26 00 14 PERMITS and FEES

A. The respective Contractor or Subcontractor shall apply for, obtain and pay for all charges for permits and fees required to install the respective Work. The Contractor shall arrange for and pay all required charges and/or fees to inspect and accept the Work by the appropriate authority.

B. Any deficiency arising from the improper administering or complying with requirements for permits, fees, or inspections shall be corrected by the Contractor without additional compensation.

26 00 20 CONDITIONS, JOBSITE

26 00 21 TEMPORARY FACILITIES

A. General

In general, the General Contractor or the Owner to the extent as described in Division 1 of the Specifications will provide temporary facilities. However, if that is not the case, the specific conditions of this project are identified as follows:

B. CONSTRUCTION ELECTRIC POWER and LIGHTING:

1. The Owner will allow Contractor to utilize 120V, 60 HZ, single phase building power via convenience outlets for hand tools and to use the building's permanent lighting during construction, to the extent feasible.

2. It shall be the responsibility of the respective Contractor or Subcontractor to provide extension(s) and any necessary protection devices from the distribution panel(s) for their requirement(s). All cords shall be grounded.

3. The Contractor shall maintain temporary lighting to provide minimum illumination levels in accordance with OSHA 1926.56.

4. The Contractor shall maintain temporary convenience power such that no point in the building is further than 50 feet from a distribution panel. It shall be the responsibility of the respective Contractor or Subcontractor to provide extension(s) and any necessary protection devices from the distribution panel(s) for their requirement(s). All cords shall be grounded and GFCI protected.

5. The respective Contractor or Subcontractor shall provide his own three (3) phase electric power requirements.

C. TEMPORARY TOILETS and WATER:

1. The Owner will permit the Contractor to use toilets designated by the Owner and to use the building's domestic water faucets and hose bibs.

2. The Contractor shall keep the toilet areas clean and in full working order during construction.
3. Any connections to the domestic water which could cause contamination shall be connected via a backflow prevention device.

D. JOB SITE SECURITY:

1. The Contractor shall cooperate with the Owner in the procedures and requirements for entering and exiting the building.

2. The Contractors work hours shall conform to the building's normal operating hours unless special arrangements are made with the Owner.

3. Each trade shall be responsible for securing its trailers, lockboxes, materials, supplies, tools, etc. and Owner will not be responsible for damage, theft, or loss.

E. JOB SITE PARKING:

1. Contractor shall park in only the designated areas assigned to them for use by the General Contractor or Owner and shall not park in No Parking Areas, on lawns, or unpaved areas and shall not block access to loading docks, fire hydrants, etc.

26 00 22 REQUIREMENTS TO PURSUE THE WORK

A. Work space: The respective Contractors and Subcontractors shall be assigned areas at the job site for construction trailers, lay-down, storage and work spaces as arranged with the General Contractor. All spaces shall be accessible to the Architect/Engineer. All material and equipment shall be protected during the course of construction against weather, dirt, comprehensive damage and theft. All items subject to water damage shall be adequately protected. Damage occurring or defects detected before acceptance shall be repaired or replaced at no additional compensation.

B. Tools: The Contractors and Subcontractors shall provide their own tools and services to perform their respective Work. Rented or leased services shall have proper and adequate insurance.

C. Temporary storage: The Contractors and Subcontractors shall be responsible for any requirements to temporarily store material and equipment until it is incorporated into the Project.

26 00 30 PROJECT DOCUMENTS

26 00 31 GENERAL

A. The Plans and the Specifications are intended to define complete and satisfactorily functioning systems. The Contractor shall be responsible for providing all necessary material, labor and services to provide the completed, operating systems at no additional compensation even though each and every element thereof is not specifically identified.

B. The Plans are diagrammatic and indicate general arrangements, approximate sizes and relative locations of principal equipment and materials to provide for the design and intent of the Electrical Work and shall be followed as closely as actual building and site conditions and work of other trades will permit. The Work shall conform to the requirements and intent of the Project Documents. Because of the scale of the drawings, the Plans do not represent every
offset, fitting, accessory, etc. that may be required for the conduit or other appurtenances, nor is it implied that all conflicts between elements of the Work or building components have been resolved. The Contractor shall prepare details and/or coordination drawings where it may be required and submit to the Architect/Engineer for approval before proceeding with the Work.

C. To the extent contained in the Project Documents, elevations, sections, typical details, and schematic diagrams are included for instructions to the craftsperson. If any additional diagrams are desired and/or required for further instruction to the craftsperson, for permit applications, or for any other reason, the Contractor shall develop the drawings.

D. Significant discrepancies and/or changes required to accomplish the intent of the Project Documents, in the opinion of the Contractor, shall be identified and submitted to the Architect/Engineer for approval before proceeding with the Work in question. Changes originated by the Architect/Engineer shall be processed under the subsection heading “Changes in the Work”.

E. The Plans and the Specifications are mutually complementary. Work required by one, but not the other, shall be performed as if required by both.

F. In the event of conflict between the Plans and the Specifications, the Contractor shall notify the Engineer for clarification. Prior to clarification, the Contractor shall assume that the stricter requirements apply.

26 00 33 SPECIFICATIONS

A. Referenced sections of other Divisions whether attached or in separate volumes or binders shall be a part of the Contract Documents.

26 00 34 ADDENDA

A. The Architect/Engineer may issue revisions, modifications, attachments or other documentation in the form of addenda to the Project (Bid) Documents during the bidding phase only to change, detail or clarify the scope of the Work.

B. The addenda shall become a part of the Contract Documents.

26 00 35 INTERPRETATIONS

A. The electrical Engineer shall be the sole source of interpretation of the electrical design and intent of the Project Documents.

26 00 36 CONSTRUCTION SCHEDULE

A. The Contractor shall furnish sufficient manpower as the schedule dictates and is required to maintain the overall project schedule. Manpower or overtime to meet the project schedule including, but not limited to, premium time, inefficiencies associated with longer days/hours, inefficiencies associated with additional manpower, or other labor burdens shall be included in the Contract Sum.

B. The Contractor shall coordinate with their Subcontractors to develop an overall project schedule.
26 00 37 AS-BUILT DRAWINGS

A. The Contractor shall maintain a separate set of plans at the jobsite, and mark thereon as an As-Built of Work as the construction proceeds. These As-Built, “redline” drawings shall include exact locations and relevant details (i.e. elevations, sizes, dimensions related to building lines, etc.) of all underground work, concealed feeders, pull/junction boxes, cable tray, all considerations requiring periodic attention and access thereto.

B. At the completion of the project, the Contractor shall provide the “redline”, As-Built drawings and/or scanned color PDF of the As-Built, flattened to the Engineer.

C. At the completion of the project, the Architect/Engineer will provide PDF drawings (including all issued revisions to the Contract) for the Contractor’s use to transfer all of the information from the As-Built drawings to a final, clean set.

D. At the completion of the project, the Architect/Engineer will provide Contractor CAD files for the Contractor’s use to transfer the information on the drawings to CAD. The layering system on the drawings provided shall be strictly adhered to. The Contractor for their representation and accuracy of the final installation conditions shall certify these As-Built drawings. The As-Built CAD drawings shall be submitted to the Engineer digitally via thumb drive, shared cloud drive, etc. for review.

26 00 40 DUTIES OF CONTRACTOR

26 00 41 GENERAL (Pursuit of Work)

A. The Contractor shall thoroughly examine all Bid Documents before submitting a bid/proposal for the Work. If, in the opinion of the Contractor, there are any deficiencies in the Documents, that might impact the intent or the scope of the work, the Contractor shall bring the matter to the attention of the Architect/Engineer for clarification. If in the judgment of the Architect/Engineer clarification is warranted, an addendum to the Documents will be issued. If the Contractor fails to request clarification or otherwise submits a bid without qualifications, the Contractor thereby agrees to install a complete and functional system with no change in the contract price.

B. The Contractor shall be responsible for changes required for compliance with codes, standards, regulations, ordinances, etc. and implementing any such change at no change in contract price. In the event of conflict with the Project Documents or other requirements, the more stringent shall apply. The Contractor shall promptly notify the Architect/Engineer of any discrepancy.

C. The Contractor shall perform the Work to comply with all terms, conditions and intentions, whether explicit or implicit, of this Section and applicable requirements of other Sections of Division 26, the Plans and any other documentation so identified. Should the Contractor perform any Work that does not comply with the Project Documents or is not in accordance with common trade practices, the Contractor shall bear all costs, at no change in contract price, arising in correcting the Work.

D. The Contractor shall be responsible for all aspects of the Work for their respective contractual agreement. The Work of the respective suppliers and subcontractors shall be administered properly to assure that all elements thereof have been provided for complete and functioning system(s).

26 00 43 SUBMITTALS for APPROVAL
A. All shop drawings must be submitted prior to the receipt of the second partial payment request. No further payment will be made until shop drawings have been submitted.

B. The Contractor shall forward the quantity required for distribution within a reasonable time following the award of the contract. Prior to submitting shop drawings, Contractor shall verify equipment delivery for compliance with the overall project schedule. Any delays due to delivery or due to submittals being late, inadequate, or incorrect and therefore rejected by the Architect/Engineer shall be the responsibility of the Contractor making said submittal. The Contractor shall bear all cost for expediting charges or obtaining materials from another vendor to meet the overall project schedule.

C. The Engineer may take up to two (2) weeks to review a complete and properly processed submittal from the time it arrives at the Engineer’s office until the time it is returned to the Architect. Resubmittals will be reviewed within two (2) weeks for a complete and properly processed resubmittal from the time they arrive at the Engineer’s office until the time they are returned to the Architect.

D. The submittals shall include shop drawings, engineering data and support information to sufficiently substantiate compliance with the Project Documents. All submittals must include the following information in order to be considered for review. Submittals found to be lacking may be rejected without review.

1. Shop drawing shall be derived from manufacturers original documents. Reproductions shall be of sufficient quality to accommodate a review.
2. Stamped date of receipt by the Contractor(s).
3. Identification of the project name and/or Owner’s project number.
4. Indication that the Contractor has reviewed the submittal and is satisfied that it complies with the Project Documents.
5. Identification of the Specification section or subsection that specifies the submitted item.
6. Identification of the submitted item by the same description that is used in the Project Documents.

E. Submittals shall be delivered to the Engineer digitally via email, thumb drive, shared cloud drive, or other agreed upon means for review. Submittals or submittal notices that are emailed shall be sent to CA@mcclureeng.com at a minimum.

F. The approval of the submittal shall not relieve the Contractor from complying with all of the terms and conditions of the Project Documents. The Contractor shall be responsible for all physical and performance requirements of equipment provided, including any differences in the cost of installation for variations from these requirements.

G. Include the manufacturer’s installation instructions and maintenance manual with the equipment submittal for approval for inclusion in the Operations and Maintenance Manuals as specified in Subsection 26 00 46.

H. In general, all items purchased by Contractor for installation where a make and model is specified shall require submittals. Items required for the Work such as screws, bolts, clips, etc. which are not specified are not required to be submitted unless specifically requested.

I. The following shall be submitted under this Division of the specifications:

1. List of subcontractors and equipment supplier.
2. Payment breakdown.
3. Construction Schedule.
4. Detailed submittals.
5. Catalog Data
6. Operating and maintenance manuals.
7. As-built drawings.
8. Contractor developed details and coordination drawings (when applicable).
9. Proposed substitution (when applicable).

Division 26
1. Wiring Devices
2. Seismic, Sway Bracing, Anchorage Details/Drawings
3. Floor Boxes/ Poke Through Devices
4. Fire Stopping
5. Surface Mounted Raceway Systems
6. Disconnect Switches
7. Dry-Type Transformers
8. Distribution Panelboards
9. Circuit Breaker Panelboards
10. Isolated Power Panelboards
11. Surge Protective Devices
12. Fuses
13. Motor Starters / RIB (relay in a box) / Contactors
14. Light Fixtures
15. LED Drivers
16. Low Voltage Lighting Control Systems
17. Occupancy Sensors / Digital Timers

Division 27
1. Voice/Data/Video Systems and Accessories

Division 28
1. Fire Alarm System
2. Access Control

3. CCTV – Security Camera System

J. At the completion of the project provide a single PDF document containing only those shop drawings that were approved and incorporated into the project.

