T-Dubs Dining Hall
Renovation Project

TCNJ Advertised Bid # AB140010

SPECIFICATIONS

Volume 2

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SUMMARY OF WORK

PART 1- GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of all work noted on the drawings and in these specifications for the T-Dubs Dining Hall Renovation

1. Project Location: The College of New Jersey, Ewing New Jersey
2. Owner: The College of New Jersey, State of New Jersey

1.03 CONTRACTS

A. The project contract is between The College of New Jersey and the single prime contractor performing the work specified.

B. Definition of Extent of Contract Work: The contract documents, specifications, project drawings, manufacturer’s installation handbooks, TCNJ form of agreement, and the contractors response to the RFP represent the extent of the construction contract.

1.04 CONTRACTORS USE OF PREMISES

A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The contractor’s use of the premises is limited only by the Owner’s right to perform work, retain other contractors on portions of associated projects, or to access the building for the occupants.

1. Contractor is to coordinate their work with the activities for each work location.

B. Use of the Site: Limit use of the premises to areas required for equipment and material storage and access to the roof area. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas immediately adjacent to the building where the work is being performed.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner’s employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials unless previously approved by the owner. Schedule deliveries to minimize space and time requirements or storage of materials and equipment on -site.
3. Burial of Waste Materials: Disposal of organic and hazardous materials on-site either by burial or burning, will not be permitted.
3. Parking is allowed with in the construction fence only. If more parking is needed, there is additional parking provided at the colleges Carlton Avenue parking lot. The contractor is responsible to shuttle workers back and forth as needed.
C. Use of the Existing Building: Maintain any existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building, its contents, components, and systems and its occupants during the construction period.

PART 2 - PRODUCTS (Not Applicable)

PART 3- EXECUTION (Not Applicable)

END OF SECTION 01010
SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SCHEDULE OF VALUES

A. Each Contractor shall prepare a schedule of values in coordination with the preparation of progress schedule. Correlate line items with other administrative schedules and forms required for the work, including progress schedule, payment request form, listing of subcontractors, schedule of allowances if any, schedule of alternates if any, listing of products and principal suppliers and fabricators, and schedule of submittals. Break down principal subcontract amounts into multiple line items for each entity of work. Round off to nearest whole dollar, but with total equal to Contract Sum. Submit 4 copies of schedule of values to the Owner and Architect for review and approval.

- Upon Owner/Architect approval, Owner will return the Schedule of Values to the Contractor for the Contractor to submit to the bonding company for their acceptance. Payments will not be made to the Contractor until the bonding company has provided a written acceptance to the Owner.

B. The schedule of values shall be tabulated into subcontracts and trades with the Quantity, Labor, Material, and Total Cost indicated. The Schedule of Values shall include such items as bonds, insurance, allowances and alternates, punchlist/close out documents and shall enclose copies of invoices and/or cancelled checks from bonding and insurance agents.

C. Schedule of values shall be submitted on AIA Form G703 or similar form approved by the Architect and Owner.

D. Each Contractor’s monthly application for payment shall be in the same schedule form, reflecting the same items from above. Unit costs shall be realistic for their part of the Work.

1.02 CHANGES IN THE WORK

A. When a change in the Work includes a category or categories of Work both added to and deducted from the Contract, the total quantities of added Work and of deleted Work shall be determined separately for each category and the appropriate unit price or net cost of the Work shall be applied to the difference between the two total quantities.

B. Unit prices shall be inclusive of all costs and shall be applied to units of measure as defined in the Specifications for each category of Work.

C. For all extra Work performed by the Contractor, the gross cost to the Owner shall include the net cost of the Work to the Contractor plus an allowance for overhead and profit not to exceed 15% of the net cost.

D. For all extra Work performed by a Subcontractor, the gross cost to the Owner shall include the net cost of the Work to the Subcontractor plus an allowance for overhead and profit not to exceed 15% of the net cost, plus the Prime Contractor’s overhead and profit not to exceed 5% of the Subcontractor’s cost.

E. Net cost of extra Work shall be the actual or pro-rated cost of:

1. Labor, including foreman, at the prevailing rate of wages, contributions and taxes.

2. Materials entering permanently into the Work, including delivery to the site.

3. The ownership or rental cost of construction equipment and expendable tools, pro-rated for the time necessary for the Work.
4. Power and consumable supplies for the operation of power equipment, pro-rated for the time necessary for the Work.

5. Insurance and Bonds.

F. Gross costs shall be net costs plus the mark up allowances described above, such mark up allowances being inclusive, of all cost of superintendence, supervision, engineering, overhead, profit, administrative and site office expenses and all other general expenses.

1.03 APPLICATIONS FOR PAYMENT

A. Except as otherwise indicated, sequence of progress payments for the Contractor shall be regular, and each shall be consistent with previous applications and payments. It is recognized that certain applications involve extra requirements, including initial applications, applications at times of substantial completion, and final payment applications.


C. Except as otherwise indicated, complete every entry provided on the form, including notarization and execution by authorized persons. Incomplete applications will be returned by Architect and Owner without action. Entries shall match current data of schedule of values, progress schedules and reports. Listing shall include amounts of fully executed change orders issued prior to first day of the period of construction covered by application. Applications for payment shall include weekly payroll report. Contractor shall furnish to the Owner certified payroll reports for each payroll period with pay request, indicating name craft, social security number and actual hourly rate of wages paid to each workman employed on the project. A certified payroll record is defined as "a payroll record which is attested to by the employer, or corporate officer of such company, or an authorized agent of the employer." A payment request will not be paid until the Owner receives the certified payrolls.

D. Submit one "pencil" copy of each proposed payment application to the architect and owner, for review, not less than seven days prior to formal submissions of application.

E. Submit 4 executed copies of each payment application. Transmit with a transmittal form listing attachments, and recording appropriate information related to application.

F. Breakdown may include a line item for General Conditions. General Conditions shall include the cost of general supervision, trailers, temporary utilities and other general expenses directly related to the project and not considered overhead. The general conditions item shall be billed on monthly progress payments on a percentage of work completed.

1.04 INITIAL PAYMENT APPLICATION

A. The principal administrative actions and submittals which shall precede or coincide with submittal of the Contractor's first payment application can be summarized as follows, but not necessarily by way of limitation.

1. Listing of subcontractors and principal suppliers and fabricators.

2. Schedule of values.

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4. Schedule of submittals (preliminary if not final).

5. Copies of acquired building permits and similar authorizations and licenses from governing authorities for current performance of the work.

6. Data needed by Owner to secure related insurance coverages.

7. Performance and Payment Bond.

8. Insurance Certificates.

1.05 PROGRESS PAYMENTS

A. Based upon application for payments submitted to the Architect and the Owner, by the Contractor, on or about the 25th day of each month for the period ending the last day of the previous second month, and Certificate of Payment issued by the Architect and the Owner, the Owner will make progress payments on account of the Contract Sum to the Contractor as follows:

1. On or after the 20th day of each month, the Contractor shall submit to the Architect and Owner a "pencil copy" indicating the previous payment and the proposed amounts for each line item for the current period. After review and approval or changes, the Contractor shall prepare the final billing for presentation to the Architect and Owner.

2. a. Whenever any contract, the total price of which exceeds $100,000, entered into by a State college, for the construction, reconstruction, alteration or repair of any building, structure, facility or other improvement to real property, requires the withholding of payment of a percentage of the amount of the contract, the contractor may agree to the withholding of payments in the manner prescribed in the contract, or may deposit with the State college registered book bonds, entry municipal bonds, State bonds or other appropriate bonds of the State of New Jersey, or negotiable bearer bonds or notes of any political subdivision of the State, the value of which is equal to the amount necessary to satisfy the amount that otherwise would be withheld pursuant to the terms of the contract. The nature and amount of the bonds or notes to be deposited shall be subject to approval by the State college. For purposes of this section, "value" shall mean par value or current market value, whichever is lower.

If the contractor agrees to the withholding of payments, the amount withheld shall be deposited, with a banking institution or savings and loan association insured by an agency of the Federal government, in an account bearing interest at the rate currently paid by such institutions or associations on time or savings deposits. The amount withheld, or the bonds or notes deposited, and any interest accruing on such bonds or notes, shall be returned to the contractor upon fulfillment of the terms of the contract relating to such withholding. Any interest accruing on cash payments withheld shall be credited to the State college.

b. Any contract, the total price of which exceeds $100,000, entered into by a State college involving the construction, reconstruction, alteration, repair or maintenance of any building, structure, facility or other improvement to real property, shall provide for partial payments to be made at least once each month as the work progresses, unless the contractor shall agree to deposit bonds with the State college pursuant to section 1.

c. 1. With respect to any contract entered into by a State college pursuant to section 2 for which the contractor shall agree to the withholding of payments pursuant to section 1, 2% of the amount due on each partial payment shall be withheld by the State college pending completion of the contract.

2. Upon acceptance of the work performed pursuant to the contract for which the contractor has agreed to the withholding of payments pursuant to subsection a. of this section, all amounts
being withheld by the State college shall be released and paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college, without further withholding of any amounts for any purpose whatsoever, provided that the contract has been completed as indicated. If the State college requires maintenance security after acceptance of the work performed pursuant to the contract, such security shall be obtained in the form of a maintenance bond. The maintenance bond shall be no longer than two years and shall be no more than 100% of the project costs.

d. This act shall take effect immediately. This bill supplements the “State College Contracts Law,” P.L.1986, c.43 (C.18A:64-52 et seq.), and applies to any State college contract for over $100,000 which involves the construction, reconstruction, alteration or repair of any building, structure, facility or other improvement to real property. Under the provisions of this bill, whenever a contract of this type requires the withholding of payment of a percentage of the amount of the contract, the contractor would have the choice of either agreeing to a retainage deduction from each monthly progress payment, or the contractor could choose to deposit bonds in the amount necessary to satisfy the amount that otherwise would be withheld under the contract. If a contractor chooses a retainage deduction from each monthly payment, then the retainage would be limited to 2% of the amount due on each partial payment. Upon acceptance of the work performed pursuant to the contract for which the contractor has agreed to a retainage deduction, all amounts being withheld by the State college must be paid in full to the contractor within 45 days of the final acceptance date agreed upon by the contractor and the State college. The bill provides that if the State college requires maintenance security after acceptance of the work performed under the contract, the security must be obtained in the form of a maintenance bond, which is required to be no longer than two years and no more than 100% of the project costs. The provisions of this bill are similar to provisions in the “Local Public Contracts Law,” P.L.1971, c.198 (C.40A:11-1 et seq.) and the “Public School Contracts Law,” P.L.1977, c.114 (C.18A:18A-1 47 et seq.).

3. Upon substantial completion, the retainage shall, upon the Architect/Owner’s approval, remain at 2% of the value of work completed. Final release of retained monies will occur only upon the total completion of all punch list and closeout documentation to the satisfaction of the Architect and Owner.

4. For each day’s delay in the Contractor’s submission of an application for payment acceptable to the Architect and Owner, the Owner may delay one day in making his progress payment.

5. Owner shall make payments within 30 days of receipt of said monthly pay requisition.

1.06 APPLICATION AT TIME OF SUBSTANTIAL COMPLETION

A. Following issuance of certificate of substantial completion on each Contractor’s work, and also in part as applicable to prior certificates on portions of completed work as designated, a “special” payment application may be prepared and submitted by Contractor. The principal administrative actions and submittals which shall precede or coincide with such special applications can be summarized as follows, but not necessarily by way of limitation:

1. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner’s full access and use of completed work.

2. Warranties, guarantees, maintenance agreements and similar provisions of Contract Documents.

3. Test/adjust/balance records, maintenance instructions, meter readings, start up performance reports, and similar change over information germane to Owner’s occupancy, use, operation and maintenance of completed work.

4. Final cleaning of the work.
5. Application for reduction (if any) of retainage, with consent of surety.

6. Advice to Owner on coordination of shifting insurance coverages, including proof of extended coverage as required.

7. Listing of Contractor’s incomplete work, recognized as exceptions to certificate of substantial completion.

1.07 FINAL PAYMENT APPLICATION

A. The administrative actions and submittals which shall precede or coincide with submittal of the Contractor’s final payment application can be summarized as follows, but not necessarily by way of limitation.

1. Completion of project closeout requirements.

2. Completion of items specified for completion beyond time of substantial completion, regardless of whether special payment application was previously made.

3. Assurance, satisfactory to Owner and Owner, that unsettled claims will be settled and that work not actually completed and accepted will be completed without undue delay.

4. Transmittal of required project construction records to Owner via the Owner.

5. Proof, satisfactory to Owner and Owner, that taxes, fees and similar obligations of Contractor have been paid.

6. Removal of temporary facilities, services, surplus materials, rubbish and similar elements.

7. Notarized consent of surety for final payment.

1.08 WAIVER OF LIENS

A. Each Contractor, for himself, and for all Subcontractors and material men, agrees that no mechanic's lien or other claim shall be filed or maintained by the Contractor or by any Subcontractor, materialmen, laborer or any other person whatsoever for, or on account of any work performed or materials furnished under this Contract. This agreement shall be an independent contract, and the Contractor shall execute and deliver a separate Waiver of Liens in form and substance satisfactory to the Architect and Owner contemporaneously with the execution of the Owner-Contractor Agreement and before any work is begun at the site.

B. In every subcontract entered into by each Contractor after execution of this Contract or in connection herewith, the Contractor shall incorporate a provision, similar to the foregoing paragraph, to the effect that neither the Subcontractor nor any party acting through or under him shall file or maintain any mechanic's lien or other claim against the Architect or Owner in connection with the Work.
SECTION 01100 - PROJECT PROCEDURES

PART 1 - GENERAL

1.01   SPECIAL REQUIREMENTS

A. Schedule: Contractor shall provide a master schedule showing sequencing of work utilizing the CPM method. The Contractor shall supply a schedule with all subcontractor activities, relationships, and durations, utilizing the CPM method via SureTrak/Primavera, Version 3.0, or a Microsoft scheduling software to the Owner on a working version CDrom and coordinate their schedule with the Owner.

• The Contractor is required to update at the end of each month the CPM Schedule based on the percentage completed for each activity on the approved schedule (in concert with the submission of the percentage completed in the monthly proposed schedule of values).

• The contractor in their bid includes a cost of $500.00 per month for this schedule submission, for the duration of construction (per the milestone schedule in the bidding documents). This only applies to projects in excess of 2 million dollars in base price price. The contractors schedule of values shall include this cost, and can only be billed for upon TCNJ's successful receipt of said schedule. Should any schedule not be received at the end of any month during construction, TCNJ will issue a deduct change order in the amount of $500.00 to the contractor.

B. Each Contractor shall take all necessary precautions to ensure the safety of all structural elements during all phases of all work. No materials, cranes, trucks or any other construction loads shall be placed on any part of the structure until the Contractor has determined the adequacy of that structure to carry the intended load without damage or overstress.

C. Entrance into, or other use of the building will not be permitted except as may be necessary for the execution of the Work, and shall be subject to the restrictions and instructions of the Owner.

NOTE: any personnel working in any residence hall, including delivery personnel are to have a State Police Background check completed before entering any residence hall. Contractor is to provide the background check for all personnel at the kick off meeting, and/or prior to start of their work. Should a person not have a background check but is on site for a short period of time, said person shall be escorted by a TCNJ project manager/superintendent and/or a designated person that has provided the appropriate back ground check information. All back ground checks will be forwarded to TCNJ police for review and filing.

NOTE: any personnel working in a residence hall must wear a badge with the name of the vendor/contractor they work for and their personal name. This badge must be worn at all times.

D. Routes of ingress and egress to areas where work is being performed shall be subject to the restrictions and instructions of the Owner.

E. Materials shall be moved through the Building using rubber tired vehicles which shall be properly controlled at all times to avoid damage to existing wall, floor or ceiling surfaces.

F. Water damage cannot be tolerated and it is incumbent upon Contractors to take any steps necessary to keep the existing premises dry at all times.

G. Any damage to the new building from heavy equipment, striking the Building or any other damage to any part of the premises shall be repaired at the expense of the Contractors.

H. All welding and cutting shall be performed by qualified and certified welders. Certificates shall be on file with the Contractor prior to commencement of any welding.

I. No work shall start before 8:30am.unless agreed to in advance with the College.
PART 2 - PRODUCTS
NOT APPLICABLE

PART 3 - EXECUTION

3.01 GENERAL

A. Contractors shall perform the work on or about the premises in a careful manner with full consideration to fire protection as required by the National Fire Protection Association Standards, National Board of Fire Underwriters and State and Local Departments having jurisdiction. Fire resistant materials shall be used for temporary enclosures.

B. Chemical extinguishers approved by the Owner shall be provided by the General Contractor during the progress of the work where and as required by the Owner, the Local Fire Marshal and the National Board of Fire Underwriters.

C. The Contractor shall maintain an active program of fire prevention to keep workmen fire conscious during the entire life of the Contract. Designate one member of the organization to execute and coordinate fire control measures of his own organization and that of all subcontractors under his jurisdiction.

D. All sub-contractors shall cooperate with the Contractor in carrying out the above program.

E. Storage of flammable materials will not be permitted in the Building unless written permission is obtained from the Owner. Storage of all such materials shall be the Contractors' responsibility.

F. On-site open burning of rubbish, garbage, trade waste, leaves or plant life is prohibited.

G. Safety Program: The Contractor shall institute a safety program in accordance with OSHA and any local, state, or federal guidelines. The contractor shall name a safety officer to monitor this program and shall submit a safety report at job meetings.

H. Stockpiling: Stockpiling of materials on site will be allowed (but limited due to the limited space on this site). Such materials shall not impair or impede the functioning of the facility. Materials stored on site shall be secured to prevent loss from theft, damage, vandalism or fire. By stockpiling materials on site, the contractor assumes full responsibility for said materials, and shall protect them to the fullest extent possible. Specific locations for stockpiling materials shall be coordinated with the Architect, and Owner.

I. Safety Barriers: The Contractor shall erect safety barriers to deter and prohibit unauthorized access to the construction site; such barriers may take the form of fences and shall be clearly marked with signage prohibiting unauthorized access. The Contractor shall be responsible for safety barriers within the building. The contractor shall be liable for damages to persons or property due to the construction process if adequate safety measures are not undertaken. The Owner and Architect shall review safety precautions for their adequacy but shall not be held liable for Contractors failure to maintain or provide adequate protection.

J. Sequencing: The Contractor will work with the Sub-Contractors to sequence the work during the submission of monthly project schedules. Contractors shall endeavor to coordinate their work efforts with the Owner's requirements. Interruptions of utility services shall be coordinated with the Architect, and Owner, but in no instance shall last longer than 2 hours.

K. Limited staging and on site parking will be provided by General Contractor. The Contractor will coordinate parking areas with all the subcontractors and TCNJ.

1. Parking will be available at Carlton Avenue. Contractor will provide shuttle service to and from the
1. Contractor will be permitted to have vehicles on site with in the construction fencing only. Contractor is to provide stone in all parking areas on site to prevent the buildup of ruts and mud, thus minimizing the amount of mud leaving the site and being left behind on TCNJ roads.

L. Site Utilities: Electric power and water are available on site. Toilet facilities will be made available by the Contractor. These facilities shall remain clean by the Contractors throughout the course of the project. The Contractors shall repair and/or replace any damaged fixtures, partitions, etc. The Electrical Sub-Contractor shall tie in a temporary power panel (or panels as required) for all trades to use during construction. Interruption of building services shall not occur without prior consent and coordination by the Owner and Owner.

1. Provide portable toilets for all construction personnel.

M. Construction Lighting: The Electrical Sub-Contractor shall run sufficient strings and fixtures to maintain a 50 foot-candle/sq.ft.intensity of light throughout the project areas.

N. Dumpster Location and Cleanup: The Architect and Owner shall coordinate the dumpster location with the Contractors. The Contractor shall be responsible for obtaining, maintaining, and disposing of dumpsters, and shall maintain clean work areas throughout the course of the project.

- Contractor is to provide adequate manpower during the entire course of the project to maintain the site in a clean, neat and professional manner. At a minimum the contractor is to clean the entire site twice per week (on different days) by picking up all debris in and around the site. Sweeping the entire building daily is required once the floor slabs are in place. Contractor is to place garbage cans on each floor minimum 3 per floor in designated locations to assist in keeping the site clean. The owner will not tolerate a building project that is not maintained in a professional manner at all times.

3.02 PROGRESS MEETINGS

A. Progress Meetings shall be held bi-weekly at the job site at a regular time and day mutually agreed upon. The frequency may be changed by the Architect or Owner to reflect current conditions. The Contractors, those of his/her subcontractors concerned with current progress or with scheduling of future progress, the Architect, the Owner, and the Owner shall each be represented at these job meetings by persons familiar with the details of the work and authorized to conclude matters relative to work progress, establishment of progress schedules, etc., as may be necessary to expedite completion of the work.

B. The Contractors and his/their subcontractors attending these meetings shall present complete and definite reports as to the status of their respective work, conditions of product and equipment manufacturer, labor availability, productivity and cooperation, shipping data, time of completion, sequence of the work, safety program, and any other information bearing upon the execution of the Contract or subcontract. For the Owner's convenience the Owner will chair the meetings.

3.03 MONTHLY REPORTS

A. The Contractor is to provide TCNJ a brief monthly status report on the last working day of each month dividing the status of the project into the following categories (report must be complete in all respects, piece meal submissions will not be accepted):

- Project overview
- Financial status
- Updated project schedule
- Change order request log
- Submittal log
f. RFI log

  g. Owner/Architect issues that need immediate resolution

  h. Order/delivery issues

B. The Contractor is to provide TCNJ with this monthly report, and include in their bid a cost of $500.00 per month for all projects in excess of 2 million dollars base bid price for the duration of the construction period as noted in the bidding milestone schedule. This total cost will be listed in the contractor’s schedule of values and can be billed for on a monthly basis only if said report is received in whole as noted above. Should TCNJ not receive said complete report a deduct change order will be issued to the contractor for $500.00 for that month.

END OF SECTION 01100
SECTION 01300 – SUBMITTALS AND SUBSTITUTIONS

PART 1 – GENERAL

1.1 PROGRESS SCHEDULE / COORDINATION DRAWINGS

A. The Contractor's schedule, shall coordinate with all trades to produce a coordinated CPM via Suretrak/Primavera version 3.0 or a Microsoft scheduling program schedule indicating the start and completion dates for each portion of the work as defined by the schedule of values, with the total time as defined by the contract time and milestone dates as set forth in these specifications. The Contractor’s CPM schedule shall be submitted in electronic format (Suretrak 3.0 or a Microsoft Scheduling program) to and reviewed by the Owner and Architect prior to first application for payment. Any revisions or additional information requested by the Owner or Architect shall be provided. (No payment shall be made to any Contractor not providing a schedule that reflects their entire work).

• Also refer to Section 01100-1 – Project Procedures.

B. The Contractor shall revise the progress schedule on a monthly basis as the work progresses reflecting therein any delays, including those not within the Contractor's control, or accelerations in the progress of the work. The progress schedule, as revised for any weekly period, shall be discussed at the bi-weekly job meetings with the, Owner, the Architect, and the Contractor and the major trades in order to insure that the percentage of actual completion of any portion of the work as called for in the progress schedule for that bi-weekly period is attained. Monthly updates to the progress schedule shall be made prior to application for payment.

C. Should any delay occur in the progress of the work or any portion thereof, the Contractor shall be required to implement all necessary measures to accelerate the construction, to meet the percentages of completion dictated by the progress schedule on the applicable dates, without additional cost to the Owner.

1.2 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Shop drawings, product data and samples will not be processed by the Owner and/or Architect until the list of subcontractors, material suppliers and fabricators is submitted as required under Paragraph 3.12 of the General Conditions.

• The successful Contractor shall submit their list of proposed substitutions with in 20 calendar days of the Contract Award.

• The Architect shall be compensated on an hourly basis for review of all shop drawings or samples that do not meet the requirements of the contract documents after two submissions. The compensation shall be deducted from the contractors contract via a deduct change order, or other means that both parties agree to.

B. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Allow two weeks for review/approval by the Architect for the approval process. Allow additional time if processing must be delayed to permit coordination with subsequent submittals with others.

C. Provide permanent marking on each submittal to identify Project, date, Contractor, subcontractor, submittal name, Specification section, drawing reference, and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space (5" x 7") for Architect’s Action marking and space for Owner's review marking. Package each submittal appropriately for transmittal and handling. Submittals received, which are lacking the above information, will be returned without action. Submittals, which are received from sources other than through Contractor’s office, will be returned without action.

D. Each submission shall be complete, with all options clearly marked and with all components required for the assembly fully described and detailed. Submissions missing important information will be returned.
E. Transmittal Form: Submittals shall be accompanied by a transmittal form. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents. 
   • Transmit all submittals and shop drawings to the Architect or Engineer with a copy of the transmittal to the Owner.

F. Except as otherwise indicated in individual work sections, comply with requirements specified herein for each indicated category of submittal. Provide and process intermediate submittals, where required between initial and final, similar to initial submittals.

G. Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Architect, and by Owner.

H. Do not proceed with installation of materials, products or systems until final copy of applicable shop drawings, product data and samples are in possession of Installer.

I. Provide newly prepared shop drawings, on reproducible sheets, with graphic information at accurate scale, with company name of preparer indicated. Show dimensions and note which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards, and special coordination requirements. Do not allow shop drawing copies without appropriate final Action markings by Architect to be used in connection with the work.

1. Initial and Intermediate Submittals: One correctable translucent reproducible print and 5 blue line or black line prints; reproducible will be returned.
2. Final Submittal: 6 prints, plus 3 additional prints where required for maintenance manuals; 4 will be retained and remainder will be returned, one of which shall be marked up and maintained by Contractor as "Record Document".
3. Electronic submittals are acceptable in AutoCad format only. Contractor shall be responsible for printing and distribution of multiple copies as required.

J. Collect required product data into one submittal for each unit of work or system; and mark each copy to show which choices and options are applicable to the project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements that have been checked, and special coordination requirements. Maintain one set of product data for each submittal at project site, available for reference by Architect and others.

K. Submittals will be accepted from the Contractor only. Submittals received from other entities will be returned without review or action.
1. Submittals received without a transmittal form will be returned without review or action.
2. Transmittal form: Use a form matching the sample form attached to this section. Include the following:
   a. List of deviations.
   b. The Contractor's certification signature.
3. Fill out a separate transmittal form for each submittal; also include the following:
   a. Other relevant information.
   b. Request for additional information.

L. Do not submit product data, or allow its use on the project, until compliance with requirements of Contract Documents has been confirmed by Contractor. Submittal is for information and record unless otherwise indicated. Initial submittal is final submittal unless returned promptly by Architect marked with an Action that indicates and observed noncompliance. Submit 6 copies, plus 3 additional copies, which will be returned, where required for maintenance manuals.
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1. Electronic submittals are acceptable in 8 ½” x 11” format only.

M. Provide three (3) samples identical with final condition of proposed materials or products for the work. Include range samples, not less than 3 units, where unavoidable variations between units of each set. Provide full set of optional samples where Architect's selection is required. Prepare samples to match Architect's sample where so indicated. Include information with sample to show generic description, source or products name and manufacturer, limitations, and compliance with standards. Samples are submitted for review and confirmation of color, pattern, texture and kind by Architect. Architect will not test samples, except as otherwise indicated, for compliance with other requirements, which are therefore the exclusive responsibility of the Contractor.

N. Upon receipt of a signed copy of the Architects’ Waiver form, electronic copies of CAD drawings of the Contract Documents will be provided by the Architect for Contractor's use in preparing submittals. Copy of Waiver form is attached.

O. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the named product or an equivalent.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product of the manufacturer or source that complies with requirements, or an equivalent.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements, or an equivalent. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

4. Manufacturers: Where specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed, or an equivalent, that complies with requirements. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

5. Product Options: Where Specification paragraphs or subparagraphs refer to "Product Options and Substitutions," indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system; provide the specific product or system or an equivalent product or system by another manufacturer. Comply with provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

6. Basis of Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" introduce or refer to a list of manufacturers' names, provide either the specified product or an equivalent. Drawings and Specifications indicate sizes, profiles, dimensions and other characteristics that are based on the product names. Comply with the provisions of "Product Options and Substitutions," Section 1.4 of Division 1300 of these specifications when submitting an equivalent product.

1.3 MISCELLANEOUS SUBMITTALS

A. Miscellaneous submittals related directly to the work include warranties, maintenance agreements, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports,
copies of industry standards, record drawings, field measurement data, operating and maintenance materials, overrun stock, and similar information, devices and materials applicable to the work and not processed as shop drawings, product data or samples.

B. Refer to sections for specific general requirements on warranties, product/workmanship bonds, and maintenance agreements. In addition to copies desired for Contractor's use, furnish 2 executed copies, except furnish 3 additional copies where required for maintenance manuals.