26 00 44   CHANGES IN WORK

A. The only condition under which a change in the contract price will be considered is if there is to be a change in the scope of intent of the project requirements. Such changes would be limited to revisions in the project initiated by the Owner. The Architect/Engineer will issue a proposal for the new scope of work for the Contractor to prepare a price. After approval, the Architect/Engineer will prepare change order or change orders to adjust the contract sum and/or the contract time as necessary to carry out the changes.

B. No claim for an addition to the Contract Sum will be valid unless authorized as aforesaid in writing by the Owner. Any work completed by the Contractor outside the original project scope without written approval from the Owner will be deemed as a waiver by the Contractor for additional compensation for said work.

C. No requests for change orders will be reviewed or considered for approval that are not submitted with all of the following information. No cost associated with labor burden or manpower inefficiencies will be approved for a change order without documentation of the present labor burden, manpower requirements, and the critical path nature of the scope change.

1. A complete and detailed line item takeoff of materials and equipment.
2. A unit cost identified for each line item with material cost, labor hours, and labor rate identified separately for each line item.
3. All fringes and mark-ups identified separately.

D. Where major subcontracts are involved, the respective subcontractor's calculation, including all of the above data, shall be included with the Contractor's request.

E. Where there are net differences, the above data shall be included for all items added and for all items deducted with the net calculation clearly identified. Mark-ups shall be applied only after net differences are calculated.

F. The overhead charged by the Contractor shall be considered to include, but not limited to, performance bond, insurance, job site office expense, normal hand tools, man-lifts, incidental job supervision, field supervision, safety training, general office overhead, and cost associated with the preparation of design documents, layout drawings, shop drawings, or as-built drawings.

G. In evaluating the value of the contractor's request, for comparison purposes, the Architect/Engineer may use cost and unit data from the current edition of the R. S. Means Company's Cost Data, or information from appropriate suppliers or vendors of the respective materials or equipment.

H. Any requests submitted without the above details will be returned without review for resubmittal in the proper form.
26 00 45 COMPLETION and ACCEPTANCE

A. If, at the Owner’s direction, a portion of the building is to be occupied or a portion of the Electrical System is utilized for beneficial use by the Owner prior to completion and acceptance of the Project, the start of the warranty shall begin with the “beneficial use” of the related Work.

B. The Engineer shall inspect the portion of the system for approval prior to acceptance of the system or subsystem.

C. The Contractor shall prepare a certificate of acceptance for approval by the Owner for that portion of the Work and submit a copy to the Architect/Engineer for record purposes.

26 00 46 OPERATIONS AND MAINTENANCE MANUALS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following to receive payment beyond 75% of the contract amount. This information shall be submitted as soon as practical and while the Contractor is on site.

1. Provide digital PDF documents containing information on installation operation and maintenance for each piece of equipment supplied. Operation and Maintenance Manuals shall be the manufacturers original PDF documents.

2. The Electrical Operations and Maintenance Manuals shall be submitted as separate files per specification section to the Engineer digitally via thumb drive, shared cloud drive, etc. for review.

3. The information shall list any maintenance requirements and schedule for required maintenance.

4. The information shall show all parts and part numbers of available replacement parts available for each piece of equipment.

5. A cross-index of material and equipment furnished containing:
   a. An alphabetical listing of material and equipment.
   b. An alphabetical listing by manufacturer’s name, address and contact person of the local sales representative.
   c. An alphabetical listing of all subcontractors including name, address, contact person, and specific work performed.

26 00 48 CLOSE-OUT REQUIREMENTS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following before final payment will be released. This information shall be submitted prior to project completion:

1. Equipment tag list.

2. Installed Arc-Flash Labels

3. Equipment Name Plates

4. Operation and Maintenance Manuals

5. As-built drawings.

6. At the completion of the project, all contractors/subcontractors shall submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all penetrations are smoke or fire stopped as required by the Code.
26 00 49 GUARANTEE

A. The Contractor shall guarantee all material, equipment and workmanship provided for this project to be free from defects for a period of one (1) year after final acceptance. The guarantee shall include replacement of the defective part(s) and related labor. Manufacturer’s written guarantees shall be provided where it is published.

B. Any obvious defects shall be corrected before final acceptance. For additional defects after final acceptance, the Owner shall advise the Contractor in writing, unless the situation is urgent, to address the deficiency or malfunction. The Contractor shall respond promptly and with no additional compensation for a valid guarantee claim.

C. Longer guarantee periods of time or special conditions may be specified. See particular specifications for these requirements.

D. If a written guarantee is offered for conditions or period exceeding specified requirements; this guarantee shall be included in the “Close-out” specifications of Subsection 26 00 48.

E. The Contractor shall not qualify the guarantee with requirements placed upon the Owner. If the Contractor has concerns with maintenance of a piece of equipment then Contractor shall allow for making periodic inspections, adjustments, etc. during the warranty period.

26 00 50 PAYMENTS

A. See General Conditions Article – Payment to the Contractor, and General Conditions Article – Contractor’s Payment to the Subcontractor.

26 00 60 MATERIAL AND EQUIPMENT

A. All equipment and materials furnished and installed by Contractor shall be new. The equipment to be furnished and installed shall be standard cataloged products of manufacturers regularly engaged in the production of this type of equipment and shall be of the latest design. Equipment of the same general type shall be of the same make throughout the Project.

B. Manufacturers shall have been in business for two (2) consecutive years operating under the same name.

C. Products shall be in production at time of the bid date. A scheduled release of a new product during construction is not acceptable. Prototype, alpha or beta products shall not be used.

D. Products for which fewer than 100 units have been produced and which have been in service for less than one year shall be submitted in writing to the Engineer for approval prior to the bid date.

E. The Contractor shall be responsible for the physical fit and configuration of the equipment to suit the space available and the intent of the Work. Due consideration shall be included for external connections and service maintenance access to the equipment.

F. The Contractor shall verify in the course of preparing the submittal that the respective material and equipment comply with the following criteria of the Project Documents:

   G. The performance ratings meet the specified requirements.

   H. The mechanical and electrical physical characteristics meet the specified requirements.
I. The identification of the material or equipment to catalog data is correct and proper.

J. Confirm (or establish) the quantity required.

K. The application of the material or equipment is acceptable to the manufacturer and to the intent of the scope of Work.

L. Any inability of material and/or equipment to comply with the aforementioned criteria shall be promptly brought to the attention of Architect/Engineer.

26 00 61 EQUIPMENT MANUFACTURERS

A. The equipment manufacturer may be specified in any one of the following manners. Equivalent shall mean, equivalent in the opinion of the Engineer. Where equipment is scheduled on the drawings, the scheduled manufacturer is what the design is based upon:

1. Single manufacturer named, "No substitution allowed":

2. Single manufacturer named followed by "or approved equivalent": The design has been based on this particular make and model for acceptable physical characteristics, performance and quality. Any other comparable and equivalent product may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

3. Limited multiple manufacturers named: The design has been based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

4. Limited multiple manufacturers named followed by "or approved equivalent": The design is based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and along with other comparable and equivalent product may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

5. List of "Acceptable Manufacturers": Where a specific product from a manufacturer is listed along with the words “Acceptable Manufacturers” and a list of manufacturers this equal product(s) of any of the limited list may be submitted without concern from Subsection 26 00 62.

B. The Contractor shall follow the option specified from above as applied to each respective material and equipment specification subsection. The Contractor shall indicate within the options allowed the respective supply source(s) for the listing requested in Subsection 26 00 43. The Contractor shall assume all responsibilities and liabilities of “or equivalent” substitutions (see Subsection 26 00 62).

C. The Contractor shall prepare and transmit submittals for approval, even for the option of Subsection 26 00 61.1.
A. General: As previously stated, the design has been based on a single manufacturer and model. Substitution, where permitted (as described above), may cause consequential effects that may impact on the Project. These effects may take various forms and may require changes in the design. These changes and any additional costs associated therewith are the responsibility of the Contractor proposing the substitution; no additional compensation shall be provided to the Contractor.

B. A possible change in design may result from the proposed substitution from one or more of, but not limited to, the following conditions:

1. Architectural: different physical configuration, size or fit, aesthetics effected.
2. Structural: different bearing or heavier loading.
3. Capacity: different performance, lesser output is unacceptable.
4. Mechanical: change in flow rates (air, water, etc.), different configuration and size of external piping or ductwork connections.
5. Electrical: different horsepower requirements, effect on distribution.
6. Controls: interconnections with control devices and equipment, additional requirements.
7. Impact on environmental or energy efficiency issues.
8. Departure from intent of original design or Project Documents.

C. Changes in loading, sizing and/or performance of the proposed substitution shall consider the total requirements served or needed by the particular equipment. A revised design to accommodate the substitution shall be extended to the point where the change has no effect on the parameters used in the original design.

D. An equipment substitution requiring a change in the design shall be processed as follows:

1. The Contractor shall prepare and submit to the Architect/Engineer for review, a proposal to provide a substitution that shall require a change in the design. Substantiate that the substitution complies with the intent of the Project Documents and include sufficient information of the changes required so that a judgment may be rendered.
2. Proposal shall include an original drawing originated by the Contractor, and shall not be a catalog cut, assembly manual, or other generic documented printed by the manufacturer or their representative. The design shall show the intended installation to the same level of detail as that of the original design.
3. Prior to submitting the proposal, the Contractor shall notify all other contractors whose work may be affected and request details and pricing for their respective changes. This information along with the Contractor's details shall be transmitted to the Architect/Engineer for approval.
4. The Contractor in preparing the proposal recognizes that they shall compensate other trades that are affected by said proposal.
5. If the proposal and the substitution are acceptable, the Architect/Engineer will approve the submittal and initiate a change order, at no additional compensation, and a notice to proceed.

E. Equipment that was listed as a multiple manufacturer with a model number shall be submitted as a shop drawing. Contractor shall be responsible for all other provisions of Section 26 00 52. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Product Documents.
F. Equipment that is being proposed as ‘or equivalent’ or was listed as a multiple manufacturer without a model number shall be in the form of a written proposal before the shop drawing phase. ‘Or equivalent’ shall mean or equivalent in the opinion of the Architect/Engineer and they shall have sole discretion to determine whether or not a proposed substitute manufacturer and/or model is to be considered as acceptably equivalent and may be submitted in the form of shop drawings. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Project Documents.

G. If changes are in fact required or a delay in work occurs because of the material or equipment substitution which were not properly processed, the Contractor initiating the substitution shall be liable for all consequential effects and expenses to accommodate the change or delay.

26 00 63 MOTORS

A. The following are basic minimum requirements for all motors. Additional motors, more detailed and specific requirements may be specified with the respective equipment.

B. Single-phase motors shall be provided for all motors 1/2 HP or less, except as specified or scheduled otherwise and shall be of the permanent split capacitor (PSC) type.

C. Polyphase motors shall be provided for all motors 3/4 HP or larger, except as specified or scheduled otherwise with a minimum power factor of .85 at 65% of full load or shall be power factor corrected.

D. Multi-speed motors shall have dual windings wound to the speeds scheduled or specified.

E. Torque characteristics shall be sufficient to satisfactorily accelerate the driven load(s) with low in rush current.

F. Motor horsepower sizes shall be large enough so that the driven load shall not require the motor to operate in the service factor range.

G. Temperature rating: Rated for 40 deg. C environment with maximum temperature rise for continuous duty at full load of 40°C for open dripproof motors, 50°C for splash proof motors, and 55°C for totally enclosed motors (Class B insulation). Motors used with variable frequency drives/inverters shall have a Class B temperature rise with Class F insulation design to resist transient spikes, high frequencies, and short rise time pulses produced by inverters.

H. Starting capability: Frequency of starts as specified by the automatic control system. For manually controlled motors, not less than five (5) evenly time spaced starts per hour.

I. Service factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

J. Motor construction:

1. NEMA standard frame sizes, general-purpose open dripproof (unless otherwise specified), continuous duty, Design “B” (unless “C” is required for high starting torque). Motor frame, end bells and conduit box shall be cast iron; stator windings shall be copper. Aluminum is unacceptable for any parts. Provide grounding lug in motor terminal box.

2. Motors located outdoors or otherwise exposed to water, dust, etc where an open motor would not be suited, shall be totally enclosed fan-cooled (TEFC).

3. Bearings: Ball or roller bearings with inner and outer shaft seals. Externally accessible inlet/outlet grease fittings. Where motors are enclosed within equipment, extend grease tubing to exterior of the enclosure. Bearings designed to resist thrust loading for drives producing lateral or axial thrust. Fractional horsepower, light duty motors may have sleeve bearings.
4. **Overload protection**: Built-in thermal overload protection.