C. For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work.

1.4 PRODUCT OPTIONS AND SUBSTITUTIONS

A. DEFINITIONS

1. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   a. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

   b. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

   c. Equivalent Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

2. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

3. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

4. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

5. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. General Requirements:

1. The requirements for substitutions do not apply to specified Contractor options on products and construction methods. Revisions to Contract Documents, where requested by Owner or Architect are changes, not substitutions. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute a basis for change orders. Otherwise, Contractor's requests for changes in products, materials, and methods of construction required by Contract Documents are considered requests for substitutions, and are subject to requirements hereto.
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To the greatest extent possible, provide products, materials and equipment of a singular generic kind
and from a single source.
Where more than one choice is available as options for Contractor's selection of a product or material,
select an option that is compatible with other products and materials already selected. Total
compatibility among options is not assured by limitations within Contract Documents, but shall be
provided by Contractor. Compatibility is a basic general requirement of product/material selections.
Any and all contractor substitutions that require additional work by other trades not specifically called
for in the documents shall be paid for by the contractor requesting the substitution if any other trade
increase is required.
Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or
other considerations, after deducting additional responsibilities Owner must assume. Owner's
additional responsibilities may include compensation to Architect for redesign and evaluation services,
increased cost of other construction by Owner, and similar considerations.

C.

Submittals: Submit 6 copies, utilizing Substitution Request Form, CSI Form 13.1.A, fully identified for
product or method being requested for substitution, including related specification section and drawing
numbers, and fully documented to show compliance with requirements for substitutions. Include product
data/drawings, description of methods, samples where applicable, Contractor's details comparison of
significant qualities between specified item and proposed substitution, statement of effect on construction
time and coordination with other affected work and contractors, cost information or proposal, warranty
information, compatibility with other work, approval of all authorities having jurisdiction, and Contractor's
statement to the effect that proposed substitution will result in overall work equal to or better than work
originally indicated.

D.

Contractor's options for selecting products are limited by Contract Documents requirements, and governing
regulations. Required procedures include, but are not necessarily limited to, the following for various
indicated methods or specifying:
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Single product/manufacturer name; provide product indicated or equivalent, except advise Architect
before proceeding, where known that named product is not a feasible or acceptable selection.
Two or more product/manufacturer names; provide one of the named products or equivalent, at
Contractor's option; but excluding products which do not comply with requirements. Advise Architect
before proceeding.
Equivalent; where named products in Specifications text are accompanied by the term "or equivalent",
or other language of similar effect, comply with those Contract Documents provisions concerning
substitutions for obtaining Architect's approval of equivalent product.
Named, except as otherwise indicated, is defined to mean manufacturer's name for product, as
recorded in published product literature, of latest issue as of date of Contract Documents. Refer
requests to use products of a later or earlier model to Architect for acceptance before proceeding.
Where compliance with an imposed standard, code or regulation is required, selection from among
products that comply with requirements including those standards, codes and regulations, is
Contractor's option.
Provide products which comply with specific performances indicated, and which are recommended by
manufacturer, in published product literature or by individual certification, for application indicated.
Overall performance of a product is implied where product is specified for specific performance.
Provide products that have been produced in accordance with prescriptive requirements, using
specified ingredients and components, and complying with specified requirements for mixing,
fabricating, curing, finishing, testing and similar operations in manufacturing process.
Where matching of an established sample is required, final judgment of whether a product proposed by
Contractor matches sample satisfactorily is Architect's judgment. Where no product within specified
cost category is available, which matches sample satisfactorily and complies with requirements,
comply with Contract Document provisions concerning substitutions for selection of a matching
product outside established cost category or not complying with requirements.
Where specified product requirements include "...as selected from manufacturer's full range of colors,

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SUBMITTALS AND SUBSTITUTIONS


patterns, textures..." or words of similar effect, the selection of manufacturer and basic product data is
to comply with requirements of the Contract, and selection shall be from the full range of products
within the requirements. Where specified product requirements include "... as the industry...", or
words to that effect, selection of product complying with requirements, is Architect's selection,
including designation of manufacturer, where necessary to obtain desired color, pattern or texture.

E. Substitutions may be permitted by the Architect, if, in his opinion, the requirements of the proposed
substitution comply with the requirements specified for the material, article or piece of equipment; however,
the Architect is not required to permit substitution pursuant to the case of Whitten Corporation vs. Paddock,
Incorporated, United States District Court, Massachusetts, April 12, 1974, affirmed by the Federal First
Circuit Court, December 14, 1974.

F. After award of contract, the Contractor may submit substitutes to the Architect for review, fully documented
and certified, and accompanied by a proposal for a reduction in the Contract Sum.

G. Contractor's request for substitution will be received and considered when extensive revisions to Contract
Documents are not required and changes are in keeping with general intent of Contract Documents; when
timely, fully documented and properly submitted; and when one or more of following conditions is satisfied,
all as judged by Architect. Otherwise, requests will be returned without action except to record
noncompliance with these requirements.

1. Where request is directly related to an "equivalent" clause or other language of same effect in Contract
Documents.
2. Where required product, material or method cannot be provided within Contract Time, but not as a
result of Contractor's failure to pursue the work promptly or coordinate various activities properly.
3. Where required product, material or method cannot be provided in a manner which is compatible with
other materials of the work, or cannot be properly coordinated therewith, or cannot be warranted
(guaranteed) as required, or cannot be used without adversely affecting Owner's insurance coverage on
completed work, or will encounter other substantial noncompliances which are not possible to
otherwise overcome except by making requested substitution, which Contractor thereby certifies to
overcome such incompatibility, uncoordination, nonwarrant, noninsurability or other noncompliance
as claimed.
4. Where substantial advantage is offered Owner, in terms of cost, time or other valuable considerations,
after deducting offsetting responsibilities Owner may be required to bear, including additional
compensation to Architect for redesign and evaluation services, increased cost of other work by Owner
or separate Contractors, and similar considerations.

H. Contractor's submittal of, and Architect's acceptance of, shop drawings, product data or samples which
indicate work not complying with requirements of Contract Documents, does not constitute an acceptable and
valid request for, nor approval of, a substitution.

I. QUALITY ASSURANCE

Compatibility of Options: If Contractor is given option of selecting between two or more products for use on
Project, product selected shall be compatible with products previously selected, even if previously selected
products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with
products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products,
Architect will determine which products shall be used.

J. EQUIVALENT PRODUCTS
Where products or manufacturers are specified by name, Contractor must submit the following, in addition to other required submittals, to obtain approval of an unnamed product proposed as an equivalent:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS AND EQUIPMENT WARRANTIES

A. The Contractor shall orient and instruct the responsible maintenance personnel designated by the Owner in the Operation of all equipment and shall provide the maintenance personnel with pertinent literature and operational manuals for all equipment. Date and time of demonstrations shall be mutually agreed upon with the Owner. Provide qualified personnel for as long as necessary to fully orient and instruct the Owner. Contractor shall videotape instruction session and provide owner with completed video.

B. The manuals shall be submitted in (quadruplicate) 3-ring loose-leaf type binders to the Architect for approval with all additional information that the Architect may request and considers necessary for the proper servicing and maintenance of all equipment. Manuals are to include plain paper copies of approved shop drawings and catalog cuts. The quality of the copies may be subject to approval by the Architect. Upon completion and approval, 3 copies will be forwarded to the Owner and one copy retained by the Architect.

C. Manuals shall include no less than the following:

1. Operating Procedures:
   a. Typewritten procedures indicating each mode of operation of each piece of equipment or system. Procedures shall indicate the status of each component of a system in each operating mode.
   b. Procedures shall indicate names, symbol numbers, valve tags, circuit numbers, schematic control and wiring diagrams, locations of thermostats, manual starters, control cabinets, and other controls of each system.
   c. Emergency shutdown procedures for each piece of equipment or system, both automatic and manual as appropriate.

2. Maintenance Schedule: Typewritten schedule describing manufacturer’s recommended schedule of maintenance and maintenance procedures.

3. Catalog cuts and shop drawings:
   a. Catalog cuts shall clearly indicate the exact model and type of each piece of equipment installed in the Project, including all options provided.
   b. Catalog cuts shall fully describe equipment including physical, electrical, mechanical and other characteristics, performance characteristics and installation or erection diagrams.
   c. Catalog cuts shall indicate spare part numbers and name, address and telephone number of local representative or service department.

4. Typewritten list of all subcontractors on the Project including name, address, telephone number and responsibility on the Project.

5. Manuals shall be indexed with dividers indicating each system or piece of equipment.

6. Warranties, permits, inspection stickers/approvals and Certificate of Occupancy are to be included.

D. Required equipment warranties shall be submitted in three copies to the Architect.
E. The Contractor shall video tape all instructional sessions and demonstrations and provide the Owner with a copy of the videotape at the end of all demonstrations.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 ACTION ON SUBMITTALS

A. One copy of all submissions will be returned to the Contractor for his files. The Contractor shall mark up other copies so as to conform with the copy returned to him and forward them to all interested Contractors, Subcontractors, and Suppliers.

B. The Architect will review and stamp submitted shop drawings in one of the following ways (the actual stamp may be different; below language is shown for an example only)
   1. "No Exceptions Taken": Approved.
   2. "Make Corrections Noted": Approved, provided the work complies with corrections marked on the submittal.
   3. "Revise and Resubmit": Do not commence work of this submittal. Revise and resubmit or prepare a new submittal; comply with notations marked on submittal.
   4. "Rejected": Fundamentally not in compliance. Prepare a new submittal. No notations or comments made.

C. Work shall be executed in accordance with "Approved", "Approved As Noted", or "Resubmit for Record" stamp only.

D. Architect's review of shop drawings/submittals will constitute checking for general arrangement only, and shall not relieve the Contractor of responsibility for complete compliance with Drawings and Specifications. Contractor shall be responsible for quantities and dimensions to assure a proper fit under field conditions.

3.2 DISTRIBUTION

A. Provide additional distribution of submittals, not included in foregoing copy submittal requirements, to subcontractors, suppliers, fabricators, installers, governing authorities and others as necessary for proper performance of the work. Include such additional copies in transmittal to Architect where required to receive Action marking before final distribution. Show such distributions on transmittal forms.

3.3 COLOR SELECTIONS

A. All colors for all finished surfaces and materials will be selected or approved by the Architect. The color selections will be made at one time to provide a complete and coordinated color schedule which, upon acceptance of the Owner, will be provided to the Contractor. Any and all specific color selections for materials not noted on drawings or in specification shall be chosen by Architect after submittal of samples.

B. It is imperative that all color information be submitted to the Architect by the Contractor before color selections can be made. If any color selection information is not available when colors are needed to meet the project schedule, the Architect will select colors from one of the named manufacturers in the Specifications, and the Contractor will be required to exactly match that color. A claim for delay will not be accepted if the color schedule is late due to the failure of the Contractor to provide the Architect with all required color information, nor will an extra be entertained if the selected color is not available from the manufacturer the Contractor intended to use but neglected to submit.

C. The Contractors are reminded of the requirement to declare all substitutions within 20 days of execution of their Contract as specified.
1 ENDOFSECTION01300
SECTION 01310 - QUALITY CONTROL

PART 1 - GENERAL

1.01 TRADESMEN AND WORKMANSHIP

A. Each Contractor shall ensure that tradesmen performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

B. In certain instances, specification text requires that specific work be assigned to specialists or expert entities, who shall be engaged for performance of those units of work. These shall be recognized as special requirements over which Contractor has no choice or option. These assignments shall not be confused with, and are not intended to interfere with, normal application of regulations, union jurisdictions and similar conventions. One purpose of such assignments is to establish which party or entity involved in a specific unit of work is recognized as "expert" for indicated construction processes or operations. Nevertheless, final responsibility for fulfillment of entire set of requirements remains with Contractor.

1.02 INSPECTION, TESTS AND REPORTS

A. Required inspection and testing services are intended to assist in determination of probable compliances of the work with requirements, but do not relieve any Contractor of responsibility for those compliances, or for general fulfillment of requirements of Contract Documents. Specified inspections and tests are not intended to limit any Contractor's quality control program. Afford reasonable access to agencies performing tests and inspections.

B. Contractors are responsible for all testing associated with their work (foundations, soils compaction, concrete, steel, roof material testing etc.) and shall submit the name of their proposed testing agency within 15 days of Notice-to-Proceed. Each Contractor is responsible to coordinate the activities of the testing agency to assure that work is tested prior to being covered up or other activities associated to the work begin.

1.03 ROOF DRAIN TESTING

A. Pre-Construction Testing: Prior to the start of any work on the roof, the Contractor shall water-flow test all roof drains (5 minutes at each drain), to determine if any full or partial drain clogs exist in the drainage system.

1. The Owner shall have a representative at the test.

2. The results of the testing shall be reported to the Owner, in writing, prior to the start of work.

3. The Owner will be responsible for correction of any drain-age problems reported by the Contractor prior to the start of work.

4. Any drains, piping or other components, whether exposed, concealed, below grade, etc., found to be clogged after the start of construction, and not reported to the Owner prior to the start of construction, shall be cleared, repaired or replaced as required to restore full drainage capacity. All work shall be performed by the Contractor at no additional cost to the Owner, including patching, repair or re-
placement of any materials, finishes, landscaping, etc., disturbed in gaining access to drainage components.

B. Post-Construction Testing: When all work reaches substantial completion, the Contractor shall water-flow test all roof drains (5 minutes at each drain), to determine if any full or partial drain clogs exist in the drainage system.

1. The Owner shall have a representative at the test.

2. Report the results of testing to the Owner in writing prior to preparation of the final punchlist inspection.

3. Any drains, piping or other components, whether exposed, concealed, below grade, etc., found to be clogged shall be cleared, repaired or replaced as required to restore full drainage capacity. All work shall be performed by the Contractor at no additional cost to the Owner, including patching, repair or replacement of any materials, finishes, landscaping, etc., disturbed in gaining access to drainage components.

1.04 ROOF DRAIN PROTECTION

A. Contractor is to make every effort to prevent materials from entering roof drains. Contractor is to install roof rain filters prior to removal of any roof materials.

B. All debris is to be cleaned away from drains at the end of each day.

PART 2 - PRODUCTS

2.01 ROOF DRAIN FILTERS

A. Tiddy Gutter DF100001 Roof Drain Foam Filter or Equal.

PART 3 - EXECUTION

3.01 REPLACEMENT OF WORK

A. The Contractor shall, within 24 hours after rejection of Work, remove all materials and equipment so rejected and immediately replace said Work, at his cost, to the satisfaction of the Architect. Should the Work of the Owner or other Contractors be damaged by such removal or replacement, the Contractor shall reimburse the
3.02 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions prior to work starting: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.03 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's/Owner's written permission.
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C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.


3.04 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing conditions and dimensions. If discrepancies are discovered, notify Architect and Owner promptly.

3.05 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Only use the best quality tools and equipment with proper attenuations for the latest acceptable sound levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

END OF SECTION 01310
SECTION 01320 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in General Conditions and other Contract Documents. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication that such temporary activity is not required for successful completion of the work and compliance with requirements of Contract Documents.

B. Each Contractor is specifically assigned certain responsibilities for temporary facilities to be used by all Contractors, other entities at the site, the Owner’s work forces and other personnel including occupants of the project, the Owner, the Architect, test agencies, personnel of governing authorities, and similar entities and personnel authorized to be at the project site during construction. In general, each Contractor is assigned the responsibilities for installation, operation and removal of each temporary facility which is related by recognized trades to its scope of contract work; and, except as otherwise indicated, each is responsible for costs and use charges associated therewith, including fuel, power usage, water usage and similar usage costs. The Contractor is responsible for temporary facilities not related to any other Contractor's scope of contract work and not otherwise specifically assigned, as designated by the Architect.

C. No costs or usage charges for temporary facilities are chargeable to the Owner, nor can any Contractor's cost or usage charges for temporary facilities be accepted as the basis for a change order extra. The total costs and usage charges for temporary facilities are included, collectively, in the Contract Amounts.

1.02 GENERAL REQUIREMENTS

A. Each Contractor shall provide and operate all hoists, cranes, helicopters and furnish and erect all ladders and scaffolding required by him and his subcontractors, constructed to afford proper protection to craftsmen, Work and other Work in progress and previously executed.

1.03 JOB CONDITIONS

A. Each Contractor shall establish and initiate use of each temporary facility at time first reasonably required for proper performance of the total work of project. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

B. Each Contractor shall install, operate, maintain and protect temporary facilities in a manner and at locations that will be safe, nonhazardous, sanitary, protective of persons and property, and free of deleterious effects.

1.04 ENVIRONMENTAL PROTECTION

A. Each Contractor shall provide facilities, establish procedures, and conduct construction activities in a manner that will ensure compliance with environmental and other regulations controlling construction activities at project site. The Contractor shall designate one person, the Construction Superintendent or other, to enforce strict discipline on activities related to generation of wastes, pollution of air/water/soil, generation of noise, and similar harmful or deleterious effects which might violate regulations or reasonably irritate persons at or in vicinity of project site. Anti-pollution measures required by D.E.P., as applicable are to be followed.

1.05 SECURITY
A. The Contractor shall maintain complete security on the site at all times during and outside of normal working hours to protect the Work and all field offices, and to secure the area of construction by restricting all trespassers.

- This means locking the doors and/or gates. A guard is not required.

1.06 TEMPORARY CONSTRUCTION FACILITIES

A. Where mud, snow, ice or other hazardous conditions exist in the purview (Scope of Work) of any Sub Contractor, the Contractor shall remove the hazards immediately and replace with suitable material for the other contractors use. If the Owner is compelled to remove the hazards with their own forces due to inaction by the Contractor, then that Contractor will be back-charged for the work performed by the Owner.

B. No welding, cutting by torch, or Work utilizing or causing flammable waste shall be done unless adequate fire protection is provided and maintained for the duration of the Work in the area of operations.

1.07 DEBRIS CONTROL (Refer to Section 01524 for further delineation)

A. The Contractor shall be responsible for daily cleaning up of spillages and debris resulting from his operations and from those of his Subcontractors; and shall be responsible for complete removal and disposition of hazardous and toxic waste materials. The Contractor shall provide containers at grade, sufficient for the depositing of nonhazardous/nontoxic waste materials, and shall remove such waste materials from project site at least weekly during cold weather (daily high temperatures below 50°F) and at least twice weekly during mild and warm weather.

- Contractor is responsible to provide and pay for all dumpsters.

B. The Contractor shall daily clean all mud, dirt and debris resulting from all trades operations from the adjacent streets, sidewalks, drives and parking areas and shall repair all damage caused by the cleaning to the satisfaction of the Owner.

C. The Contractor is to provide and maintain appropriate means of trash disposal (i.e., chutes) to grade/dumpster. Multiple units may be required and shall be figured for in the bid.

PART 2 - EXECUTION

2.01 ENCLOSURES

A. At earliest possible date, the Contractor shall secure project area against unauthorized entrance at times when personnel are not working. Provide secure temporary enclosure at ground floor and other locations of possible entry, with locked entrances.

B. Where any form of demolition will expose the interior of the building to weather, demolition shall follow the erection of weatherproof walls by the Contractor installed inside the demolition line, sealed and flashed, as required, to keep all water from the building interior. Keep temporary weatherproofing in place until new construction has been completed to the stage where water will not enter the building.

C. The Contractor shall provide constant protection against rain, wind, storms, frost or heat to maintain the work, materials, apparatus and fixtures free from damage. At the end of each day's work, cover work likely to be damaged. During cold weather, protect work from damage by freezing and provide such enclosures and heating apparatus as may be necessary diligently to prosecute the Work without stoppage for reason of unfavorable weather.

D. Wherever a Contractor provides openings through walls or slabs, each location shall be adequately protected at the end of each working day with temporary enclosures to make these areas tight. Openings through exterior walls shall be watertight.
E. Install an 8 foot high fence around the entire site with wind screening. Provide gates as needed to properly access the site to complete the work. Remove the fence once the project is substantially completed. Fence is to have poles into the ground where the fence will be untouched per a period of time, and can have feet with sandbags in areas that the fence may have to be moved occasionally to not interfere with the work.

F. For renovation projects: Contractor is to maintain the building in a water tight condition during all construction activities by whatever means necessary. Contractor is to never do any more removal work during any given day than that contractor can replace in the same day in order to make sure the occupants of the building will be protected from the possibility of water leakage into the building. Should any leakage occur, the contractor is to immediately make the building water tight (on a 24 hour basis) and repair any damage caused by the leakage or replace any equipment damaged by the leakage.

2.02 TEMPORARY ELECTRICITY

A. Power is available on site.

2.03 TEMPORARY VENTILATION

A. A trade requiring ventilation for Work shall provide fans to induce circulation of air.

2.04 TEMPORARY TELEPHONES

A. Each Contractor is responsible for their own telephone service and for payment of all charges relating to that service.

2.05 TEMPORARY WATER

A. Water is available on site.

2.06 TEMPORARY SANITARY FACILITIES

A. Starting at time of start of work at project site, the Contractor shall provide and maintain self-contained toilet units of type acceptable to governing authorities, adequate, at all stages of construction, for use of personnel at project site. Provide separate facilities for male and female personnel when both sexes are working, in any capacity, at project site. Facilities shall remain in use until completion of project. Use of permanent facilities will not be permitted.

2.07 REMOVAL AND RESTORATION

A. Prior to acceptance of the Project, each contractor shall remove temporary work for which he has been responsible.

2.08 OWNER’S RIGHTS

A. If any Contractor fails to carry out his responsibilities in providing temporary facilities, as set forth above, the Owner shall have the right to take such action as he deems proper for the protection and conduct of the Work, and to deduct the cost thereof from the amount due the Contractor at fault.

B. Extended work days, hours, shifts, weekend work, etc. may be allowed upon coordination and approval by Architect, Owner at no additional cost to the Owner.
• Should the schedule begin to slip, for any reason, each contractor will be required to work additional shifts or weekends to recover the lost time. Should there be a cost to the College for this overtime work, the contractor will be required to reimburse the owner for said costs.

2.09 Parking: parking is allowed for two vehicles only. All other parking is to be at the TCNJ Carlton Avenue parking lot. The contractor is responsible to shuttle workers back and forth as needed.

END OF SECTION 01320
SECTION 01330 – CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 DEFINITION

A. Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for final acceptance, final payment, normal termination of Contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in sections of Divisions 2 through 16. Time of closeout is directly related to Substantial Completion, and therefore may be either a single time period for entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. That time variation, if any, shall be applicable to other provisions of this section.

B. Substantial completion shall be defined that every material item has been installed. Nothing is missing and therefore, the punch list can begin.

1.02 PREREQUISITES TO SUBSTANTIAL COMPLETION

A. Prior to requesting the Architect's inspection for certification of substantial completion, for either entire work or portions thereof, complete the following and list known exceptions in request:

1. In progress payment request coincident with or first following date claimed, show either 100% completion for portion of work claimed as substantially complete, or list incomplete items, value of incomplete items, and reasons for being incomplete.

2. Include supporting documentation for completion as indicated in these Contract Documents.

   a. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

3. Submit statement showing accounting of changes to the Contract Sum.

4. Advise Owner of pending insurance change over requirements.

5. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications and similar documents.

6. All fire sprinklers, devices, alarm system, roofing system, doors, insulation, etc. requiring FM Research approval to submit certification from Factory Mutual.

7. Obtain and submit releases enabling Owner's full and unrestricted use of the work and access to services and utilities, including occupancy permits, operating certificates, and similar releases.

8. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner obtaining a signed receipt of materials delivered. Refer to individual work sections for required quantities of spare parts, extra and overrun stock, maintenance tools and devices, keys, and similar physical units to be submitted.

9. Complete start up testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue, or change over, and remove from project site temporary facilities and services, along with construction tools and facilities, mockups, and similar elements.

10. Complete final clean up requirements.

11. Touch up and otherwise repair and restore marred exposed finishes.

12. Inspection: Submit a written request for inspection for Substantial Completion to Project Manager. On receipt of request, Architect and Project Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection, the Project Manager will notify Contractor of items, either on Contractor's list or additional items identified by Architect that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

B. Upon receipt of Contractor's request, the Project Manager and Architect will proceed with substantial completion inspection. Following inspection, the Architect will either prepare the certificate of substantial completion, or advise the Contractor of work which shall be performed prior to issuance of certificate. The work remaining to be performed shall be completed prior to the punch list for final acceptance.

C. Upon receipt of Contractor's notice that work has been completed, including all punch list items, but excepting incomplete items delayed because of circumstances acceptable to the Project Manager and Architect, the Project Manager and Architect will reinspect the work. Upon completion of reinspection, the Architect will either prepare the certificate of final acceptance or advise the Contractor of work not completed or obligations not fulfilled as required for final acceptance.

D. In the event that the work is not completed or obligations are not fulfilled as required for final acceptance and the Architect/CM is required to reinspect the work more often than the two inspections described, the Contractor shall compensate the Architect and/or the Project Manager at the rate of $500.00 for each additional site visit required for reinspections. The compensation shall be processed by change order as a deduction to the Contractor's Contract Sum, which amount will be paid to the Architect or Project Manager by the Owner, through a change order as an addition to the Architect's or Project Manager's Contract Sum.

E. Substantial Completion shall be defined for this project that every element of the project/construction and the contract, based on the contract and amended drawings and specification sections, are installed and the building is deemed complete, less repairs and/or touch up type work that would be generally referred to as punchlist work. If any components of the building, or site work associated with this contract are not installed, the project cannot be deemed substantially completed.

1.03 PREREQUISITES TO FINAL ACCEPTANCE

A. Prior to requesting Project Manager and Architect's final inspection for certification of final acceptance and final payment, complete the following and list known exceptions, in request:

1. Submit final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit release of liens for all subcontractors.

3. Submit Contractor's statement that his final application, as presented, is the final bill and no other claims will be presented.

4. Submit updated final statement, accounting for additional changes to Contract Sum including change orders and allowances.

5. Submit certified copy of Architect's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, endorsed and dated by Architect.

6. Submit one set of record documents, bound copies of maintenance/operating manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

7. Complete final clean up requirements.

8. Touch up and otherwise repair and restore marred exposed finishes.

9. Submit notarized consent of surety to final payment.

10. Submit final liquidated damages settlement statement, if required, acceptable to Project Manager and the Owner.
11. Revise and submit evidence of final, continuing insurance coverage complying with insurance requirements.

12. A letter from the Owner’s representative certifying that he has been properly instructed in the operation and maintenance of equipment by the Contractor.

13. 10% one year Maintenance Bond.


15. Fire Alarm Certification and Description - NFPA form 72C including local County of Chester.

16. HVAC Contractor to submit certified balancing report.

17. Final acceptance by Architect of record documents.

B. Except as otherwise indicated or requested by Project Manager/Architect, remove temporary protection devices and facilities that were installed during course of the work to protect previously completed work during remainder of construction period.

1.04 CLEAN UP

A. Remove waste materials from site and dispose of in a lawful manner.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.01 CLEANING

A. Where extra materials of value remaining after completion of associated work have become Owner's property, dispose of these to Owner's best advantage as directed.

B. After Substantial Completion of the Work, each Contractor shall do the final cleaning of the surfaces of his installations as may be required by the various Specification sections.

C. After each Contractor has cleaned their work, The General Contractor shall engage a professional cleaning service to perform final cleaning of the work consisting of cleaning each surface or unit to normal clean condition. Comply with manufacturer's instructions for cleaning operations and chemicals. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove labels that are not required as permanent labels.

2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances that are noticeable as vision obscuring materials. Replace broken glass and damaged transparent materials.

3. Clean exposed exterior and interior hard surfaced finishes, to a dirt free condition, free of dust, stains, films and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective conditions.

4. Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment; remove excess lubrication and other substances.

5. Remove debris and surface dust from limited access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics and similar spaces.

6. Vacuum and clean carpeted surfaces and similar soft surfaces.

7. Clean light fixtures and lamps to function with full efficiency.

8. Clean and wax or polish all hard floors following manufacturer’s instructions.

9. Clean all window surfaces inside and outside.

10. Perform final cleaning in, on and around all casework, sinks, toilets fixtures, etc.
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11. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape
development areas, of rubbish, waste material, litter, and other foreign substances.
12. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
13. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
14. Remove tools, construction equipment, machinery, and surplus material from Project site.
15. Remove snow and ice to provide safe access to building.
16. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films,
   and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore
   reflective surfaces to their original condition.
17. Sweep concrete floors broom clean.
18. Replace parts subject to unusual operating conditions.
19. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water
   exposure.
20. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers,
   registers, and grills.
21. Clean ducts, blowers, and coils if units were operated without filters during construction.
22. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out
   bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and
   mercury vapor fixtures to comply with requirements for new fixtures.
23. Leave Project clean and ready for occupancy.
24. D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess
   materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage
   systems. Remove waste materials from Project site and dispose of lawfully.