5. **Noise rating**: Motors shall meet IEEE, Standard 85.


7. **Nameplate**: Indicate full identification of manufacturer's name, model number, serial number, horsepower, speed, voltage, characteristics, construction, special features, etc. Nameplates in harsh environments such as for cooling towers, or in pool equipment rooms, etc. shall be suited to the specific application.


### 26 00 64 ACCESS DOORS

A. Openings in building components for access to concealed mechanical work shall be furnished by the Contractor and installed with the building construction work. Access doors shall be located as indicated on the Plans or as strategically required for inspection, maintenance, and service. The model and style shall fit the building construction, fire rating requirements and provide adequate size and function.

B. Access doors shall be sized as shown on the drawings or shall be a minimum size of 18” x 18” and otherwise shall be large enough for purpose intended and shall be fabricated of heavy gauge steel frames and door panels with double action concealed spring hinges, 1/4 turn flush screwdriver operated cam locks and prime coat paint finish. Access doors for various applications shall be as follows:

- **Building Construction**:
  - Flush door in dry wall construction (walls and ceilings)
  - Flush door in masonry or tile walls with exposed frame flange
  - Flush door in plaster construction (walls and ceilings)
  - Recessed door in acoustical plaster ceiling
  - Recessed door in suspended drywall ceiling
  - Door in suspended drywall ceiling
  - Fire rated separation (walls and ceilings) - fire rated door

- **Milcor Access Door**:
  - Style DW
  - Style M (steel), Style MS (stainless)
  - Style K
  - Style AP
  - Style CT (aluminum - wet locations)
  - Style CF (aluminum - wet locations)
  - Style ATR (fire resistive door)

C. Access doors are not required for Work above lay-in panel ceilings.

D. Submittals shall indicate schedule of locations, sizes, types, adjacent building construction, finish, fire rating including thickness and type of insulation, conformance to UL requirements and associated labeling, metal and gauge of fabrication. Access door shall be as manufactured by Karp Associates, Milcor, or Higgins Mfg. Company.

### 26 00 70 BASIC ELECTRICAL METHODS - GENERAL

#### 26 00 71 COORDINATION OF WORK

A. The Contractor shall compare the electrical drawings and specifications with the site conditions, drawings and specifications of other trades and shall report any discrepancies between them to the Architect and obtain from him written permission for changes necessary in the electrical work. The Contractor at no addition to the contract price shall perform any such changes.
required. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required in the work of the Contractor caused by his neglect to properly coordinate the work shall be made by him at his own expense.

B. In new construction, anchor bolts, sleeves, inserts and supports required for the electrical work shall be furnished under the same Section of the Specifications as the respective items to be supported; and they shall be installed, except as otherwise specified, by the trade furnishing them in cooperation with the trade furnishing and installing the material in which they are to be located. It shall be the responsibility of the Contractor who locates the anchor bolts, sleeves, inserts and supports to also ensure that they are properly and safely installed.

C. Slots, chases, openings, and recesses through floors, walls, ceilings, partitions, and roofs shall be provided as the building is erected. It shall be the responsibility of the Contractor or trade requiring and providing the opening to verify the size and location of openings required and to furnish necessary sleeves, boxes, etc., for the equipment to be supplied. Patching of oversize openings and finished thereof shall be the responsibility of the trade or Contractor requiring the opening. All patching and finishing shall be done to match the adjacent materials as described in other respective divisions and sections of the specifications. No openings shall be cut in structural members without prior written approval of the Architect.

D. Locations of conduits, electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each conduit, duct and electrical raceway prior to fabrication. If the Contractor fails to do so, any relocation and reinstallation required will be directed by the Architect and must be implemented by the Contractor at no cost to the Owner.

E. Right-of-way: Lines which pitch shall have the right of way over those which do not pitch. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed. Offsets, transitions and changes in direction in pipes and buss ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all elbows, pullboxes, turns, fittings, supports, etc., as required to effect these offsets, transitions and changes in direction.

26 00 72 STORAGE AND INSTALLATION OF EQUIPMENT AND ACCESSORIES

A. Equipment and materials shall be delivered to the site, stored in location(s) approved by the Architect, and suitably sheltered from the weather, but readily accessible for inspection by the Owner. All items subject to moisture damage shall be stored in dry, heated spaces. All equipment shall be covered and protected against dirt, water and chemical or mechanical injury in a manner approved by the manufacturer and against theft, during storage, installation, and construction. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

B. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation of all equipment and materials. The Contractor shall promptly notify the Architect in writing of any conflict between any requirement of the contract documents and the manufacturer's directions. They shall obtain the Architect's written instruction before proceeding with the work. In case of a difference between the installation instructions of the manufacturer and the instructions in the contract documents, the most stringent shall govern. Any costs related to changes required due to manufacturer's instructions differing from the contract documents shall be borne by the Contractor at no cost to the Owner.
C. Should the Contractor perform any work that does not comply with the manufacturer’s directions, any written instructions from the Architect, or which shall cause a significant deviation from the drawings which has not been by the Architect they shall bear all costs arising in correcting the deficiencies in a manner directed by the Architect.

D. Where switchgear, motor controls, transformers, or other electrical equipment is located in a space with a concrete or other type of paved flooring, it shall be set on a raised concrete pad. Unless otherwise noted on drawings or elsewhere in these specifications, concrete pads and bases shall be furnished and installed by the Contractor furnishing the equipment. This Contractor shall establish sizes and location of the various concrete bases required and shall provide all necessary anchor bolts together with templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with a suitable plate at bottom end of sleeve to hold the bolt. Each concrete base shall be not less than 9” high, unless noted otherwise, which shall project 1-1/2” beyond the equipment on all sides.

E. Where equipment is located in a space where it does not rest on a concrete or similar paved floor, it shall be supported from or on the available structure on a structural frame made of suitable channels, wide flange members or angles. The structural frames shall allow no deflection with the loads imposed and the respective supporting points, shall distribute the load equally to two or more major building structural elements, and shall be designed to carry all loads into the major building structural members, creating no measurable deflection on these members nor importing any vibration into the building structure.

F. All machinery which contains rotating or reciprocating parts or which is connected to other machinery with such parts shall be provided with vibration isolation mounts which shall be selected at a maximum transmissibility of 0.03 (isolation efficiency of 97%) at the lowest anticipated operating speed of the device.

G. The Contractor shall support plumb, rigid and true-to-line all work and equipment furnished under each section. The Contractor shall study thoroughly all general, structural, mechanical and electrical drawings, shop drawings and catalog data to determine how equipment, fixtures, etc., are to be supported, mounted or suspended and shall provide steel bolts, inserts, pipe stands, brackets, and accessories for proper support whether or not shown on drawings. When directed by the Architect, the Contractor shall submit drawings showing supports for approval.

H. All conduit connecting to switchgear, panels, motors, and other equipment shall be installed without strain at the connections. The Contractor may be required, as directed, to disconnect conduits piping to demonstrate that they have been so connected.

I. The Contractor shall install all electrical work to permit removal (without damage to other parts) of switches, contactors, motors, drawout circuit breakers, belt guards, sheaves and drives and all other parts requiring periodic replacement and maintenance. The Contractor shall provide conduits, pullboxes, junction boxes, bus ducts, switchgear, raceways and equipment to permit ready access to components and to clear the openings of swinging and overhead doors and of access panels.

J. The Contractor shall change the routing of conduits and buss ducts when required to meet job conditions. The Contractor shall secure approval of Owner prior to fabrication of equipment requiring such changes.

26 00 80 BASIC ELECTRICAL METHODS – RELATED WORK

26 00 81 DEMOLITION

A. Work Included:
1. The Owner shall keep possession of the designated equipment, including switchgear, transformers, motors, generators, panelboards, light fixtures, etc., as shown on the Plans, or as indicated during construction, or as hereinafter specified. The Contractor shall deliver, off-load and store this property as directed by the Owner. Machinery components not to be retained by the owner, including the above type of equipment and conduit, wire, hangers, brackets, insulation, wiring devices, etc., must be disconnected and removed from the premises, to be disposed of by the Contractor.

2. Contractor shall disconnect and remove all existing machinery, equipment, and apparatus to the extent shown on the drawings or otherwise described herein.

3. The Contractor shall legally dispose of the designated equipment, and/or apparatus. Any cost of removal or salvage value shall be credited to the Contractor's account and shall be considered accordingly in the Contractor's bid.

B. Work Not Included:

1. The removal and disposal of asbestos based insulation or other hazardous materials applied to, or contained in, the mechanical equipment, and material designated to be demolished shall not be included in the scope of the work regardless if known ahead of time or discovered in the course of performing the Work. In the latter case, the Contractor shall notify the Architect/Engineer and shall not pursue that portion of the Work until others have removed the asbestos-based material. The removal and disposal of asbestos-based material shall be arranged by and to the account of the Owner, and conducted separately from the demolition work.

C. Miscellaneous:

1. Where items are specifically identified to be abandoned, all loose ends of the system shall be trimmed clear and appropriately capped or sealed in a safe and secure manner as approved by the Architect/Engineer.

26 00 82 CUTTING AND PATCHING

A. The basic premise of this Sub-section is that the cutting and patching (where required) are performed in existing building components. In “new” construction, the premise is that the building component is already in place.

B. The Contractor requiring the penetration of or the access way in the building structure to fulfill the intent of the Project Documents for his Work shall be responsible for the cutting and the subsequent patching in accordance with the following criteria:

1. No structural component of the building shall be cut or violated without express approval of the Architect/Engineer.

2. The Contractor shall verify the presence of any concealed utility or service within the structure (walls, roof, floor, etc.) in question, and shall be responsible for maintaining continuity and/or replacing it.

C. Cutting of work-in-place in “new” construction because of error, neglect or damage inflicted shall be the responsibility of the Contractor precipitating the issue.

D. “Patching” shall be construed as the repairing or replacing of the building structure to return it to an original or new condition, in the opinion of the Owner and/or Architect/Engineer, as existed prior to the cutting.

E. Patching and finishing work shall be the responsibility of the Contractor requiring the cutting. The patching shall match all the substantive and visual aspects of the structure and adjacent surfaces. Restoration and finishes shall be as specified and executed in the respective sections, schedules and/or details of the Project Documents for the general construction work.
Completed work and any special requirements shall be subject to approval by and satisfaction of the Architect/Engineer.

26 00 83  LUBRICATION

A. This Contractor shall provide all oil for the operation of all equipment furnished by him until acceptance. Run in all bearings, and after they are run in, drain all oil from the bearings, flush out all bearings, and refill with new oil. The Electrical Contractor and Subcontractors shall be held responsible for all damage to bearings while the equipment is being operated by them up to the date of acceptance of the equipment. Protect all bearings during installation and thoroughly grease steel shafts and other unpainted steel surfaces to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

26 00 90  TESTING AND ADJUSTING

26 00 91  INSTRUCTIONS OF OWNER'S REPRESENTATIVE

A. Instruct the designated representative of the Owner in the proper operation and maintenance of all elements of the electrical systems. A competent representative of the Contractor shall provide such formal instruction and shall spend such additional time as directed by Architect/Engineer to fully prepare Owner to operate and maintain the electrical systems.

26 00 92  TESTING AND ADJUSTING

A. Contractor shall, at the conclusion of the project, performance test and adjust all of the electrical systems to provide performance of all systems and subsystems installed and in all areas of the building. All power systems, communication systems, control systems and other related devices and subsystems shall be operated by the Contractor for a period of no less than seventy-two (72) hours and shall be systematically tested for proper sequencing, control, connection, phasing, rotation and calibration of control devices.

B. Testing shall be systematic and thorough, and the results of these tests shall be submitted to the Architect/Engineer prior to final acceptance of the work. The format of this testing and adjusting effort, including all measurement techniques and methods, shall be submitted sixty (60) days prior to the completion of the work. After agreement with the Architect/Engineer on the format of the testing and adjusting work, the Contractor shall perform the work and resolve any and all deficiencies as they appear during the testing. It shall be the responsibility of the Contractor to provide any and all devices required for the successful testing and adjusting of the system.
PART 1 GENERAL

1.1 DESCRIPTION

A. The purpose of this section is to specify the Contractor’s responsibilities and participation in the commissioning process.

B. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Commissioning is primarily the responsibility of the Commissioning Authority, with start-up, testing and support for commissioning the responsibility of Division 26. The commissioning process does not relieve the Contractor from participation in the process or diminish the role and obligations to complete all portions of work in a satisfactory and fully operational manner.

C. Work of Division 26 includes:

1. Testing and start-up of the electrical equipment.
3. Providing qualified personnel to assist in commissioning tests required after the initial commissioning.
4. Completion and endorsement of Pre-functional Construction Checklists provided by the Commissioning Authority to assure that Division 26 equipment and systems are fully operational and ready for functional testing.
5. Providing equipment, materials and labor necessary to correct deficiencies found during the commissioning process which fulfill contract and warranty requirements.
6. Providing operation and maintenance information and as-built drawings to the Commissioning Authority for review verification and organization prior to distribution.
7. Providing assistance to the Commissioning Authority to develop, edit and document system operation descriptions.
8. Provide a detailed start up plan for Burns & McDonnell (BMcD)’s review, comment and recommendation.
9. Provide at the end of the job the following items for inclusion in the systems manual.
   a. Control drawings, sequences of control
   b. A table of all set points
   c. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown
d. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems.

10. Use (BMcD)'s on-line and window based Commissioning application to fill out Construction Checklist and to track issues resolutions. Attendance a one BMcD training class is required for all contractors. This training will take place at the construction Cx kick off.

11. Providing training for the systems specified in this Division.

1.2 RELATED WORK

A. All installation, testing and start-up procedures and documentation requirements specified within Division 26 and related portions of this project.

B. Section 019113 – Commissioning

C. Commissioning Functional Test Procedures that required participation of the Division 26 Contractors.

D. Cooperate with the Commissioning Authority in the following manner:

1. Provide all testing and start-up procedures and documentation requirements specified within Division 1 and Division 26 and related portions of this project.

2. Allow sufficient time before final completion dates so electrical systems start-up and commissioning can be accomplished.

3. Provide labor, specialty equipment and material to make required connections, circuitry and delay.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. Standard test equipment for commissioning will be provided by the Contractor.

B. Division 26 Contractor or 3rd party NETA certified agency shall provide standard and specialized test equipment as necessary to test and start up the electrical systems.

C. Proprietary test equipment required by the manufacturer, whether specified or not, shall be provided by the manufacturer of the equipment through the installing contractor. Manufacturer shall provide the test
equipment, demonstrate its use and assist the Commissioning Authority in the commissioning process.

D. The Contractor shall provide all equipment, software and all test programming support as necessary to start up, calibrate, debug and verify proper function of the control/facility management system. This equipment and software shall be provided for use by both the test and balance contractor and the Commissioning Authority.

PART 3 EXECUTION

3.1 WORK PRIOR TO COMMISSIONING

A. Complete all phases of work so the systems can be energized, started, tested and otherwise commissioned. Division 26 has primary start-up responsibilities with obligations to complete systems, including all sub-systems, so they are functional. This includes the complete installation of all equipment materials, raceways, wire, terminations, controls, etc., per the Contract Documents and related directives, clarifications, change orders, etc.

B. A Commissioning Plan will be developed by the Commissioning Authority. Upon request of the Commissioning Authority, the Contractor shall provide assistance and consultation. The Commissioning Plan will be developed prior to completion of the installation. The Contractor is obligated to assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If Contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect and the Contractor may be obligated to compensate the Commissioning Authority to test the revised product or confirm the suitability/unsuitability of the substitution or revision.

C. Specific pre-commissioning responsibilities of Division 26 are as follows:

1. Normal start-up services required bringing each system into a fully operational state. This includes motor rotational check cleaning, lug tightening, control sequences of operation, etc. The Commissioning Authority will not begin the commissioning process until each system is complete, including normal contractor start-up and debugging.

2. The Contractor shall perform pre-functional construction checklists on the systems to be commissioned to verify that all aspects of the work are complete in compliance with the plans and Specifications. Contractor start-up forms may be substituted for the pre-functional test forms with prior approval by the Commissioning Authority.
SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

3. Factory start-up services will be provided for key equipment and systems specified in Division 26. Factory start-up activities to be documented and submitted. The Contractor shall coordinate this work with the manufacturer and the Commissioning Authority.

4. Notify Construction Manager and Commissioning Authority when systems are ready for functional testing.

D. Commissioning is intended to begin upon completion of a system. Commissioning may proceed prior to the completion of systems and/or sub-systems, if expediting this work is in the best interests of the Owner. Commissioning activities and schedule will be coordinated with the Contractor. Start of commissioning before system completion will not relieve the Contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING

A. Commissioning testing shall be performed by this division Contractor and documented by the Commissioning Authority. Provide skilled technicians to start up and debug all systems within this division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Contractor. Contractor will ensure the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments and/or problem resolutions.

B. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and/or reconstruction of systems and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purpose of this work.
3.3 WORK TO RESOLVE DEFICIENCIES

A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in a system that does not meet the original design intent. Correction of work will be completed under direction of the Architect, with input from the Contractor, equipment supplier and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate and work out problems, the Architect/Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance.

3.4 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor, suppliers and Commissioning Authority shall include a reasonable reserve to complete this work as part of their standard contractual obligations.

B. The cost of compensation of the Commissioning Authority for repeat testing or troubleshooting due to systems that do not meet specified performance shall be borne by the Contractor.

C. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process.

3.5 SYSTEMS TO BE COMMISSIONED

Refer to specification section 019113.

3.6 TRAINING

A. This Contractor will be required to participate in the training of the Owner’s engineering and maintenance staff for each system and the related components. Training may be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids, or in the field with the specific equipment. The type of training will be per the Owner’s option.

3.7 SYSTEMS DOCUMENTATION

A. Maintain as-built red-lines on the job site as required in Division 1. Given the size and complexity of this project, red-lining of the drawings at completion of construction based on memory of key personnel is not satisfactory. Continuous and regular red-lining and/or posting of drawings is considered essential and mandatory.
B. In addition to the stated requirements for operation and maintenance data, provide one (1) copy of equipment technical literature, operation and maintenance literature and shop drawings to the Commissioning Authority as soon as they are available. This requirement is for review of these documents prior to distribution of multiple copies for the Owner’s final use.

C. Schedules, instructions for operation of each piece of equipment for emergencies, seasonal adjustment, startup and shutdown

D. A list of all manufacture recommended preventive maintenance procedures for all equipment and systems

END OF SECTION
26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

A. Extent: The work in this division consists of furnishing material and labor required to completely execute the electrical work for this project as per drawings and as specified herein.

C. Interface with Other Trades: This contractor shall connect some items furnished in place by others such as prewired mechanical control assemblies. This will require coordination and cooperation with the other contractors. The extent of the required electrical work is shown on the drawings.

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

A. Material

1. Provisions for Wiring: Wire and cable of the sizes and types shown on the plans and/or hereinafter specified shall be furnished and installed by the Contractor. All wire and cable shall be new soft drawn copper and shall conform to all the latest requirements of the National Electrical Code IPCEA, and meet the specifications of the ASTM.

2. Power Conductors: All feeder and branch circuit wire shall be 600V 90°C insulated of the THHN & THWN-2 type unless shown or specified to be otherwise No wire less than No. 12 AWG shall be used except for control circuits or low voltage wiring. All wire sizes shown are American Wire Gauge sizes.

   a. 20A Branch Circuit Homeruns shall be sized as follows:
      120V: 0 – 100 feet shall be #12AWG wire minimum  
             101 – 200 feet shall be #10AWG wire minimum  
             In excess of 200 feet shall be #8AWG wire minimum
      277V: 0 – 250 feet shall be #12AWG wire minimum  
             In excess of 250 feet shall be #10AWG wire minimum

3. Control Conductors: Control circuit wiring shall be No. 12 AWG or smaller stranded wire. Stranded control wire shall be provided with crimp type spade terminators. Control circuit wiring shall be color-coded or numbered using an identical number on both ends of the conductor.

B. Installation

1. All 120V and 277V single phase circuits require a dedicated neutral conductor. The neutral conductor shall be numbered and identified with associated phase conductor at the panelboard as well as all junction boxes.

4. Where circuit runs are combined, upsize conduit and conductors to accommodate for conduit fill and conductor derating respectively.

3. Metal Clad (MC) Cable

   a. Type MC cable is not permitted.

4. BX/AC Cable

   a. Type BX/AC cable is not permitted.
26 05 26  GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

A. Material

1. Contractor shall extend the existing equipment grounding system in accordance with the National Electrical Code and shall use only UL listed grounding clamps and connectors.

B. Installation

1. The grounding system grounding electrode conductor shall be connected to the neutral bar inside the main panel.

2. The equipment grounding system shall consist of a continuous conduit installation and a green insulated equipment grounding conductor. This grounding conductor shall be installed in every conduit or raceway with the feeder or branch circuit conductors. **This grounding conductor shall be extended from the housing of every electrical load, through panelboard equipment grounding busses, to the equipment grounding bus in the main panel.** The grounding bus shall be bonded to the grounded neutral bar inside the main panel using a Main Bonding Jumper.

3. When transformers are used to provide a separately derived system, the Contractor shall connect the grounding electrode conductor to the neutral bar (grounded system conductor) inside the transformer. The system bonding jumper shall also be installed inside the transformer.

4. The transformer cover shall not be installed until the Engineer has inspected the transformer grounding. Provide pictures to engineer if this does not work with project schedule.

26 05 33  RACEWAY FOR ELECTRICAL SYSTEMS

A. General Requirements

1. Minimum conduit size shall be ¾” trade size for branch circuits except for switch legs which may be ½” trade size. Minimum conduit size shall be 1” trade size for feeders and shall be sized at least one size above the NEC requirement of wire being installed or anticipated to be installed.

2. A bushing shall be used where conduit enters a panel box or equipment enclosure.

3. Grounding Bushings shall be used to bond conduits entering a panel box or equipment that are not mechanically connected.

4. Expansion fittings shall be provided at all conduits across building expansion joints. Fittings shall be Type “AX” or “TX” as made by O-Z Electric Company, or approved equal. Provide copper bonding jumper at each expansion fitting.

5. Conduit bends shall be made with standard benders of proper size; radius of bends to be at least 6 times the diameter of the conduit. Runs between outlets shall not contain more than the equivalent of three 90-degree bends. Conduit runs shall be continuous from outlet to outlet, outlet to cabinet, etc.

6. All exposed conduits shall be installed parallel or perpendicular to the building walls or floors.
7. Conduits shall be securely fastened to or supported from the building structure. Conduits not fastened directly to building structure shall be supported by a rigid assembly, free of sway and adequately braced, connected directly to the building structure. The use of ‘pencil’ wire, ceiling wire, and cable hangers shall not be permitted.

8. Anchor or stake down all direct burial conduits to prevent shifting during grading and concrete pours. Spacers shall be provided for trenches with 2 or more conduits with any conduit 2” or larger.

9. Install #12AWG pull wires for tracing for all underground non-metallic empty conduits with a minimum of 12 inches of slack on each end. Pull strings shall be used for empty above grade or metallic conduits.

10. All raceways installed within 1½” of the roof deck shall be GRS or IMC. Boxes shall be offset below the 1½”.

11. All exposed raceways installed in a finished space will be painted to match the background, unless noted otherwise. Finished spaces include all areas open to the general public. Spaces such as storage, mechanical, IT, and electrical rooms and other similar areas only accessible to qualified personnel are considered unfinished.

12. All penetrations through not rated walls shall be sealed for draft stopping with caulk, putty, etc. designed for this use.

13. Fire / Smoke seals:
   a. All penetrations through fire rated walls and floors shall be fire sealed in accordance with ASTM E814/UL1479 or manufacturer’s recommendations.
   b. Materials and installation details shall be submitted for approval.

B. Electrical Metallic (EMT) Conduit

1. EMT conduit shall be installed for all work concealed in partitions or in concrete block walls and for all conduits run in ceiling plenums and exposed runs, except where noted otherwise. EMT conduit shall not be used outdoors, in wet locations, in floor crawl spaces, or below 7’ AFF in areas where raceway may receive physical abuse (such as hallways, mechanical rooms, storage rooms, and janitor closets) unless the conduit is 2” or larger in diameter.

2. EMT couplings and connectors shall be steel or diecast, compression type.

C. Galvanized Rigid Steel (GRS) Conduit

1. Galvanized rigid steel conduits shall be installed for all exposed outdoor conduit, and for all indoor medium voltage cable runs.