3.02 RECORD DOCUMENTS (Refer to Section 01340, project requirements for submitting Record Documents)

3.03 REMOVE TEMPORARY FACILITIES

A. At the completion of the work prior to final payment, remove all temporary facilities entirely from site,
   including, but not limited to, the following: Field offices, trailers, shanties, sheds, job telephone, temporary
   toilets, temporary enclosures, dust barriers and other temporary protection devices.

END OF SECTION 01330
SECTION 01340 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Project record documents consisting of:
   a. Record drawings.
   b. Record project manual (specifications).

1.02 SUBMITTALS

A. Project Record Documents: Submit after substantial completion, but prior to final completion.

1. Record drawings: Submit in form of opaque prints.
   a. Sets shall include all drawings, whether changed or not.
2. Other record documents: Submit originals or good quality photocopies.
3. Each Sub contractor is responsible for their respective trade, record documents and record drawings.
   Combine with General Contractor record drawing documents for a complete set.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 MAINTENANCE OF PROJECT RECORD DOCUMENTS

A. Do not use record documents of any type for construction purposes.

B. Maintain record documents in a secure location at the site while providing for access by the contractor and the
   architect during normal working hours; store in a fire-resistive room or container outside of normal working
   hours.

C. Record information as soon as possible after it is obtained.

D. Assign a person or persons responsible for maintaining record documents.

E. Record the following types of information on all applicable record documents:

   1. Dimensional changes.
   2. New and revised details.
   3. Revisions to electrical circuits.
   4. Locations of utilities concealed in construction.
   5. Particulars on concealed products which will not be easy to identify later.
   6. Changes made by modifications to the contract; note identification numbers if applicable.
   7. New information which may be useful to the owner, but which was not shown in either the contract
      documents or submittals.

3.02 RECORD DRAWINGS

A. Maintain a complete set of opaque prints of the contract drawings, marked to show changes.
B. Where the actual work differs from that shown on the drawings, mark this set to show the actual work.

1. Mark location of concealed items before they are covered by other work.
2. Mark either record contract drawings or shop drawings, whichever are best suited to show the change.

C. When the contractor is required by a provision of a modification to prepare a new drawing, rather than to revise existing drawings, obtain instructions from the architect as to the drawing scale and information required.

D. Keep drawings in labeled, bound sets.

1. Mark with red pencil.
2. Mark work of separate contracts with different colors of pencils.
3. Incorporate new drawings into existing sets, as they are issued.

E. Where record drawings are also required as part of operation and maintenance data submittals, copy marks to another opaque print obtained from the architect.

3.03 RECORD PROJECT MANUAL

A. Maintain a complete copy of the project manual, marked to show changes.

B. Where the actual work differs from that shown in the project manual, mark the record copy to show the actual work.

1. Include a copy of each addendum and modification to the contract.
2. In addition to the types of information required on all record documents, record the following types of information:
   a. Product options taken, when the specification allows more than one.
   b. Proprietary name and model number of actual products furnished, for each product, material, and item of equipment specified.
   c. Name of the supplier and installer, for each product for which neither a product data submittal nor a maintenance data submittal was specified.

3.04 TRANSMITTAL TO OWNER (through the Architect)

A. Collect, organize, label, and package ready for reference.

1. Bind print sets with durable paper covers.
2. Label each document (and each sheet of drawings) with “PROJECT RECORD DOCUMENTS - This document has been prepared using information furnished by _____” [insert the contractor's name], and the date of preparation.

B. Submit to the Project Manager for transmittal to the Architect, unless otherwise indicated.

C. Submit to the Architect four (4) sets of Operation and Maintenance Manuals in three-ring binders, by volume, and indexed per binder (with one master index) to be transmitted to the Architect/Engineer for approval: All to be submitted at one time, not piece meal. Indexing should follow the specification section numbers.

- Include all inspection/approvals/certifications
- All approved submittals and cut sheets as well as manufacturer's operation and maintenance manuals for each section.
- Manuals are to be completed in volumes, three ring binders, starting with Division 1 and continuing
through the last projects Division. The number of volumes is determined by the number of spec section
the projects has and by the amount of paper/copies for complete sets of three ring binders.
• List of all contractors and vendors for the project with names, addresses and phone numbers.

END OF SECTION 01340
SECTION 01524 – CONSTRUCTION WASTE MANAGEMENT

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 administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Sections include the following:

1. All of Division 1 and attached specifications and drawings that make a part of this contract.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

1.4 SUBMITTALS

A. Waste Management Plan: Submit 4 copies of plan within 30 days of date established for the Notice to Proceed.

B. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

C. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
1.5  QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.6  WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, and waste reduction work plan. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1  PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Project Manager. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with Division 1 Section “Temporary Facilities” for operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Division 1 Section “Temporary Facilities and Controls” for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Sale and Donation: Not permitted on Project site.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to the Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination and remove contaminated materials if found.
   b. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to present windblown dust.
   c. Stockpile materials away from construction area.
   d. Store components off the ground and protect from the weather.
   e. Remove recyclable waste off Owner’s property and transport to recycling receiving or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: break up and sort rebar as best as possible. Recycle all concrete.

C. Recycle all metal products from the building before demolition (aluminum, steel etc)

D. Recycle as much product as possible and provide a complete report to TCNJ to confirm the percentage recycled on the project.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.


3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials on site.

C. Burying: Do not bury waste materials on site.

D. Disposal: Transport waste materials off Owner's property and legally dispose of them.

E. Washing waste materials into sewers or drains is not permitted.

END OF SECTION 01524
SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

1.2 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: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

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

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Predemolition Photographs or Video: Submit before Work begins.

C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

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

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

E. Storage or sale of removed items or materials on-site is not 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 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

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

C. 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.

D. Perform an engineering survey of 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 building demolition operations.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
   1. Comply with requirements specified in Section 01322 "Photographic Documentation."

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
   1. Comply with requirements for existing services/systems interruptions specified in Section 01010 "Summary of Work."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION
A. 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. Comply with requirements for access and protection specified in Section 01320 "Temporary Facilities."

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

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL
A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. 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.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches 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.
4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly. Comply with requirements in Section 01524 "Construction Waste Management and Disposal."
B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

C. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
END OF SECTION 024119
SECTION 060620 – DECORATIVE PLASTIC-LAMINATE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

B. Related Requirements:
   1. Section 114000 "Foodservice Equipment."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including high-pressure decorative laminate adhesive for bonding plastic laminate.

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

C. Samples:
   1. Plastic laminates, for each color, pattern, and surface finish.

PART 2 - PRODUCTS

2.1 HIGH-PRESSURE DECORATIVE LAMINATE (PL-1)

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. Wilsonart International; Div. of Premark International, Inc.

B. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Vertical Surfaces: Grade HGS.
   3. Pattern Direction: N/A.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by laminate manufacturer's designations. Refer to finish schedule.
2.2 HIGH-PRESSURE DECORATIVE LAMINATE (PL-2)

1. **Manufacturers**: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. Formica Corporation.

B. **Laminate Cladding for Exposed Surfaces**:

   1. **Horizontal Surfaces**: Grade HGS.
   2. **Vertical Surfaces**: Grade HGS.
   3. **Pattern Direction**: Horizontally for drawer fronts, doors, and fixed panels.

C. **Colors, Patterns, and Finishes**: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

   1. As indicated by laminate manufacturer's designations. Refer to finish schedule.

2.3 HIGH-PRESSURE DECORATIVE LAMINATE (PL-3)

A. **Manufacturers**: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. Wilsonart International; Div. of Premark International, Inc.

B. **Laminate Cladding for Exposed Surfaces**:

   1. **Horizontal Surfaces**: Grade HGS.
   2. **Vertical Surfaces**: Grade HGS.
   3. **Pattern Direction**: N/A.

C. **Colors, Patterns, and Finishes**: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

   1. As indicated by laminate manufacturer's designations. Refer to finish schedule.

2.4 MISCELLANEOUS MATERIALS

A. **Adhesive for Bonding Plastic Laminate**: As recommended by the manufacturer to bond to the substrate

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine surfaces for conditions that would adversely affect decorative plastic laminate surfacing or edge performance.
3.2 INSTALLATION

A. General: Install decorative plastic laminate in accordance with manufacturer's written installation instructions, approved Submittals and requirements of Section 114000 "Foodservice Equipment."

3.3 CLEANING & PROTECTION

A. Clean decorative plastic laminate surfaces and edge moldings in accordance with manufacturer's instructions.

B. Do not permit construction near unprotected surfaces.

END OF SECTION 060620
SECTION 061063 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood fences.

1.2 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products.

B. LEED Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates:
   1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

B. Evaluation Reports: For preservative-treated wood products, from ICC-ES.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
   1. Factory mark each item with grade stamp of grading agency.
   2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:
   1. Boards: 15 percent.
   2. Dimension Lumber: 19 percent.
   3. Timber: 19 percent.
2.2 LUMBER

A. Dimension Lumber: Select Structural grade and any of the following species:
   1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
   2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
   3. Mixed southern pine; SPIB.
   4. Redwood; RIS.

B. Boards: Any of the following species and grades:
   1. Douglas fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
   2. Hem-fir, C & Btr finish or C Select; NLGA, WCLIB, or WWPA.
   3. Redwood, Heart Clear; RIS.
   4. Southern pine, B & B finish; SPIB.
   5. Western red cedar, Clear Heart; NLGA, WCLIB, or WWPA.

2.3 POSTS

A. Dimension Lumber Posts: No. 2 grade and any of the following species:
   1. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
   2. Mixed southern pine; SPIB.
   3. Northern species; NLGA.
   4. Eastern softwoods; NeLMA.
   5. Western woods; WCLIB or WWPA.

2.4 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.

C. Preservative Chemicals: Acceptable to authorities having jurisdiction.
   1. Do not use chemicals containing arsenic or chromium.

D. After treatment, redry boards and dimension lumber to 19 percent maximum moisture content.

E. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
   1. For items indicated to receive a stained or natural finish, mark each piece on surface that will not be exposed or omit marking and provide certificates of treatment compliance issued by inspection agency.
F. Application: Treat all wood unless otherwise indicated.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or ASTM F 2329 unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.

B. Postinstalled Anchors: Stainless-steel, chemical or torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E 488, conducted by a qualified independent testing and inspecting agency.


PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install metal framing anchors to comply with manufacturer's written instructions.

D. Do not splice structural members between supports unless otherwise indicated.

E. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

F. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. ICC-ES AC70 for power-driven fasteners.

END OF SECTION 061063
SECTION 064120 – SLATWALL DISPLAY SYSTEMS

PART 1 – GENERAL

1.1 SECTION INCLUDES
   A. Pre-finished slatwall panel system for merchandise displays. Use as perimeter walls and/or floor fixtures for Retail displays.

1.2 RELATED SECTIONS
   A. Section 060620 – Decorative Plastic Laminate

1.3 SUBMITTALS
   A. Product Data: Manufacturer’s product data sheets on each product to be used.
   B. Product Drawings: Manufacturer’s drawings showing details and dimensions.
   C. Product Installation: Manufacturer’s installation instruction & procedures.
   D. Product Samples: For each finish specified, select from manufacturer’s full range of available colors and patterns.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. Open packaging promptly after deliver and inspect panels carefully. Contact Freight carrier if damaged in transit. Contact manufacturer for replacement order.
   B. Store panels in cool dry environment. Do not subject to moisture.
   C. Do not stack panels directly on floor.

1.5 PROJECT CONDITIONS
   A. Condition panels to normal room temperature, and low humidity prior to installation

1.6 WARRANTY
   A. All products shall be warranted to be free of defects for a period of 30 days after installation.

PART 2 - PRODUCTS

2.1 SLATWALL DISPLAY SYSTEMS
   A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:

2.2 MATERIALS
   A. All pre-finished panels & floor fixtures shall be slatwall panels.
   B. All slatwall panels shall be constructed utilizing a 48# density medium density fiberboard (MDF) substrate, having an internal bond strength of 110# per square inch minimum. All slatwall panels shall have formaldehyde emissions of .3 PPM or less and shall comply with HUD 24 CFR Part 3280 Standards set fourth for particleboard panels.
   C. All slatwall panels shall have engineered “T” grooves factory machined into ¾” thick substrate.
      1. Groove finish: Vinyl snap-in inserts:
2. Grove color: To be selected from manufacturer’s color options.

D. All slatwall panels shall have surface (face) finish as follows (specifier to select from manufacturer’s finish guide):
   1. High Pressure Laminate: a .030” thick high-pressure laminate sheet bonded via cold press with polyvinyl acetate (PVA) type II, water resistant adhesives. Finish color to be selected from HPL manufacturer’s color options.

E. All slatwall panels shall have grooves machined on (specifier to select):
   1. 6” on-center

2.03 FABRICATION / FACTORY FINISHING
A. Tolerances for panels:
   1. Dimensional: ± .0625”
   2. Squareness: .125” across diagonals
   3. Thickness: ± .008”
   4. Grooving: ± .031” (groove width and spacing between grooves)

PART 3 - EXECUTION

3.01 PREPARATION
A. All walls or partitions which are to receive slatwall panels shall be dry, solid and flat. Recommended stud spacing is 16” on-center. Slatwall panels may be applied directly to open studs or over drywall. Care must be taken to prevent moisture penetration through the walls. Refer to manufacturer’s installation instructions.

3.02 INSTALLATION
A. All slatwall panels are to be installed in strict accordance with the manufacturer’s written installation instructions.

END OF SECTION 064120
SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

1.2 ACTION SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design
designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting
      agency's illustration for a particular penetration firestopping condition, submit
      illustration, with modifications marked, approved by penetration firestopping
      manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-
      resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in
   compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following
   requirements:
      1. Penetration firestopping tests are performed by UL.
      2. Penetration firestopping is identical to those tested per testing standard referenced in
         "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified
         testing and inspection agency.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2. Grace Construction Products.
3. Hilti, Inc.
6. NUCO Inc.
8. RectorSeal Corporation.
9. Specified Technologies Inc.
10. 3M Fire Protection Products.
12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is 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 construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. Install forming 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 and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

D. Install fill materials for firestopping 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.
3.3 PENETRATION FIRESTOPPING SCHEDULE

A. See Drawings for schedule

END OF SECTION 078413
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mildew-resistant joint sealants.
   2. Latex joint sealants.

1.2 ACTION SUBMITTALS

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

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.4 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

   a. Dow Corning Corporation; 786-M White.
   b. GE Construction Sealants; SCS1700 Sanitary.
   c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
   d. Soudal USA; RTV GP.
   e. Tremco Incorporated; Tremsil 200.

2.2 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

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

   a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
   c. Pecora Corporation; AC-20.
   d. Sherwin-Williams Company (The); 850A or 950A.
   e. Tremco Incorporated; Tremflex 834.

2.3 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Construction Chemicals, LLC, Building Systems.
   b. Construction Foam Products, a division of Nomaco, Inc.
B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.4 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.

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

PART 3 - EXECUTION

3.1 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 laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind 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.

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

D. 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.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement JS-1.

1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   d. Other joints as indicated on Drawings.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200
SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes hollow-metal frames.

1.2 DEFINITIONS
A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Include elevations, frame profiles, metal thicknesses, preparations for hardware, and other details.
C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS
A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ceco Door Products; an Assa Abloy Group company.
   2. Curries Company; an Assa Abloy Group company.
   3. Steelcraft; an Ingersoll-Rand company.
   4. Steward Steel; Door Division.

2.2 INTERIOR FRAMES
A. Standard-Duty Frames: SDI A250.8, Level 1..
   1. Physical Performance: Level C according to SDI A250.4.
2. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).

2.3 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
   2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.
C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
E. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
G. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
   4. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing.
      b. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
   5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 STEEL FINISHES
   A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

2.7 ACCESSORIES
   A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
   B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   b. Install frames with removable stops located on secure side of opening.
   c. Install door silencers in frames before grouting.
   d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
   1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.
C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081213
SECTION 083800 – TRAFFIC DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Light to medium duty traffic doors.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Operation and maintenance data.

B. Shop Drawings: Show fabrication and installation details; include door elevations, head, jamb, and meeting stile details including full or partial gaskets.

C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Manufacturer’s warranties.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation. Do not lay flat.

1.4 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.5 WARRANTY

A. Provide manufacturer's standard two-year warranty that products are free of defects in material and workmanship and guaranteeing to replace (exclusive of freight and labor) parts proven defective within two years after date of shipment to purchaser.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. **Manufacturers:** Subject to compliance with requirements, provide products by the following or approved equivalent:

1. **Eliason Corporation; SCP-6.**

### 2.2 TRAFFIC DOORS

A. **Light to Medium Duty Doors:** 3/4 inch (19 mm) exterior grade solid wood core; 1 inch (25 mm) total thickness; light to medium duty. Easy swing hardware.

1. **Facing:** Decorative plastic laminate.
   a. **Top Panels:** 0.032 inch (0.81 mm) decorative laminate, both sides.
   b. **Base Plates:** 48 inches (1219 mm) high 20 gauge (0.91 mm) stainless steel both sides.
   c. 20 gauge stainless steel back channel and edge trim.
2. **Window Size:** 9 inches (229 mm) wide by 14 inches (356 mm) high.
3. **Glazing:** Clear acrylic.
4. **Laminate Finish:** As selected from manufacturer's standard selection.

#### 2.3 HARDWARE AND ACCESSORIES

A. **Hinges:** Double Action hinges.

1. **Easy swing hardware:**
   a. **Finish:** Zinc plated.
   b. **Size:** 3 inches (76 mm) wide by 9 inches (229 mm) high.

B. **Base Plates:** Base plates to install on base of door surface; in pairs for front and back.

1. **Material:** Stainless steel, both sides.

C. **Push Plates:** Stainless steel; 5-3/4 inches (146 mm) by 11-3/4 inches (298 mm).

### PART 3 EXECUTION

#### 3.1 EXAMINATION

A. **Do not begin installation until substrates have been properly prepared.**

B. **Verify jambs are plumb and square.**

C. **If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.**

#### 3.2 PREPARATION

A. **Clean surfaces thoroughly prior to installation.**

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

#### 3.3 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Anchor assembly to wall construction and building framing without distortion or stress.
C. Fit and align door assembly including hardware.
D. Minimum jamb construction of double studded 2 by 4 wood construction or equivalent.
E. Reinforce hollow metal jambs at hardware locations.
F. Steel channel jambs are required for heavy duty traffic doors.
G. Adjust door assembly to smooth operation and in full contact with weatherstripping.

3.4 CLEANING
A. Clean doors, frames [and glass].
B. Remove temporary labels and visible markings.

3.5 PROTECTION
A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 083800
SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1  SUMMARY

A.  Section Includes:

   1.  Interior sliding storefront entrance.

1.2  ACTION SUBMITTALS

A.  Product Data: For each type of product.

B.  Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

   1.  Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C.  Samples: For each exposed finish required.

D.  Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E.  Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3  INFORMATIONAL SUBMITTALS

A.  Product test reports.

B.  Sample warranties.

1.4  CLOSEOUT SUBMITTALS

A.  Maintenance data.

1.5  QUALITY ASSURANCE

A.  Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR SLIDING STOREFRONT ENTRANCE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America, Trifab 1010C Sliding Mall Front or approved equivalent.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

2. Glazing System: Retained mechanically with gaskets on four sides.
5. Fabrication Method: Field-fabricated stick system.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

F. Sliding Entrance Doors: Manufacturer’s standard glazed entrance doors for manual sliding operation.
   1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. Door Design: Narrow stile; 2-1/8-inch (54-mm) nominal width.

G. Sliding Entrance Door Hardware: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
   2. Cylinders: Manufacturer’s standard.
      a. Keying: Master key system to match owner’s standard.
   3. Flush Pulls: Manufacturer’s standard.
   4. Thresholds: Manufacturer’s standard raised thresholds bevelled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).

2.2 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.3 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.4 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.


PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components plumb and true in alignment with established lines and grades.

D. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
E. Install glazing as specified in Section 088000 "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

END OF SECTION 084113
SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes:
      1. Glass for doors & storefront framing.
      2. Glazing sealants and accessories.

1.2 COORDINATION
   A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
   C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE
   A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.2 GLASS PRODUCTS, GENERAL
   A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.

2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

3. Interlayer Color: Clear unless otherwise indicated.

2.5 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

   1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear annealed float glass.

   1. Minimum Thickness: 6 mm.

B. Glass Type GL-2: Clear fully tempered float glass.

   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

END OF SECTION 088000
SECTION 088810 - FIRE RATED GLASS & FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Fire rated framing system.
   1. Fire resistive, temperature rise, framing system with decorative cladding interior applications.
   2. Applications of fire rated framing includes:
      a. Full vision fire rated doors & sidelites, with fire rating requirement as specified.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   2. ASTM E152 Methods of Fire Tests of Door Assemblies.
   5. ASTM E2110-1: Standard Test for Positive Pressure of Fire Tests of Window Assemblies.

B. National Fire Protection Association (NFPA):

C. Underwriters Laboratories, Inc. (UL):

D. Standard Council of Canada (ULC):
   2. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.

E. Consumer Product Safety Commission (CPSC):

F. Glass Association of North America (GANA)
1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
1. Fire Rating: 90 or 120 minutes as specified.
2. Fire Resistive Wall Assembly Certifications: 120 minute fire resistive wall assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
3. Fire Resistive Door Assembly Certifications: 90 minute fire resistive door assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
4. Testing Laboratory: Fire test shall be conducted by a nationally recognized independent testing laboratory.

B. Listings and Labels:
1. Fire rated framing system shall be under current follow-up service by a nationally recognized independent laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

C. Appearance:
1. Fire rated wall/door assembly shall have a neat finished appearance with minimum joints at decorative cover intersections.

1.4 SUBMITTALS

A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.
1. Shop Drawings: Submit shop drawings showing layout, profiles and product components.
2. Samples: Submit samples for finishes, colors and textures.

1.5 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials to specified destinations in manufacturer’s or distributor’s packaging undamaged, complete with installation instructions.

C. Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

1.6 FABRICATION DIMENSIONS

A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field
measurements and fabrication schedule with construction progress to avoid construction delays.

1.7 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document. Manufacturer’s warranty is not intended to limit other rights that the Owner may have under the Contract Documents.
   1. Warranty Period: 5 years from date of shipping.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Fire rated glass and framing must be provided by a single-source, US manufacturer. Distributors of fire rated glass and framing are not to be considered as manufacturers.

2.2 MATERIALS – FRAMING

A. Fire resistive, temperature rise framing system rated for 120 minutes.

B. Properties:
   1. Frame thickness: 3” to 5”
   2. Internal framing: Internal tube steel framing shall conform to ASTM A501. Formed steel retainers shall be galvanized conforming to ASTM A527.
   3. Insulation: The framing system shall insulate against the effects of fire, smoke and heat transfer from either side. The perimeter of the framing system to the rough opening shall be firmly packed with mineral wool fire stop insulation or appropriately rated intumescent sealant.
   4. Fasteners: Type recommended by manufacturer.
   5. Framing covers: aluminum alloy 5052.
   6. Glazing accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant glazing tape. The glazing panel shall be caulked continuously around the edge to the tube steel frame utilizing neutral cure silicone.

C. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   1. SAFTI\textit{fire} GPX Framing as manufactured and distributed by SAFTI \textit{FIRST} Fire Rated Glazing Solutions.

2.3 MATERIALS – GLASS

A. Fire resistive glazing rated for 90 minutes (doors) or 120 minutes (sidelites).
B. **Properties:**

1. **Make-up:** Must be comprised of an inboard and outboard lite of clear tempered glass protecting a clear, fire resistive, intumescent interlayer.
2. **Thickness:** 1-1/2” (39 mm) standard profile.
3. **Individual Lites shall be permanently identified with a listing mark.**
4. **Glazing material installed in “Hazardous Locations” (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ANSI Z97.1 Standard for Safety Glazing Materials Used In Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.**
5. **Temperature rise on the unexposed side of glazing material shall be limited to 250 degrees Fahrenheit when required.**

A. **Manufacturers:** Subject to compliance with requirements, provide products by the following or an approved equal:

1. **SuperLite II-XL** as manufactured and distributed by SAFTI FIRST Fire Rated Glazing Solutions.

C. **Logo:** Each piece of fire rated glazing shall be labeled with a permanent logo.

2.3 **FABRICATION**

A. **Assemblies shall be furnished assembled (should configurations and job site conditions allow.)**

B. **Door assemblies shall be factory prepared for field mounting of hardware.**

C. **Fabrication Dimensions:** Fabricate to approved dimensions. The general contractor shall guarantee dimensions within required tolerance. Obtain approved shop drawings prior to fabrication.

2.4 **FINISHES**

A. **Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designing finishes.**

B. **Covers shall be chemically cleaned and pretreated; then, finished with (choose one):**

1. **Clear Anodized.**

C. **Protect finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.**

D. **Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.**

2.5 **DOOR HARDWARE FOR SINGLE AND PAIRED DOORS**
A. Hardware shall be supplied with the fire door. Hardware selection shall be from door manufacturer’s standard recommended hardware groups as specified below.

B. Standard operating hardware for pair doors.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Finish</th>
</tr>
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<tr>
<td>1</td>
<td>Hinges</td>
<td>Heavy-duty Continuous Geared OKC</td>
<td>Pemko</td>
<td>Anodized</td>
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<tr>
<td>1</td>
<td>Panic Device</td>
<td>Modern Touchbar with Surface Vertical Rods</td>
<td>Von Duprin 9827F w/ 996 L-trim</td>
<td>US32D</td>
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<tr>
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<td>Closing Device</td>
<td>Heavy-duty Surface Applied Closer</td>
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<td>1</td>
<td>Auto Door Bottoms</td>
<td>420APKL</td>
<td>Pemko</td>
<td></td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 MANUFACTURER’S INSTRUCTIONS

A. Compliance: Comply with manufacturer’s product data including product technical bulletins and installation instructions.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, have been previously installed under other sections, and are acceptable for product installation in accordance with manufacturer’s instructions. Openings shall be plumb, square and within allowable tolerances. The Architect/Engineer shall be notified of any conditions that jeopardize the integrity of the proposed fire wall/door framing system. Do not proceed until such conditions are corrected.

3.3 INSTALLATION

A. Fire wall/door installation shall be by a licensed contractor and in strict accordance with the approved shop drawings.

3.4 CLEANING AND PROTECTION

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove such substances by method approved by manufacturer.

B. Wash glass on both faces not more than four days prior to date schedule for inspections intended to establish date of Substantial Completion. Wash glass by method recommended by glass manufacturer.

C. Remove temporary coverings and protection of adjacent work areas.
D. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 088810
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
   2. Suspension systems for interior gypsum ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.

2.2 FRAMING SYSTEMS

A. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
   1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
   2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
   1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
   2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
   3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) **MBA Building Supplies;** FlatSteel Deflection Track or Slotted Deflecto Track.
3) **Steel Network Inc. (The);** VertiClip SLD or VertiTrack VTD Series.
4) **Superior Metal Trim;** Superior Flex Track System (SFT).
5) **Telling Industries;** Vertical Slip Track or Vertical Slip Track II.

C. **Firestop Tracks:** Manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. **Products:** Subject to compliance with requirements, provide one of the following:
   
a. **Fire Trak Corp.;** Fire Trak System.
b. **Grace Construction Products;** FlameSafe FlowTrak System.
c. **Metal-Lite, Inc.;** The System.

D. **Flat Strap and Backing Plate:** Steel sheet for blocking and bracing in length and width indicated.

1. **Minimum Base-Metal Thickness:** 0.027 inch (0.68 mm).

E. **Cold-Rolled Channel Bridging:** Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. **Depth:** 1-1/2 inches (38 mm).
2. **Clip Angle:** Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

F. **Hat-Shaped, Rigid Furring Channels:** ASTM C 645.

1. **Minimum Base-Metal Thickness:** 0.018 inch (0.45 mm).
2. **Depth:** 7/8 inch (22.2 mm).

G. **Cold-Rolled Furring Channels:** 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. **Depth:** 3/4 inch (19 mm).
2. **Furring Brackets:** Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. **Tie Wire:** ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

H. **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 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 **SUSPENSION SYSTEMS**

A. **Tie Wire:** ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. **Hanger Attachments to Concrete:**
1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
   a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.
2. Powder-Actuated Fasteners: Capable of sustaining a load equal to 10 times that imposed as determined by ASTM E 1190.
C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 2 inches (51 mm).
F. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
   2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
      a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
      b. Depth: 2-1/2 inches (64 mm).
   3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
      a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).

2.4 AUXILIARY MATERIALS
A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt or foam gasket.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL
A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated.

   b. 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 in finished assembly.

   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: 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.