2. All GRS couplings and threaded hubs shall have no less than five threads of the coupling engaged. Running threads shall not be used. All GRS conduits shall be reamed.

3. All GRS conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub.

D. Rigid Aluminum Conduit
1. Rigid aluminum conduits shall be installed for all exterior conduits supplying cooling towers.

E. Polyvinyl Chloride (PVC) Conduit

1. Conduits installed underground shall be schedule 40 PVC and a minimum size of ¾” trade size. Rigid galvanized steel elbows shall be used for all stub-ups through or out of concrete slabs or through underground wall penetrations.

2. All PVC fittings shall be connected with PVC primer and glue.

F. Metal Clad (MC) Cable

1. **Type MC cable is not permitted.**

G. BX/AC Cable

1. **Type BX/AC cable is not permitted.**

H. Jacketed Flexible Steel Conduit

1. Jacketed flexible steel conduit (‘Sealtite’) shall be used in wet areas where flexible conduit connections are required and on all motorized equipment and motors in all locations.

I. Flexible Steel Conduit

1. Flexible steel conduit (‘Greenfield’) shall be used where vibration isolation is required, including all transformers and uninterruptible power systems.

J. High Density Polyethylene (HDPE) – Not used

K. PVC coated Galvanized Rigid Steel Conduit – Not Used

L. MI Cable – Not Used

M. Surface Mounted Raceway

1. General Requirements
   a. Surface mounted raceway shall be as manufactured by Wiremold, Panduit, Hubbell, or Monosystems. Part numbers listed in these specifications or the drawings refer to Wiremold products unless noted otherwise.
   
   b. Furnish raceways with all elbows, fittings, boxes, clips, supports and accessories for a complete installation.

   c. All field modifications to surface mounted raceway shall be made using the manufacturer’s cutting tool with shearing action, maintaining clean joints, free from all burrs.

   d. Furnish and install dividers in all raceways for which dividers are an option.

2. Small Raceway

   a. Raceway shall be V500/V700 Series, V700 shall be used in all areas where V500 fill is exceeded, unless otherwise noted.
b. Raceway shall be steel.
   1. Raceway shall be ivory.

c. Raceway shall be used to route cabling and branch circuiting on existing walls in finished spaces where conduit and wiring cannot be concealed, unless noted otherwise. In mechanical, electrical, and data rooms conduit shall be used in lieu of surface mounted raceway. Refer to this specification section for all conduit requirements.

3. Prewired Raceway, Single Cell
   a. Where indicated on the drawings the Contractor shall furnish and install single cell raceway factory prewired, for power or precut punched data covers with device spacing and wiring as indicated on the drawings.
   
b. Raceway shall be steel- Series 3000.
   
c. The raceway shall be furnished with covers in 12” lengths.
   
d. Refer to specification section 26 27 26 for wiring device requirements. If applicable, provide standard single gang opening for low voltage device faceplates. Contractor shall install low voltage wiring and terminate cables as required by Division 27. All accessories shall be provided with the raceway to accommodate low voltage cable install.
   
e. Custom, project specific shop drawings shall be submitted for review prior to rough-in.

26 05 34   BOXES FOR ELECTRICAL SYSTEMS

   A. Outlet Boxes, Junction Boxes, Fittings
      1. Mounting: Outlets must be centered with regard to paneling, furring, trim, etc. Outlets shall be set plumb or horizontal and shall extend to finished surface of wall, ceiling, or floor without projecting beyond or behind finished surface. Outlet boxes shall not be installed “back-to-back”.
      2. Attaching: Boxes shall be attached by fastener designed for the purpose and shall provide adequate mechanical strength for future maintenance.
         a. Boxes installed in metal stud partitions shall be secured to the metal studs using appropriate clips, fasteners, hangers, or supports as required, and shall provide adequate far side box support to fulfill the intent of all applicable codes.
      3. Pull boxes and junction boxes shall be installed where indicated on the drawings or where required to facilitate wire installation.
         a. Size: Outlet, junction, and pull boxes not dimensioned shall be 4 inch square by 2-1/8” deep minimum and comply with sizing as required by Article 314 of the National Electrical Code.
      4. In fire rated drywall walls, 24” spacing must be maintained between boxes on opposite sides of walls. Moldable fire protective putty pads, firestopping coverplate gaskets, internal fire rated pads or other acceptable fire sealing means shall be installed on outlet boxes where the 24” spacing cannot be maintained.
5. Steel faceplates must be used on fire rated drywall walls and painted to match device color. Faceplates shall be Mulberry Metal Products or equivalent.

6. All outdoor junction boxes and condulets shall be gasketed.

26 05 48 SEISMIC RESTRAINT

A. All materials and workmanship shall specifically comply with the above listed Building Code with respect to seismic requirements for the support and anchorage of all electrical, communications and electronic safety and security systems and equipment as installed on this project. Lateral forces to be restrained shall be as required by IBC Section 1621 Architectural, Mechanical, and Electrical Component Seismic Design Requirements and ASCE 7-02 Section 9.6 Architectural, Mechanical, and Electrical Components and Systems with the following design parameters:

Site Class as Defined in the IBC: B
Assigned Seismic Use Group or Building Category as Defined in the IBC: II

C. All conduit support and restraint details and practices shall conform to the publication “Seismic Restraint Systems Guidelines” by Cooper B-line-TOLCO.

D. Seismic restraint submittals shall be provided for engineer review and include, but not be limited to, detailed drawings showing seismic restraint types, anchor type and attachment details, calculations and spacing requirements of unique equipment and conduit for this specific project. Submittals shall include floor plan drawings indicating equipment, ductwork and piping to be restrained, restraint locations and restraint component types. All submittals and floor plan drawings shall bear the seal of a licensed structural engineer of the State of Missouri.

26 05 73 ARC FLASH HAZARD ANALYSIS, SHORT CIRCUIT AND SELECTIVE COORDINATION

A. The contractor shall furnish an Arc Flash Hazard Analysis Study for all distribution equipment downstream of both ‘RDP1’ and ‘CDP2’, including but not limited to control panels, starters, disconnects, etc. per the requirements set forth in the current version of NFPA 70E. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002.

B. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer, licensed in the State of Missouri, and skilled in performing and interpreting the power system studies.

C. The studies shall be performed using the latest version of SKM Systems Analysis PowerTools for Windows (PTW) software program.

D. Short Circuit Analysis:

1. Transformer design impedances shall be used when test impedances are not available.

2. Provide the following:

   a. Calculation methods and assumptions

   b. Selected base per unit quantities
c. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis. Labeling of components shall match the one-line and floorplans.

d. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions greater than 10HP, and other circuit information as related to the short-circuit calculations.

e. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.

f. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

3. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

E. Protective Device Coordination Analysis:

1. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

2. Include on each TCC graph, a complete title with descriptive device names.

3. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

4. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

5. Plot the following characteristics on the TCC graphs, where applicable:
   a. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands
   b. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands
   c. Transformer full-load current, magnetizing inrush current, inrush/full load current multiplier, and ANSI through-fault protection curves
   d. Medium voltage conductor damage curves
   e. Ground fault protective devices, as applicable
   f. Pertinent motor starting characteristics and motor damage points, where applicable
   g. The largest feeder circuit breaker in each motor control center and applicable panelboard.
6. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

7. Final overcurrent device settings as identified by the protective device coordination study shall be implemented by the installing contractor.

F. Arc Flash Hazard Analysis:

1. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in the latest version of NFPA70E, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis and the protective device time-current coordination analysis.

2. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

3. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

4. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

5. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

6. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

7. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

8. Fault contribution from induction motors should not be considered beyond 5 cycles.

9. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment’s main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
10. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

11. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

12. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

G. Submittal:

1. The results of studies shall be summarized in a preliminary and final report. The preliminary report shall be provided prior to submitted equipment approval. Three (3) bound copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided. The report shall include:

   a. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

   b. Log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

   c. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

   d. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, minimum personal-protective equipment AFIE rating and AFIE (Arc Flash Incident Energy) levels.

   e. Arc Flash Labels shall be furnished and installed in accordance with NFPA 70E and all applicable local codes and standards.

   f. Notify the engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current, of any significant deficiencies in protection and/or coordination and of any significant deficiencies in protection and/or coordination.

   g. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
A. OCCUPANCY SENSORS

1. Ceiling mounted occupancy sensors shall be dual-technology and white in color unless otherwise noted: Watt Stopper #DT-300, Hubbell #OMNI-DT-1000, Leviton #OSC10-MOW, Sensorswitch #CM-PDT-9, Lutron LOS-LDT-1000-WH or approved equivalent.
   a. Sensors shall be programmed to the following time delays:
      1. Open Offices/Classrooms – 30 minutes
      2. Bathrooms – 10 minutes
      3. Conference Rooms – 5 minutes
      4. Corridors – 5 minutes

2. Wall mounted occupancy sensors shall be dual-technology and ivory in color: Watt Stopper #DT-200, Hubbell #LODT, Leviton #OSW12-RMW, Sensorswitch #WV-PDT-16, Lutron LOS-WDT-WH or approved equivalent.
   a. Time delays – Refer to ceiling mount occupancy sensors.

3. Wallswitch occupancy sensors shall be ivory in color and be Watt-Stopper #DSW-100, Hubbell #LHMTS1, Leviton #OSSMD, Sensorswitch #WSD-PDT, Lutron MS-B102 or approved equivalent.
   a. Sensors shall be programmed to the following time delays:
      1. Offices – Adaptive if available, otherwise 30 seconds, walk-through enabled
      2. Conference Rooms – 5 minutes, walk-through enabled
      3. Storage Rooms – 30 seconds, walk-through enabled
      4. Wall Switch Occupancy Sensor Dimmer shall be white/ivory in color and be Wattstopper #DW-311, Lutron MS-Z101-XX or approved equivalent. Time delays – Refer to wallswitch occupancy sensors.

4. Dual relay wall switch occupancy sensors shall be ivory in color and be: Wattstopper #DW-200, Hubbell #LHMTD2, Leviton #OSSMD, Sensorswitch #WSD-PDT-2P, Lutron MS-B202 or approved equipment.
   a. Time delays – Refer to wall switch occupancy sensors.

5. Provide occupancy sensors with relay packs as required or shown on the drawings.

6. Occupancy sensors shall be programmed to ‘manual-on’ unless otherwise specified.

7. Provide open plenum rated wiring in accordance with manufacturer’s wiring diagrams.

8. Rooms or areas with multiple sensors shall be wired so that any sensor activates all lights.

9. Sensors shall be installed a minimum of 6’ from all diffusers.

10. Refer to wiring diagrams on drawings for additional requirements.

B. DIGITAL COUNTDOWN TIMERS
1. WattStopper TS-400, Leviton 61244 Digital Countdown Timer or approved equivalent.
2. Countdown Timer to be programmed to the following:
   a. Storage Rooms – 5 minutes with audio and visual options disabled.
   b. Mechanical/Electrical Rooms – 20 minutes with audio and visual options enabled.

C. DIMMERS
1. Provide dimmer switches as shown on drawings.
2. Contractor is responsible for providing and installing dimmer compatible with LED driver of fixtures.
3. Dimmers to be manufactured by WattStopper, Hubbell, Leviton, Sensorswitch, Lutron or approved equivalent.
4. 0-10V LED dimmers requiring ‘manual-on’ shall be WattStopper #DLV2 or approved equivalent.

A. NETWORK LIGHTING CONTROLS

A. SYSTEM
1. Furnish and install a complete low voltage lighting control system consisting of relay control panels, switches and wiring to provide control as shown on the drawings.
2. Manufacturer shall submit specific connection diagrams and riser diagrams related to this project for approval.
3. System shall be a Wattstopper DLM Lighting Control System as manufactured by Wattstopper or equivalent.
   a. System shall be furnished with a handheld display unit for system programming and time clock functions.
4. System shall be networked to allow complete system control from any switch location.
5. Contractor shall program system as shown in contract documents.
   a. Contractor shall furnish panel directories indicating circuit designation, and area designation for each relay.
   b. Contractor shall furnish the following as operating and maintenance manuals:
      1. Installation and programming instructions for all system components.
      2. Operating instructions for all system components.
      3. Relay schedule documentation.
      4. Switch schedule documentation.
      5. Time Clock schedule documentation.