4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

E. Direct Furring:

   1. Screw to wood framing.

   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Furring Members:
1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

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

3.3 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend 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 suspension system.
      a. 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 locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   3. Do not attach hangers to steel roof deck.
   4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CertainTeed Corp.
   2. Georgia-Pacific Gypsum LLC.
   4. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
   1. Thickness: 1/2 inch (12.7 mm).
   2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.5 AUXILIARY MATERIALS

A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

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

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing 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 edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Install 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.
1. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900
SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass mosaic tile.
   2. Porcelain tile.
   3. Tile backing panels.
   4. Metal edge strips.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples:
   1. Each type and composition of tile and for each color and finish required.
   2. Stone thresholds.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

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

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Ceramic Tile Type CT-1: Unglazed porcelain tile.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
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CERAMIC TILING

a. **Laminam by Crossville**

2. Face Size: 1000 by 3000 mm.
3. Thickness: (3 mm).
4. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
5. Grout Color: As selected by Architect from manufacturer's full range.

B. Ceramic Tile Type CT-2: Unglazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. **Laminam by Crossville**
   2. Face Size: 1000 by 3000 mm.
   3. Thickness: (3 mm).
   4. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   5. Grout Color: As selected by Architect from manufacturer's full range.

C. Ceramic Tile Type CT-2: Unglazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. **Laminam by Crossville**
   2. Face Size: 1000 by 3000 mm.
   3. Thickness: (3 mm).
   4. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   5. Grout Color: As selected by Architect from manufacturer's full range.

D. Ceramic Tile Type CT-3: Unglazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. **Laminam by Crossville**
   2. Face Size: 1000 by 3000 mm.
   3. Thickness: (3 mm).
   4. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   5. Grout Color: As selected by Architect from manufacturer's full range.

E. Ceramic Tile Type CT-4: Unglazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. **Laminam by Crossville**
   2. Face Size: 1000 by 3000 mm.
   3. Thickness: (3 mm).
   4. Tile Color, Glaze, and Pattern: Collection Collection, Arancio
   5. Grout Color: As selected by Architect from manufacturer's full range.

F. Ceramic Tile Type CT-5: Factory-mounted glass mosaic tile.
1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
2. Module Size: 1 by 1 inch (25.4 by 25.4 mm).
3. Thickness: 1/4 inch.
4. Tile Color and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
5. Grout Color: As selected by Architect from manufacturer's full range.

G. Ceramic Tile Type FL-1: Unglazed porcelain tile.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
      a. Crossville.
   2. Certification: Tile certified by the Porcelain Tile Certification Agency.
   3. Face Size: 24 by 24 inches
   5. Dynamic Coefficient of Friction: Not less than 0.42.
   6. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   7. Grout Color: As selected by Architect from manufacturer's full range.

H. Ceramic Tile Type FL-4: Unglazed porcelain tile.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
      a. Garden State Tile.
   2. Certification: Tile certified by the Porcelain Tile Certification Agency.
   3. Face Size: 6 by 40 inches
   4. Thickness: 1/4 inch (6.4 mm).
   5. Dynamic Coefficient of Friction: Not less than 0.42.
   6. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   7. Grout Color: As selected by Architect from manufacturer's full range.

I. Ceramic Tile Type CB-1: Unglazed porcelain tile cove base.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
      a. Crossville.
   2. Certification: Tile certified by the Porcelain Tile Certification Agency.
   3. Cove Base: Surface bullnose, module size 6”x12”.
   4. Tile Color, Glaze, and Pattern: As indicated by manufacturer's designations. Refer to finish schedule.
   5. Grout Color: As selected by Architect from manufacturer's full range.
2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.

1. **Products:** Subject to compliance with requirements, provide the following or approved equivalent:
   a. USG Corporation; DUROCK Cement Board.

2. **Thickness:** 1/2 inch (12.7 mm).

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Custom Building Products, Megaflex Crack Prevention Mortar or comparable product by one of the following:
   a. Laticrete International, Inc.
   b. MAPEI Corporation.

2. For wall applications, provide nonsagging mortar.

2.5 GROUT MATERIALS


1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Custom Building Products, Polyblend Non-Sanded Grout or comparable product by one of the following:
   a. Laticrete International, Inc.
   b. MAPEI Corporation.


1. **Basis-of-Design Product:** Subject to compliance with requirements, provide Custom Building Products, Polyblend Sanded Grout or comparable product by one of the following:
   a. Laticrete International, Inc.
   b. MAPEI Corporation.

2.6 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 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.

1. **Manufacturers:** Subject to compliance with requirements, provide products by the following or approved equivalent:
a. Schluter Systems L.P.; QUDEC Q80EB.

C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide the following or an approved equivalent:
   a. Custom Building Products; Surfaceguard Sealer.

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 the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
   1. The contractor is to provide an allowance to patch and prepare existing substrates.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, 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 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.

B. 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.

C. 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.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Glass Mosaic Tile: As indicated on finish schedule.
   2. Porcelain Tile: As indicated on finish schedule.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Metal Edge Strips: Install at locations indicated.

K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

L. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
1. Ceramic Tile Installation: TCNA F113; thinset mortar.
   c. Grout: Standard sanded cement grout for joints 1/8” or thicker, Standard unsanded cement grout for joints less than 1/8” thick.

B. Interior Wall Installations, Masonry or Concrete:

   a. Ceramic Tile Type: CT-1.

C. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W243; thinset mortar on gypsum board.
   a. Ceramic Tile Type: CT-2.

2. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
   a. Ceramic Tile Type: CT-3, CT-4, & CT-5.

END OF SECTION 093013
SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1  SUMMARY
   A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2  ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Samples: For each exposed product and for each color and texture specified.

1.3  INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Evaluation reports.

1.4  CLOSEOUT SUBMITTALS
   A. Maintenance data.

PART 2 - PRODUCTS

2.1  PERFORMANCE REQUIREMENTS
   A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
      2. Smoke-Developed Index: 50 or less.

2.2  ACOUSTICAL PANEL CEILINGS, GENERAL
   A. Acoustical Panel Standard: Comply with ASTM E 1264.
   B. Metal Suspension System Standard: Comply with ASTM C 635.
C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS: ACP-1

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   1. USG Interiors, Inc.; Subsidiary of USG Corporation, Sheetrock Lay-In Ceiling Panel ClimaPlus.

B. Classification: Type XX, Pattern G

C. Color: White.

D. LR: .77.

E. NRC: .10, Type E-400 mounting according to ASTM E 795.

F. CAC: 35.

G. Edge/Joint Detail: Square.

H. Thickness: 1/2 inch (15 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

2.4 ACOUSTICAL PANELS: ACP-2

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   1. USG Interiors, Inc.; Subsidiary of USG Corporation, Millennia ClimaPlus.

A. Classification: Type III, Form 1, Pattern E, G

B. Color: White.

C. LR: .85.

D. NRC: .70, Type E-400 mounting according to ASTM E 795.

E. CAC: 35.

F. Edge/Joint Detail: Square.

G. Thickness: 3/4 inch (19 mm).

H. Modular Size: 24 by 24 inches (610 by 610 mm).
2.5 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   1. USG Interiors, Inc.; Subsidiary of USG Corporation, Donn DX/DXL.

A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
   1. Structural Classification: Heavy-duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Face Design: Flat, flush.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
   1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION 095113
SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

   1. Resilient base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE CB-1

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:

   1. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

   1. Style and Location:

      a. Style B, Cove: All locations unless otherwise noted.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 6 inches (152 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed or preformed.

G. Inside Corners: Job formed or preformed.

H. Colors: As indicated by manufacturer's designations. Refer to finish schedule.
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 resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
   a. Miter or cope corners to minimize open joints.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513
SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE FL-2

A. Products: Subject to compliance with requirements, provide the following or approved equivalent:

1. Centiva; A Tarkett Company.

B. Tile Standard: ASTM F 1700.


2.

C. Thickness: 0.120 inch (3.0 mm).

D. Size: 6 by 36 inches.
E. Colors and Patterns: As indicated by manufacturer's designations. Refer to finish schedule.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
   a. Perform anhydrous calcium chloride test according to 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 relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

1. The contractor is to provide an allowance to patch and prepare existing substrates.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.
3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring 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.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Cover floor tile until Substantial Completion.

END OF SECTION 096519
SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
5. Wood.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
B. Samples: For each type of paint system and in each color and gloss of topcoat.
C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product listed in other Part 2 articles for the paint category indicated or an approved equal.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system 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.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

1. Sherwin Williams, PrepRite, Interior/Exterior Block Filler, or approved equivalent.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

1. Sherwin Williams, Multi-Purpose Zero VOC Primer/Sealer, or approved equivalent.

B. Primer, Latex, for Interior Wood: MPI #39.

1. Sherwin Williams, PrepRite ProBlock, Primer/Sealer, or approved equivalent.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.
1. Sherwin Williams, Pro Industrial, Pro-Cryl Universal Primer, or approved equivalent.

   B. Primer, Galvanized, Water Based: MPI #134.

       1. Sherwin Williams, Pro Industrial, Pro-Cryl Universal Primer, or approved equivalent.

2.6 WATER-BASED PAINTS


       1. Sherwin Williams, ProMar 200 Zero VOC Interior Latex Paint, or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

   B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

       1. Concrete: 12 percent.
       3. Wood: 15 percent.
       4. Gypsum Board: 12 percent.

   C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

   D. Proceed with coating application only after unsatisfactory conditions have been corrected.

       1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

   A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

   B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

       1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

   C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:
   1. Institutional Low-Odor/VOC Latex System:
      a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
      c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

B. CMU Substrates:
   1. Institutional Low-Odor/VOC Latex System:
      c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

C. Steel Substrates:
   1. Institutional Low-Odor/VOC Latex System:
      c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

D. Galvanized-Metal Substrates:
1. Institutional Low-Odor/VOC Latex System:
   a. Prime Coat: Primer, galvanized, water based, MPI #134.
   c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

E. Wood Substrates: Including wood trim & architectural woodwork.

1. Institutional Low-Odor/VOC Latex System:
   a. Prime Coat: Primer, latex, for interior wood, MPI #39.
   c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

F. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:
   a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
   c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.

END OF SECTION 099123
SECTION 099723 - CONCRETE SEALERS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Curing and sealing compounds for interior and exterior concrete surfaces.

1.2 REFERENCES

A. AASHTO M 148 - Liquid Membrane-Forming Compounds for Curing Concrete.
B. ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete.

1.3 SUBMITTALS

A. Comply with Section 01330 - Submittal Procedures.
B. Product Data: Submit manufacturer’s product data, including surface preparation and application instructions.
C. Manufacturer’s Certification: Submit manufacturer’s ISO 9001/9002 certification.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: ISO 9001/9002 registered or provide proof of documented quality assurance system. Quality assurance system shall be registered by independent registrar accredited by ANSI Registrar Accreditation Board (ANSI-RAB) or by another internationally recognized body.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
B. Storage: Store materials in clean, dry area in accordance with manufacturer’s instructions. Keep containers sealed until ready for use. Quality of Diamond Clear VOX is reduced if allowed to freeze.
C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply curing and sealing compound when concrete surface or air temperatures are below 40 degrees F (4 degrees C).
B. Do not apply curing and sealing compound when material temperature is below 50 degrees F (10 degrees C).
PART 2 – PRODUCTS

2.1 MATERIALS

A. VOC-Compliant Concrete Curing and Sealing Compound:
   1. Type: Acrylic emulsion blend.
   2. Compliance:
      a. ASTM C 309, Type 1, Class B.
      b. AASHTO M 148, Type 1.
      c. Meets maximum VOC content of 350 g/L in accordance with EPA 40 CFR Part 59, Table 1, Subpart D for concrete curing compounds.
      d. Meets California and New Jersey air quality standards.
   3. VOC Content: 325 g/L.
   4. USDA approved.
   5. Ultraviolet resistant.
   6. Reduced odor.

B. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equivalent:
   1. The Euclid Chemical Company; Diamond Clear VOX.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine concrete surfaces to receive curing and sealing compound. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions are corrected.

3.2 SURFACE PREPARATION

A. Prepare concrete surfaces in accordance with manufacturer’s instructions.

B. Ensure surfaces are clean and free of standing water.

C. Remove dirt, dust, oil, grease, sealers, and other materials that may prevent adhesion of curing and sealing compound.

3.3 APPLICATION

A. Apply curing and sealing compound to concrete surfaces in accordance with manufacturer’s instructions.

B. Apply compound at uniform coverage rate in accordance with manufacturer’s instructions.

C. Apply as soon as possible after finishing and immediately after disappearance of surface moisture sheen, when used to cure freshly placed concrete.
D. Do not apply to concrete to receive toppings, epoxy coatings, urethane coatings, or epoxy adhesives.

E. Do not use as a bond breaker for tilt-up construction.

F. Do not dilute curing and sealing compound.

3.4 PROTECTION

A. Protect horizontal surfaces from traffic until curing and sealing compound has cured.

END OF SECTION 099723
SECTION 101423 – METAL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal signage

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show typestyles, graphic elements, and layout for each sign.

C. Shop Drawings: Show layout and location of signage, large-scale details, attachment devices, and other components.

D. Samples: For each exposed product and for each color and texture specified.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

PART 2 - PRODUCTS

2.1 METAL SIGNAGE

A. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:

1. Gemini Incorporated  www.signletters.com

B. Requirements

1. Style: Flat cut metal letters.
2. Metal: Aluminum Alloy 5502
3. Finish: Brushed.
4. Font: Universe 67
5. Height: 10”
6. Thickness: 1/2”
7. Mounting: Flush Mount
2.2 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.

2. Sign Mounting Fasteners:
   
   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.

2.3 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.

3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

4. Internally brace signs for stability and for securing fasteners.

5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Install signs so they do not protrude or obstruct according to the accessibility standard.

3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423
SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Corner guards.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For each impact-resistant wall protection unit. Include sections, details, and attachments to other work.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Material test reports.

C. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M.

2.2 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards (CG-2): Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:
   a. Construction Specialties, Inc.; CO Series

2. Material: Stainless steel, Type 304.
   a. Thickness: Minimum 0.0500 inch (1.3 mm).
   b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 3-1/2 by 3-1/2 inches (90 by 90 mm).


PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.

2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
a. Provide anchoring devices to withstand imposed loads.
b. 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, but no closer than 12 inches (305 mm).
c. Adjust end and top caps as required to ensure tight seams.

B. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

C. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600
SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS
   A. Maintenance data.

1.4 COORDINATION
   A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
   B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET
   A. Cabinet Type: Suitable for fire extinguisher (FE-1 only).
      1. Products: Subject to compliance with requirements, provide the following or an approved equivalent:
         a. Larsens Manufacturing Company, Cameo Series.
   B. Cabinet Construction: Nonrated.
1. **Fire-Rated Cabinets:** Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.