B. Relays
1. Relays shall be mounted in control panels containing terminal strips, transformers, rectifiers, all interconnecting wiring and switch interface modules for multiple relays. Relays shall maintain position during power outages.
2. Low Voltage Relays shall be Wattstopper relay modules with manual by-pass or equal.

C. Switches

1. Switches shall be 4-wire bus controlled. The 4-wire bus shall be designed for open topology.

2. Switches shall have typed labels indicating fixtures controlled per the drawings.

3. Switches shall have LEDs indicating on/off status.

4. Switches shall be capable of being configured to control a single relay, a group of relays, or pattern control.

5. Lighting Switches shall be Wattstopper switches as indicated on the drawings, or equivalent.

D. Wiring

1. All wiring shall be as required by the equipment supplier.

2. Wiring may be run as concealed open-type plenum rated cable. Exposed or inaccessible wiring shall be installed in conduit. Where possible wiring/conduit shall be concealed.

E. Testing and Checkout

1. The Contractor shall provide a representative from the company to conduct a 4-hour training class at a time scheduled in advance with the Owner and shall occur during or immediately following system startup. These instructions are to be conducted during normal working hours. All pertinent costs shall be included in this contract.
26 20 00  LOW-VOLTAGE ELECTRICAL TRANSMISSION

A. SHORT CIRCUIT RATINGS

1. All short circuit ratings shall be Fully Rated device ratings, not Series Rated.

26 22 00  LOW-VOLTAGE TRANSFORMERS

26 22 13  DRY-TYPE TRANSFORMERS

A. 600 Volts and Below

1. Furnish and install, as indicated on the electrical plans, dry-type transformer as manufactured by Square D Company, General Electric, Hevi-duty, Siemens or Eaton Cutler Hammer.

2. Three phase transformers shall be 480 delta primary and 208Y/120 secondary. Transformer shall have a minimum of 4 - 2-1/2% full current below normal and 2 - 2-1/2% full current above normal taps.

3. Transformers shall be ANSI Class AA (Self-Cooled), as defined by ANSI-C57.12.01. Transformers shall be 115°C-temperature rise above 40°C ambient. 115°C rise transformers shall be capable of carrying a 15% continuous overload without exceeding a 150°C rise in a 40°C ambient. All insulating materials to be in accordance with NEMA ST20-2014 standards for a 220°C UL component recognized insulation system.

4. Transformer efficiency shall be in accordance with DOE 10 CFR 431.192, April 2014.

5. Provide copper windings.

6. Transformers shall be US Department of Energy Candidate Standard Level (CSL) 3 with extremely low no load losses as well as being Harmonic Mitigating. Transformers shall be 115°C-temperature rise above 40°C ambient. All insulating materials to be in accordance with NEMA ST20-2014 standards for a 220°C UL component recognized insulation system.

7. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

a. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

b. Indicate value of K-factor on transformer nameplate.

8. Provide a 4”wide x 1½” high phenolic nameplate reading the following for each switch:

<table>
<thead>
<tr>
<th>kVA TRANSFORMER IDENTIFICATION</th>
<th>(3/8” Lettering)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEEDS LOAD NAME</td>
<td>(3/8” Lettering)</td>
</tr>
<tr>
<td>FED FROM SOURCE NAME</td>
<td>(1/4” Lettering)</td>
</tr>
</tbody>
</table>

9. Submittals

a. Enclosure dimensions
b. KVA rating
c. Primary and secondary nominal voltages
d. Voltage taps  
e. Weight  
f. Insulation class  
g. Temperature rise  
h. Core and coil materials  
i. Impedances  
j. Audible noise level  
k. Inrush data  

10. Refer to Section 26 00 72 for support of equipment and “housekeeping pad” requirements.

26 24 00 SWITCHBOARDS AND PANELBOARDS

26 24 16 PANELBOARDS

A. DISTRIBUTION PANELBOARDS:

1. Fusible Switches and Circuit Breakers: Fusible switches and circuit breakers shall be provided in the sizes and arrangements shown on the drawings. Fusible switches shall accept Class R fuses. Provide a 3” wide x 1” high phenolic nameplate for each switch as follows:

   EQUIPMENT IDENTIFICATION  (3/8” Lettering)  
   __AS__/__AF  (XX AMPS WITH/XX AMP FUSE) (1/4” Lettering)  

   a. The switches shall be provided with a door interlock to prevent access to fuses and switch when energized and manually operated interlock defeat mechanism. The door is to be furnished with “on-off” handle position markings and a means to lock the switch in the open position is to be provided.

8. Manufacturer: Fusible Switches and Circuit breakers shall match existing distribution panelboard manufacturer.

9. Refer to Section 20 00 72 for support of equipment and “housekeeping pad” requirements.

B. CIRCUIT BREAKER PANELBOARDS

1. Panels shall be dead front, safety type, furnished with branch circuit protecting devices, equipment grounding bus, phenolic nameplate, main bus and cable lugs factory assembled, with all components in place, ready for installation. Contractor to determine top or bottom feed for lug placement. Feed locations shall not be reviewed by the Engineer.

2. The circuit breakers shall be of the molded case, bolt-on type suitable for voltage and ampere ratings indicated on drawings and in schedules and shall have a minimum interrupting capacity of 10,000 amperes (120/208V) or 14,000 amperes (277/480V) or as noted on the drawings.

3. Buses and connectors shall be silver or tin plated hard drawn copper of 98% conductivity, with current carrying capacity to maintain established rise tests as defined in UL Standard UL 67.

4. A directory frame shall be attached to inside face of hinged door. The directory card shall be neatly typed to identify circuits. A transparent plastic facing shall protect the directory card. Room numbers shall be included in directory descriptions. Furnish a copy of each
panel directory to the Architect/Engineer. Where existing panelboard loads are modified, the panel directories shall be updated.

5. All flush mounted panelboards shall have spare 1” conduits stubbed up out of the panelboard and extended to above an accessible ceiling. Panelboards in interior wall shall have two conduits stubbed out on both sides of the wall (four conduits total). Panelboards in exterior walls shall have three conduits stubbed out into the building interior.

6. Panelboards to be by Square D Corporation, Siemens, General Electric Company, or Eaton Cutler Hammer.

26 27 00  LOW-VOLTAGE DISTRIBUTION EQUIPMENT

26 27 26  WIRING DEVICES

A. General: Furnish and install wiring devices as scheduled in Table 1 below, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA and FedSpec standards.

1. Provide ivory color devices and nylon wall plates except as otherwise indicated.

B. Listings and Standards:

Switches - UL20, FedSpec WS896-E
Hospital Grade Receptacles - UL498, FedSpec WC-596F, NEMA WD-1 and WD-6

TABLE NO. 1

Note: Ivory catalog # is listed, provide unless specified otherwise.

<table>
<thead>
<tr>
<th>DEVICES</th>
<th>Hubbell</th>
<th>Leviton</th>
<th>Cooper</th>
<th>P &amp; S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receptacles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20A Duplex</td>
<td>HBL5362-I</td>
<td>5362A-I</td>
<td>5362V</td>
<td>5362A-I</td>
</tr>
<tr>
<td>20A GFI</td>
<td>GF20IL</td>
<td>7899-I</td>
<td>VGF20V</td>
<td>2095-I</td>
</tr>
<tr>
<td>20A Duplex w/ USB</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Grade</td>
<td>HBL8300I</td>
<td>8300-I</td>
<td>8300V</td>
<td>8300-I</td>
</tr>
<tr>
<td>Hospital Grade Tamper Resistant Recessed Clock Outlet</td>
<td>HBL8300TRI</td>
<td>5262-SG</td>
<td>TR8300V</td>
<td>SG62-HI</td>
</tr>
<tr>
<td>Hospital Grade, GFI</td>
<td>---</td>
<td>688-I</td>
<td>TR775W-BOX</td>
<td></td>
</tr>
<tr>
<td>Switches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20A Single</td>
<td>1221I</td>
<td>1221-2I</td>
<td>AH2221V</td>
<td>PS20ACI-I</td>
</tr>
<tr>
<td>20A 3-way</td>
<td>1223I</td>
<td>1223-2I</td>
<td>AH2223V</td>
<td>PS20AC3-I</td>
</tr>
<tr>
<td>20A 4-way</td>
<td>1224I</td>
<td>1224-2I</td>
<td>AH2224V</td>
<td>PS20AC4-I</td>
</tr>
<tr>
<td>20A 2 pole</td>
<td>1222I</td>
<td>1222-2I</td>
<td>AH2222V</td>
<td>PS20AC2-I</td>
</tr>
<tr>
<td>20A Momentary SPDT</td>
<td>HBL1557-I</td>
<td>1257-I</td>
<td>1995V</td>
<td>PS1251-I</td>
</tr>
<tr>
<td>20A Pilot Light</td>
<td>HBL1221PL/PL7</td>
<td>1221-PLR/7PR</td>
<td>2221PL</td>
<td>PS20ACI-RPL</td>
</tr>
<tr>
<td>Nylon Plates Duplex</td>
<td>NP8I</td>
<td>80703-I</td>
<td>5132V</td>
<td>TP8-I</td>
</tr>
</tbody>
</table>
C. Incandescent Wallbox Dimmers

1. Modular preset dimmer switches for incandescent fixtures; switch poles and wattage as indicated, 120-volts, 60Hz, with continuously adjustable slide operator, and soft-tap or other quiet on-off switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch wire connecting leads. Dimmers shall be Lutron Nova Series, Leviton Decora Series, Prescolite Preset Series, or equivalent.

D. All receptacles shall be identified with a black-on-clear printed adhesive label affixed to the [back of the] coverplate. This label shall include the panel and branch circuit number supplying power to the receptacle.

26 28 00 LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

26 28 13 FUSES

A. Electrical Contractor shall furnish and install a complete set of fuses as manufactured by the Bussmann Company or Mersen Electrical Power (Ferraz Shawmut), sized for ordinary service of motors and other loads served and at each safety switch installed as shown on the drawings and as hereinafter specified.

B. Fuses for motor loads and all other loads up to 600 A and up to 600 V shall be Buss “Low-Peak” or Mersen Amptrap 2000 dual element fuses, having a minimum interrupting capacity of 200,000 A RMS symmetrical. The fuses shall be UL Class RK1.

C. Fuses for all loads above 600 A and up to 600 V shall be Buss “Low-Peak” or Ferraz Mersen Amptrap 2000 current limiting, time delay fuses, with a minimum interrupting capacity of 200,000 A RMS symmetrical. The fuses shall be UL Class L.

D. The installation of fuses of mixed manufacturers shall not be accepted. Fuse of only one manufacturer shall be installed.

E. Upon completion of the building construction, the Contractor shall provide a complete set of three spare fuses for each size and type used. Furnish and install a spare fuse cabinet equivalent to Bussmann Model SFC to store fuses over 400 amps.
A. Type of Switch: Furnish and install disconnect switches as specified where shown on the drawings.

1. All disconnect switches shall be classed Heavy Duty and enclosed as required by NEMA Standards. Switch sizes and fusing shall be as shown on the drawings.

2. Switch shall have a quick make, quick break mechanism operating through the box and not the cover. The switchblades shall be visible when the hinged door is open.

3. The cover shall be interlocked with the operating handle to prevent opening door when switch is “ON” and a means provided to lock switch in the “OFF” position. This mechanism shall be capable of being defeated.

4. Provide a 4” wide x 1½” high phenolic nameplate reading the following for each switch:

   | EQUIPMENT IDENTIFICATION               | (3/8” Lettering) |
   | SERVICE DISCONNECT                     | (3/8” Lettering) |
   | FED FROM SOURCE NAME                   | (1/4” Lettering) |

B. Manufacturer: Switches shall be by Siemens, Square D, Eaton Cutler Hammer, or General Electric.

26 29 00  LOW-VOLTAGE CONTROLLERS

A. CONTROL AND INTERLOCK WIRING

1. The Electrical Contractor shall furnish and install control and interlock wiring as shown on the electrical drawings. Control and interlock wiring required by Division 22 or 25 but not shown on the electrical drawing shall be the responsibility of the Division 22 or 25 Contractor requiring the wiring.

2. Generally this will mean that Division 26 wires the series safety circuit to the magnetic starters, furnished with Hand-Off-Auto selector switches, using switches and devices furnished by the Mechanical Contractor.

3. Starter automation, as required by the temperature control sequence of operation, will be provided and wired by Division 22 or 25 with connections made to terminals on the automatic side of the selector switch and on starter coil auxiliary contacts.

4. The intention is that Division 26 furnish and install all wiring necessary to operate the magnetic starters with the selector switch in the Hand position and that Division 22 or 25 provide all additional automation required.

5. Relays, electropneumatic relays, and any other device required by Division 22 or 25 to operate in parallel with the starter coil shall be controlled through spare auxiliary contacts on the starter furnished by Division 26 and shall not be connected to the starter coil.

6. Single-phase motors generally are controlled by line voltage controllers furnished by the Temperature Control Contractor but installed by the Electrical Contractor. If the control sequence is more complicated than a single line voltage device such as a unit mounted thermostat, a relay or control device with a horsepower rated contact will be provided by the Temperature Control Contractor for installation by the Electrical Contractor adjacent to the motor disconnect device. The Electrical Contractor shall provide power-wiring connections to this control device. Temperature Control Contractor will provide control and interlock wiring to this control device.
A. Electrical Contractor shall furnish and install all electrical devices incident to the work except as otherwise stated herein. The Mechanical Contractor will furnish prewired control panels for equipment so indicated on the plans and will furnish EP switches, electrical thermostats, pressure switches and other temperature control devices as required by the specific sequence of operation for installation by the Electrical Contractor. Others will do testing and adjusting of mechanical system devices.

B. The motor and appliance control devices shall be as follows:

1. All starters shall be installed in NEMA 1 Enclosure unless noted otherwise on the drawings. Where noted other than NEMA 1, furnish the indicated NEMA rated enclosure.

2. Single Phase Magnetic Starters - Square D Class 8536 with one overload, 120 volt coil, N.O. auxiliary contacts, heavy-duty 30 mm and hand-off-automatic selector switch in cover all in an oversized NEMA enclosure.

3. Three Phase Manual Starters - Square D Class 2510 Type M, push button operated, lock-out guard, three thermal overloads in a NEMA enclosure. Furnish with or without pilot light and auxiliary contacts as indicated on drawings.

4. Three Phase Magnetic Starters - Square D Class 8536 with three overloads, 120 volt control transformer with 2 primary and 1 secondary fuses, heavy-duty 30 mm, hand-off-automatic selector switch, heavy-duty 30 mm pilot light, and extra N.O. auxiliary contacts all in a NEMA enclosure.

5. Three Phase Combination Starter and Fusible Disconnect Switch - Square D Class 8538 with a NEMA enclosure including a three pole fusible switch and a starter with three overloads, 120 volt control transformer with 2 primary and 1 secondary fuses, heavy-duty 30 mm, hand-off-automatic selector switch and heavy-duty 30 mm pilot light and N.O. auxiliary contacts.

6. Fractional HP Single Phase Manual Starters - Square D Class 2510 Type F, toggle switch operated with lock-out guard, single thermal overload. Furnish starters single speed with or without pilot lights as indicated on the drawings. All surface mounted starters shall be mounted in a ‘FS’ conduit box.

7. Integral HP Single Phase Manual Starters – Square D Class 2510 Type M, push button operated, lock-out guard, single thermal overload in NEMA enclosure. Furnish with or without pilot light and auxiliary contacts as indicated on drawings.

8. Selector Switches and Pushbutton Stations - Square D Class 9001 heavy duty 30 mm in NEMA enclosure.

9. Provide a 3” wide x 1½” high phenolic nameplate reading the following for each motor starter:

   EQUIPMENT IDENTIFICATION
   Size ‘_’ __A Overload
   FED FROM _____

(3/8” Lettering)
(1/4” Lettering)

10. Relays - Square D Class 8501 with 120 volt coil in NEMA 1 enclosure. Furnish with number of poles indicated on the plans.

11. Provide a phenolic nameplate for each motor starter.
12 Devices of similar construction and design as manufactured by Eaton Cutler Hammer, Allen Bradley, Siemens, or General Electric are also acceptable.

**26 43 00 TRANSIENT VOLTAGE SURGE SUPPRESSION**

**26 43 13 SURGE PROTECTIVE DEVICES (SPD)**

A. This section describes the materials and installation requirements for Surge Protective Devices (SPDs), formerly TVSS, for the protection of AC electrical circuits.

B. STANDARDS – Must be listed or comply with the most recent editions of:

1. Underwriters Laboratories: UL1449 and UL 1283
4. NEMA LS-1 (rescinded Aug 19, 2009, replacement undetermined)

C. SUBMITTAL REQUIREMENTS

1. Submittal shall include a copy of the SPD performance parameters listed at www.UL.com under Certifications, searching using Category Code: VZCA, to verify SCCR, VPR, MCOV, I-n, and Type 1 compliance with this specification. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification.

D. PRODUCTS

1. Subject to compliance, the following manufacturers are acceptable:
   
   Eaton, Current Technology, LEA, Dynatech, APT, Square D, Environmental Potentials

2. SPD shall be UL labeled with a 200kA Short Circuit Current Rating (SCCR), as a Type 1 device, and a 20kA I-nominal (I-n) rating.

3. Minimum surge current capability (single pulse rated) per phase shall be:

   Service Entrance or Transfer Switch: 300kA
   Distribution panelboards & MCC: 200kA
   Branch panelboards: 100kA

4. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>L-N</th>
<th>L-G</th>
<th>L-L</th>
<th>N-G</th>
<th>MCOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>208Y/120</td>
<td>700V</td>
<td>700V</td>
<td>1200V</td>
<td>700V</td>
<td>150V</td>
</tr>
<tr>
<td>480Y/277</td>
<td>1200V</td>
<td>1200V</td>
<td>1800V</td>
<td>1200V</td>
<td>320V</td>
</tr>
</tbody>
</table>

5. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
6. All units shall also include a surge counter mounted in the enclosure.

E. INSTALLATION

1. SPD shall be installed in accordance with the manufacturer’s installation manual using the recommended breaker and wire sizes.
2. The SPD unit shall be located as close as is practical to the switch or circuit breaker serving the unit. All efforts shall be made to locate the switch or circuit breaker in a place where the SPD leads are as short as possible. In no case shall the factory SPD leads be extended or spliced.

3. All of the SPD units shall be provided in a NEMA 1 or 12 enclosure, unless otherwise specified.
26 50 00 LIGHTING

26 51 00 LIGHT FIXTURES AND LAMPS

26 51 13 INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

A. LIGHT FIXTURES

1. Furnish and install light fixtures as shown on the drawings and described herein. Fixtures shall be furnished complete with all auxiliaries, hardware, lenses, lamps, sockets, wiring, supports, etc.

2. LED drivers shall be 0-10V dimming, 1-100% unless otherwise indicated. LED drivers shall have Class ‘A’ sound rating, UL Class 2, RoHS compliance.

3. All fixtures installed in plaster or drywall ceilings shall be provided with metal plaster frames. All fixtures in acoustic tile ceilings shall be installed symmetrically in pattern, at center of tile or as noted on drawings. Fixture trim shall be installed to prevent cutting, denting, deforming, or otherwise damaging the ceiling tile.

4. Complete units and all electrical components for all lighting fixtures shall bear the Underwriters’ Laboratories and Electrical Testing Laboratory Labels.

5. All fixtures shall be rigidly supported. Fixtures installed in acoustic tile ceilings shall be rigidly mounted to ceiling frame or structure above in accordance with the NEC and ASTM E580. Fixtures mounted in plaster or gypsum board ceilings shall be secured to the ceiling structure. Fixture mountings to concrete slabs shall be with Phillips “Red Head” expansion anchors or equivalent.

6. All fixtures located in fire-rated ceilings shall be so installed as to protect the integrity of the fire-rated ceiling.

7. The actual locations of light fixtures in mechanical rooms shall be adjusted to avoid interference with mechanical equipment ductwork, and piping.

B. LAMPS

1. All LED fixtures shall have replaceable lamps/light engines for 10 years after installation date.

26 52 00 EMERGENCY LIGHTING

26 52 13 EMERGENCY BATTERY BACKUP BALLAST

A. Emergency Lighting Transfer Switch (LTS)

1. Furnish and install where indicated on the drawings, a Functional Devices, Inc. Generator Transfer Device.

2. Where indicated as type ‘LTS’, furnish and install a Functional Devices, Inc. #ESRN generator transfer device with an ‘ESRTB’ remote test button. The device shall be capable of bypassing the wall switch when the auxiliary generator powers lighting. The device shall consist of relay switching circuitry and be UL924 listed. Inputs fused at 20A maximum; shall draw 280mA and 1.6W during normal operation; and shall comply with the current NEC. The device shall be UL listed for installation remote from the fixture, warranted for a full five years from date of purchase.
27 00 00 COMMUNICATIONS

27 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 27 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 27 of these Specifications.

27 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 27.

27 00 03 REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:

Division 26 – Electrical
Division 28 – Electronic Safety and Security

27 00 04 DEFINITIONS

A. Refer to Section 26 00 05 – Definitions.

27 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications to provide for complete systems.

27 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of the Contractor - Submittals.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS

27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. All cabling shall be as shown on plans, and per specifications.

B. Cabling may be run as open-type plenum rated cable concealed above lay-in ceiling spaces. Non plenum rated cabling is not permitted. Cabling shall be installed in conduit
B. Cabling may be run as open-type plenum rated cable concealed above lay-in ceiling space and exposed open to structure above or cloud type ceilings unless noted below. Cabling shall be installed above bar joist flanges to conceal cabling from view when routed through exposed ceiling. Non plenum rated cabling is not permitted. Cabling shall be installed in conduit in all exterior locations, all areas exposed below 8' A.F.F., and all inaccessible locations including inside wall partitions or above drywall, wood, and other inaccessible ceilings. Cabling shall be installed in conduit in the following spaces:
   1. Electrical, Mechanical Equipment Rooms
   2. Storage and Janitor Closets
   3. Stairwells
   4. Restrooms

C. Cables shall be continuous from outlet to termination equipment.

D. Cables shall be terminated using tools recommended by the termination manufacturer.

E. Provide 2” minimum sleeves in all walls which cable runs pass through.

F. Furnish and install a minimum of (1) one cable pathway device through fire rated partitions and floors, and where indicated on the drawings. Device shall be Specified Technologies, Inc. EZDP33FWS, 3M QuickPass, or equivalent.

G. Furnish and install a minimum of (1) one cable pathway device over all office an exam room doors, and where indicated on the drawings. Devices shall be Specified Technologies, Inc. Acoustical EZ Path, or equivalent.

G. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls.

H. Provide access panels as necessary for cable routing.

27 05 28.29 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

A. Cables shall be supported with “J-Hooks” a minimum of every five feet. Bridal rings can be used when supporting (other than Cat 6) a maximum of six wires. Support devices are to be attached to existing permanent structure.

B. Cables shall be installed in cable tray where available.

C. Cables and supports shall be installed at a readily accessible location above ceilings.

27 05 28.33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

A. Furnish and install conduit rough-ins at all outlets locations where shown on drawings. Rough-in shall consist of a two-gang outlet box, single gang trim ring, and a minimum 1-1/4” conduit stubbed above an accessible ceiling. Plastic bushings shall be installed on both ends of conduit. Install blank covers on all unused rough-ins.

C. All conduits serving telephone/data communication outlets shall be 1-1/4” minimum. Conduits for all other system cable runs shall be sized for 40% maximum fill, or as shown on the drawings. Redundant paths shall be installed where fill exceeds 40%.
D. Provide pull strings in all conduits.
E. Conduit bends shall accommodate radius requirements of fiber cable as necessary.

27 15 00 COMMUNICATIONS HORIZONTAL CABLEING

27 15 13 COMMUNICATIONS COPPER HORIZONTAL CABLEING

A. Description of Work
1. The Electrical Contractor shall furnish and install all materials, accessories, and labor required to install an operational extension of the existing telephone and/or data cabling system. **Category cabling will be furnished, terminated, and tested by the University of Missouri Division of Information Technology. Cable shall be pulled by the Contractor.**
2. The Contractor shall be trained and certified by the equipment manufacturer.
3. The Contractor shall attend coordination meetings with the Owner and Engineer prior to installation.

B. Acceptable Manufacturers
1. Cabling to be furnished by the University of Missouri Division of Information Technology.

C. Rough-Ins
1. Furnish and install rough-ins where shown on drawings. Rough-in shall consist of a two-gang outlet box, single gang trim ring, and a minimum 1-1/4” conduit stubbed above an accessible ceiling. Install blank covers on all unused rough-ins.
2. Maximum fill of conduit is not to exceed forty percent.
3. Furnish and install minimum 2” sleeve through fire rated partitions.
4. Refer to 260529 for fire sealing of penetrations through fire rated walls.

D. Cabling
1. All cabling is provided by the University of Missouri Division of Information Technology.
3. Cable jacket color shall be in accordance with the building standards.
4. Cables shall not exceed 90 meters from termination location to wall outlet.

E. Telephone/Data Cabling Systems Equipment
1. The University of Missouri Division of Information Technology will provide and install terminal blocks for termination of voice cables. The University of Missouri Division of Information Technology will furnish and install
racks, patch panels, and horizontal management for termination of network cables and fiber.

2. Labeling and Standards
   a. Cables at wall outlets and terminations at communication closet shall be identified and labeled as follows, depending on typical vs non typical.

   **Typical**
   V1 - first telephone (or voice) cable at a given outlet.
   N1 - first network cable at a given outlet

   b. The first location shall start with the number (1) and continue, labels at wall outlet shall be TIA/EIA-606 Compliant

   c. All of work described above shall be ANSI/TIA/EIA-568B.1, B.2, B.3-1 & 569B compliant and follow NEC codes local or otherwise.

F. Testing and Labeling
   1. The University of Missouri Division of Information Technology will test telephone and data cabling.

   2. Label jacks at outlet faceplates and patch panels and label cables at the outlets and other termination location in accordance with the building standards.

   3. Provide colored cables and jacks in accordance with the building standards.

G. As Built Drawings
   1. Provide as-built drawings indicating cable routing and cable/jack/patch panel identification.

27 15 33 COMMUNICATIONS COAXIAL HORIZONTAL CABLEING

A. Furnish and install cable television system rough-ins where shown on drawings. Rough-in shall consist of a two-gang outlet box, single gang trim ring, and a 1-1/4” conduit stubbed above an accessible ceiling. Install blank covers on all unused rough-ins.

B. Install one RG-6/U plenum rated coaxial cable, provided by the University of Missouri Division of Information Technology, from each TV outlet to the telephone board in **COMM C4026**. Provide a minimum of 12” of slack at each outlet and five feet at the telephone boards.

C. Where not within a raceway, cable shall be installed in D-rings with five-foot spacing. J-hooks shall be attached to the structure. Label all cables at each end.

D. The University of Missouri Division of Information Technology will provide all cabling, connecting hardware, splitters, terminals, etc. TV outlets shall consist of a female type ‘F’ connector with an ivory faceplate.
E. Provide as-built drawings providing identification and routing of all cables.

END OF SECTION
28 00 00 ELECTRONIC SAFETY AND SECURITY

28 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 28 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 28 of these Specifications.

28 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 28.

28 00 03 REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:

Division 26 – Electrical
Division 27 – Communications

28 00 04 DEFINITIONS

A. Refer to Section 26 00 05 – Definitions.

28 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications to provide for complete systems.

28 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of the Contractor - Submittals.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

28 05 28 PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS

A. All requirements listed in 27 05 28 shall apply for Electronic Safety and Security low voltage cabling unless noted below.

B. Cabling for the following systems shall be installed in conduit:
   1. Fire Alarm
   2. Access Control
3. Video Surveillance

28 05 28.33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

A. Furnish and install conduit rough-ins where shown on drawings. Rough-in shall consist of a 4-11/16” outlet box, single gang trim ring, and a minimum 1” conduit stubbed above an accessible ceiling. Plastic bushings shall be installed on both ends of conduit. Install blank covers on all unused rough-ins.

B. Provide conduit for non plenum rated cable. Exposed or inaccessible cables shall be installed in conduit. Where possible cables/conduit shall be concealed.

C. Conduits for all cable runs shall be sized for 40% maximum fill, or as shown on the drawings.

D. Provide pull strings in all conduits.

E. Conduit bends shall accommodate radius requirements of fiber cable as necessary.

F. Provide sleeves in all walls which cable runs pass through.

G. Furnish and install a minimum of (1) one cable pathway device through fire rated partitions and floors, where indicated on the drawings. Device shall be Specified Technologies, Inc. EZDP33FWS, 3M QuickPass, or equivalent.

H. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls.

I. Provide access panels as necessary for cable routing.
28 30 00 ELECTRONIC DETECTION AND ALARM

28 31 00 FIRE DETECTION AND ALARM

A. Description of Work

1. Connect new fire alarm devices to existing fire alarm system.

2. The equipment supplier must be the local factory authorized representative and must also be factory authorized, trained and certified to perform warranty service for the equipment being supplied.

3. Firm shall be regularly engaged in manufacturer of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 5 years.

4. Firm with at least 5 years of successful experience on projects with fire alarm systems work similar to that required for this project providing local factory authorized service and spare parts inventory.

5. For a period of one year from date of Owner's first beneficial use, the system shall be under service contract, as authorized by the manufacturer. During that period, replacement components and labor shall be readily available during standard business hours. After the one-year guarantee period, the supplier warrants that he is capable of providing service on a 24 hour, 7-day a week basis for at least five (5) additional years.

6. The Contractor and (equipment supplier) shall perform conductor testing in accordance with NFPA 72, table 7-2.2, Items 11a-d, prior to installation of devices. Test results shall be submitted to the Engineer.

7. Provide shop drawings showing manufacturer’s technical product data, including specifications and installation instruction, for each type of fire alarm system equipment. Project specific point-to-point drawings, wiring diagrams, fire alarm matrix, device addresses and voltage drop and battery calculations shall be provided. Partial submittal packages may be returned without being reviewed.

8. Sealed fire alarm drawings required for permit application are the responsibility of the Contractor and fire alarm system supplier.

9. The Contractor shall provide as-built drawings with final project specific point-to-point wiring diagrams, device addresses and battery calculations. The contractor shall provide all as-builts showing manufacturer’s technical product data, including specifications and installation instruction, for each type of fire alarm system equipment. Refer to specification section 26 00 38 for all other as-built requirements.

B. Acceptable Manufacturers

1. Subject to compliance with requirements, provide fire alarm components from the following system:

   Siemens MXL
C. Fire Alarm Control Panel – Not Used  

D. Fire Alarm Communicator – Not Used  

E. Remote Annunciator – Not Used  

F. Initiating Devices  


2. Photoelectric Detectors: Intelligent analog photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Sensitivity of the detector shall have an adjustable nominal sensitivity range per UL. It shall be possible to perform a calibrated sensitivity and performance test on the detector without generating smoke. The test method shall test all detectors. The detector shall have a UL operating range of 0-4000 ft. per minute. Provide a detector at control panel and each annunciator and remote power supply. Provide standard bases model. Provide a detector at control panel and each annunciator and remote power supply.  

3. Duct Detector: Ionization duct smoke detector with sampling tube and protective housing. Provide remote test switches where noted. Contractor to provide all load relays necessary for fan shut-down.  

4. Thermal Detector: Fixed temperature low profile type device with maximum protrusion of 2.1 inches and twist lock installation. Temperature rating to be 135 degrees or 190 degrees (H version). In elevator equipment rooms and shafts, heat detectors shall be located within two feet of each sprinkler head.  

5. Relay Modules: Addressable relay modules with LED indicator light.  


8. Door Holders: Flush wall mount electromagnetic door holder controlled by fire alarm system. Provide extension rods or box extensions as necessary. Door Holders shall be 24V or 120V powered. Provide power supplies as necessary. Label power supplies “Door Holder Power Supply”. Door Holders provided by Door Hardware Supplier or Door Holders provided by fire alarm supplier.  

9. Beam Detector: Intelligent beam smoke detector with multi mounting kit, surface mount kit and remote test switches where noted.  

10. Carbon Monoxide Detector: 4-wire carbon monoxide detector monitored by fire alarm system with local alarm sounder and trouble relay. Mount per manufacturer’s instructions.  

11. All initiating devices shall be identified with a black-on-clear (1/4” text minimum) printed adhesive label affixed to the device. This label shall include the device address.  

G. Signal Devices
1. **Audible/Visual and Visual Signal Devices**

   **Wall Mounted Selectable Candela Audible/Visual Signals:** Horn shall have 84 dB output at 10 feet on the high setting. Strobes shall have 15, 15/75, 30, 75, 110, and 115 candela output.

   **Wall Mounted Selectable Candela Visual Signals:** Strobe shall have 15, 15/75, 30, 75, 110 and 115 candela output.

   **Ceiling Mounted Selectable Candela Audible/Visual Signals:** Horn shall have 84 dB output at 10 feet on the high setting. Strobes shall be multi-candela units with 15, 15/75, 30, 75, 110, and 115 candela outputs.

   **Ceiling Mounted Selectable Candela Visual Signals:** Strobes shall be multi-candela units with 15, 15/75, 30, 75, 110, and 115 candela outputs.

2. Signals shall meet the requirements of the Americans With Disabilities Act.

3. The visual section shall be polarized Xenon strobe in various candela ratings. The visual candela rating shall be as indicated on the drawings.

4. Audible signals and/or audible sections of combination signals shall be electronic multi-tone units and shall not require vibrating solenoids or contacts. The audible section shall provide for a high/medium/low setting providing different dB levels meeting the requirements of the particular room or space. Tone selection shall be continuous tones or the temporal pattern based on the ANSI S3.41 Standard shall be field selectable. Set audible signals to temporal pattern for this project and volume at high. Adjust volume for small rooms as required.

5. Visual and audible devices shall be synchronized.

6. The signals shall operate on 24 VDC polarized and meet UL 1971, UL464 and ADA. The signal shall be able to test circuit supervision without disconnecting wires.

7. There shall be FIRE lettering clearly visible from both sides. Red or white device color to be coordinated with Architect.

8. Provide remote power supplies as necessary. Provide dedicated 20A, 120V circuit to each remote power supply.

**H. System Wiring**

1. All wiring will be as required by the Equipment Supplier. Wire color-coding and the color shall remain the same throughout the system. In general, all initiating devices such as manual stations, thermal detectors, ionization detectors and all modules will be installed across a common #18AWG twisted shielded pair. The signal circuits, door release circuits, fan shut down, etc., shall require #14AWG.

2. No conduit or raceway system will include Class I or non-power limited fire protection signaling circuits with Class II or power limited fire protection signaling circuits in accordance with N.E.C. Article 725 or 760.

3. All conduit and wiring to flow switches, tamper switches, etc., shall be furnished and installed as part of this work.
4. Test results shall be submitted to Engineer.

5. Wiring may be run as concealed open-type plenum rated cable. Exposed or inaccessible wiring shall be installed in conduit. Where possible wiring/conduit shall be concealed. Provide sleeves in all walls which cable runs pass through. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls. Provide access panels as necessary for cable routing. Support devices are to be attached to existing permanent structure.

I. **Sequence of Operations**

1. Fire alarm system to evacuate entire building in the event of an alarm.

2. The following will occur upon activation of any alarm initiating device (smoke detector, heat detector, manual pull station and water flow monitor module):
   a. Activate remote station connection modules. Three distinct outputs must be provided: 1) Alarm, 2) Supervisory, 3) Trouble.
   b. Sound audible signals and flash visual signals.
   c. Display status information on the fire alarm control panel and each remote annunciator LCD screen.
   d. Activate addressable control modules to shut down air handling units, close fire/smoke dampers and release all smoke doors.
   e. Upon elevator lobby, elevator equipment room or elevator shaft detection, primary or alternate recall module contacts will close to activate elevator recall. Upon equipment room or shaft detection, an additional control module contact will close for a signal to the elevator cab.
   f. Upon activation of elevator hoist way or elevator equipment room heat detectors the elevator power shunt trip fusible switch shall be caused to trip open.

3. The following to occur upon activation of a trouble signal (open circuit, ground fault, low battery, loss of AC power, etc.):
   a. Annunciate zone at fire alarm control panel and remote annunciator.

4. Duct detector detection to shut-down all air handling units and send supervisory signal to the fire alarm control panel and remote annunciator.

5. Tamper switch state change to send supervisory signal to fire alarm control panel and remote annunciator.

6. Exterior horn/strobe at fire department connection to only activate on water flow.

7. Signal Silence control button to deactivate audible notification devices.

8. System Reset control button to deactivate visual notification devices and return status of fire alarm system to normal state.

END OF SECTION