C. **Cabinet Material:** Cold-rolled steel sheet.

D. **Surface-Mounted Cabinet:** Cabinet box fully exposed and mounted directly on wall with no trim.

E. **Cabinet Trim Material:** Steel sheet.

F. **Door Material:** Steel sheet.

G. **Door Style:** Full acrylic bubble with frame.

H. **Door Glazing:** Molded acrylic bubble.
   1. **Acrylic Bubble Color:** Clear, transparent.

I. **Door Hardware:** Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. **Accessories:**
   1. **Door Lock:** Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   2. **Identification:** Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet glazing.
         2) Application Process: Vinyl letters.
         3) Lettering Color: Red.
         4) Orientation: Vertical.

K. **Materials:**
   1. **Cold-Rolled Steel:** ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
      a. **Finish:** Baked enamel or powder coat.
      b. **Color:** As selected by Architect from full range of industry colors and color densities.

2.3 **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.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply vinyl lettering at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413
SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
   A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and maintenance data.

1.5 COORDINATION
   A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY
   A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equivalent:
   a. Larsens Manufacturing Company.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type (FE-1): UL-rated 5 lbs nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

C. Wet-Chemical Type (FE-2): UL-rated 2-A:1-B:C:K, 1.6-gal. (6-L) nominal capacity, with potassium acetate-based chemical in stainless-steel container; with pressure-indicating gage.

2.3 MOUNTING BRACKETS

A. Mounting Brackets (Wet Chemical Type Fire Extinguishers): Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
   a. Larsens Manufacturing Company.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
SECTION 114000 – FOODSERVICE EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE

A. The work referred to in this section consists of furnishing all labor and material required to provide and deliver all equipment hereinafter specified into the building, uncrate, assemble, hang, set in place, level, and completely install, exclusive of final utility connections. The kitchen equipment contractor shall provide all equipment included in this section, including all foodservice equipment counters and equipment contained in such.

B. Furnish all labor and material required to relocate all equipment noted as existing/relocated. Contractor to remove, store in secure location and redeliver all existing/relocated equipment. Contractor to clean equipment and ensure items are in full working order when returned.

C. Kitchen equipment contractor to coordinate the installation of all equipment noted as Vendor and/or Owner supplied.

1.2 SUBMITTALS

A. Upon award of Contract, furnish the Architect with hard copies of the following drawings, in accordance with the approved project schedule, which shall be made on sheets equal in size and matching the bid set drawing size. Reproduced copies of bid documents will not be accepted for this purpose in any fashion.

1. Equipment specified for fabrication shall be detailed and fully dimensioned to a minimum scale of ¾” = 1’-0” for plan and elevation views and 1-1/2” = 1’-0” for sections.

2. Prepare separate electrical and mechanical dimensioned rough-in drawings at ¼” = 1’-0” scale showing exact point of penetration of floors, walls, and ceilings for all services required to operate the equipment that the Contractor shall furnish. These drawings shall also show exact locations of final connections to equipment. Indicate floor drains, floor sink, receptacles, lights, and other special conditions.

3. Dimensioned drawings shall be submitted showing the location and size of all bases, depressions, special height walls, openings in walls for equipment, and critical dimensions, etc. Drawings shall be drawn to a scale of not less than ¼” = 1’-0”.

B. Manufacturers’ Data: Upon award of Contract, submit bound copies of Manufacturers’ Illustrations and Technical Data to the Architect for review prior to procurement. Items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to describe accurately the item to be furnished as specified, including voltage, phase, load, accessories, etc.

C. Manufacturers’ List: Submit in writing a list of all manufacturers’ representatives of the foodservice equipment, such as convection ovens, ranges, etc., and their authorized service agencies’ addresses and telephone numbers.

D. Foundation Data: Data and drawings shall be submitted for each item, if any, requiring special foundations, structures, or supports. Such foundations, structures, or supports will be provided and installed by other appropriate trades in accordance with the drawings and specifications which shall be provided by the Contractor and reviewed by the Architect.

E. Operation and Maintenance Manuals: Bound copies of operation, maintenance, and parts manuals shall be supplied for all equipment items of standard manufacture including standard component assemblies built into all custom-fabricated items.
F. Review by the Architect of the drawings and brochures submitted by the Contractor does not waive the responsibility of the Contractor to furnish each item of equipment in complete compliance with the specifications and contract drawings.

G. The number of copies of all submittals shall be as determined by the Architect.

H. Samples: Samples of materials, products, fabrication methods, and reworking of damaged areas or equipment shall be submitted for review upon request at no additional cost, before proceeding with the work.

1.3 QUALITY ASSURANCE

A. Standard Products: Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturers’ latest design that complies with the specifications.

B. Manufacturers’ Qualifications: Manufacturers shall be regularly engaged in the production of the items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.

C. Installation Qualifications: Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work defined in this Section.

D. Coordination of Work: Coordinate work with the respective trades performing preparatory work for installation of equipment under this Contract, including, but not limited to: construction of pits, trenches, receptors; rough-in of supply, waste and vent piping; electrical connections; and field verification of dimensions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver foodservice equipment in containers designed to protect equipment and finish until final installation. Make arrangements to receive equipment at project site or to hold in warehouse until delivery can be made to job site.

B. Store foodservice equipment in original containers and in location to provide adequate protection to equipment while not interfering with other construction operations.

C. Handle foodservice equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged foodservice equipment; replace and return damaged components to equipment manufacturer.

1.5 APPLICABLE CODES AND STANDARDS

A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section. Comply with all Federal, State, and Municipal regulations and notifications which bear on the execution of this work.

1. NSF Standards: Comply with applicable National Sanitation Foundation standards and criteria and provide NSF “Seal of Approval” on each manufactured item and on major items of custom-fabricated work.

2. UL Standards: For electrical components and assemblies, provide either UL labeled products or, where no labeling service is available, provide a complete index of the components used as selected from the UL “Recognized Component Index.” All fabricated
1.6 PROJECT CONDITIONS

A. Visit the job site to field check actual wall dimensions and roughing-in and be responsible for furnishing, fabricating, and installing the equipment in accordance with the available space and utility services as they exist on the job site for an accurate fit.

B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and, if necessary, check with the Contractor regarding the possibility of holding wall erection, placement of doorjambs, windows, etc., for the purpose of moving the equipment to its proper location. Any removal and rebuilding of walls, partitions, doorjambs, etc., necessary to place the equipment or, if caused by incorrect information on the Contractor’s drawings, shall be done at the expense of the Contractor.

C. Physically check the location and utility size of all “rough-ins” at the job site for compatibility with the equipment being installed before finished floors, walls, and/or ceilings are in place.

D. Check electrical characteristics and water, steam, and gas pressure. Provide pressure-regulating valves where required for proper operation of equipment.

1.7 GUARANTIES AND WARRANTIES

A. Self-contained or remote refrigeration systems furnished under this Contract shall be provided with start-up and a one-year service contract providing free service, 24 hours per day, seven days per week, including parts and labor. Hermetic or semi-hermetic compressors shall be covered by the manufacturers’ factory warranty for an additional four years. Other equipment provided shall include a one-year warranty covering parts and labor, plus any extended warranties as normally provided by individual manufacturers. Equipment including refrigeration systems both self-contained and remote shall be warranted by the Contractor on the project for one year as indicated in the preceding sentence. The first day of the first year commences upon the earlier of 1) the date the equipment is put into production at the facility or 2) the date the equipment is accepted by the Architect.

PART 2 - PRODUCTS

2.1 GENERAL
A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. Parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.

B. Means shall be provided to ensure adequate lubrication for moving parts. Oil holes, grease fittings, and filler caps shall be accessible without the use of tools.

C. Plastic nameplates, to identify controls on fabricated equipment and when specified elsewhere, shall be provided of two-ply, 1/16”, rigid plastic material which shall be specifically manufactured for engraving such nameplates. The finished nameplate shall be machine engraved with white letters on a black background and shall have edges beveled at a 45° angle. Nameplates shall be attached using an adhesive recommended by the manufacturer of the engraving material.

D. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. Guards shall provide easy access to guarded parts.

E. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by Architect in lieu of rejection of items of equipment, it shall be the Contractor’s responsibility to provide same at no additional cost.

F. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. Gauges for sheet iron and sheet steel shall be U.S. Standard Gauges and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

<table>
<thead>
<tr>
<th>GAUGE</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>#10</td>
<td>0.135</td>
</tr>
<tr>
<td>#12</td>
<td>0.105</td>
</tr>
<tr>
<td>#14</td>
<td>0.075</td>
</tr>
<tr>
<td>#16</td>
<td>0.060</td>
</tr>
<tr>
<td>#18</td>
<td>0.048</td>
</tr>
<tr>
<td>#20</td>
<td>0.036</td>
</tr>
</tbody>
</table>

G. Materials or work described in words which have a well-known and accepted technical or trade meaning shall be held to refer to such accepted meanings.

2.2 MATERIALS

A. Submit a certified copy of the mill analysis of materials if requested by the Architect.

B. Stainless steel sheets shall conform to ASTM A240, Type 304 Condition A, 18-8, having a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view. Sheets shall be uniform throughout in color, finish, and appearance.

C. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.

D. Rolled shapes shall be of the cold-rolled type conforming to ASTM A36.

E. Galvanized sheet steel shall conform to ASTM A526; where extensive forming to take place, conform to ASTM A527; conform to ASTM A525, coating designation G115, chemical treatment.

F. Galvanized steel sheets shall be cold-rolled, stretcher leveled, bonderized, and rerolled to ensure a smooth surface.
G. Castings shall be corrosion-resisting metal containing not less than 30% nickel. Castings shall be rough ground, polished, and buffed to bright luster and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion-resistant metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.

H. Not used

I. Sealant, wherever required, for sealing backslashes to walls, cabinet bodies to concrete or tile bases, roll-in refrigerators to floors, or other types of application shall be Dow-Corning #780 or General Electric “Silastic” or equivalent in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers’ recommendations for smooth, sealed finish.

2.3 FINISHES

A. Paint and coatings shall be of an NSF approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking, and mildew resistant; shall comply with all governing regulations; and shall be applied in accordance with the recommendations of the manufacturer.

B. Exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, properly primed with rust-inhibiting primer, degreased, and finished with two (2) coats of epoxy-based grey hammertone paint, unless otherwise specified.

C. Stainless steel, where exposed, shall be polished to a #4 commercial finish. Where unexposed, finish shall be #2B. The grain of polishing shall run in the same direction wherever possible. Where surfaces are disturbed by the fabricating process, such surfaces shall be finished to match adjacent undisturbed surfaces.

D. Galvanized shelving shall not be painted.

E. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable and shall be removed after the equipment installation is complete at the work site or, alternatively, when directed by the Architect.

F. Exposed surfaces on brass, bronze, or steel shall be plated with chromium over nickel in accordance with Federal Specifications WW-P-541, Paragraph 9.5 and Table 9.4, unless otherwise specified.

2.4 ELECTRICAL AND MECHANICAL REQUIREMENTS

A. Standard UL listed materials, devices, and components shall be selected and installed in accordance with NEMA Standards and recommendations and as required for safe and efficient use and operation of the foodservice equipment without objectionable noise, vibration, and sanitation problems.

1. Provide recognized commercial grade signals, “on-off” pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent engraved, plastic laminate signs and graphics identifying each item. Provide stainless steel cover plates at controls and signals.

2. Each item requiring electrical power shall be equipped with either a terminal box for permanent connection or with cord and plug for interruptible connection, as indicated. Provide NEMA standard grounding type plugs, where used.
3. Furnish foodservice equipment completely wired internally using wire and conduit suitable for a wet location, including a separate grounding wire. Provide electrical outlets and receptacles required to be mounted on or in fabricated equipment and interconnect to a suitable terminal box (subpanel, starter, or disconnect switch if so specified) with all wires neatly tagged showing item number, voltage characteristics, and load information.

4. Receptacles for all wall- and floor-mounted outlets will be provided to be used for plug-in equipment with characteristics as noted on the drawings. Provide Hubbell three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment to match receptacles provided.

5. Electrically heated equipment shall be internally wired to a thermostatic control and an “on-off” red neon light indicator, which shall be mounted in a terminal box on a removable stainless steel access panel.

6. Only rigid steel conduit shall be used, zinc-coated where unexposed and chrome-plated where exposed. Wiring shall be run concealed wherever possible.

7. Provide on or for each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating and in accordance with Underwriters Code wherever such equipment is not built in.

8. Appliances shall be furnished complete with motors, driving mechanism, starters, and controllers, including master switches, timers, cut-outs, reversing mechanism, and other electrical equipment if and as applicable. Wiring and connection diagrams shall be furnished with electrically operated machines and for electrically wired fabricated equipment.

9. Appliances shall be of rigid construction, free from objectionable vibration. Quietness of operation of all foodservice equipment is a requirement. Remove or repair any equipment producing objectionable noise and/or vibration as directed by the Architect.

10. Motors shall be of the drip-proof, splash-proof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. Motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter from the machine on which installed shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Horsepower requirements on driven equipment shall be determined by the manufacturer based on normal operation at maximum capacity. The nominal rated motor horsepower shall be not less than the horsepower required for normal operation of the equipment at maximum capacity. Insulation shall be NEMA Class B, or better.

11. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches, etc., to match the material and finish of the equipment to which they will be fastened.

12. Switches, controls, etc., shall be conspicuously labeled as to use with plastic nameplates secured to the adjacent surface as previously specified in Article 2.01-C. Submit a sample for approval if requested by Architect.

13. Where specified for custom fabricated equipment, provide compartment with electrical subpanel which shall be pre-wired in conduit concealed in cabinet body construction and connected to all electrical components built into or set upon the counter. Electrical sub-panel shall be UL listed, 3-phase, 4-wire circuit breaker type with a ground buss main breaker and individual breakers for each serviced load. Buss shall be copper and the circuit breakers shall be the molded case, bolt-on type with thermomagnetic quick-make, quick-break trip. Multi-pole circuit breakers shall have an internal trip bar. The circuit breakers shall have an interrupting capacity of 10,000 amperes at 120 volts and there shall be a separate breaker for each connected load. Each breaker shall be sized for 125% of the connected load and a minimum of two (2) extra, single pole, 20 amp circuit breakers shall be provided. The loads shall be connected through the breakers in a phased sequence to balance the load on each phase.

B. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be provided with the fixture to prevent siphoning. Where exposed, piping and fittings shall be chrome-plated. Where vacuum breaker piping is through equipment, provide chrome-plated escutcheon plates to cover holes.
1. General Contractor to provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes, chrome-plated where exposed. Extend to a point at least 1” (or as required by local or state code) above the rim of the floor drain, cut bottom on 45-degree angle and secure in position. CONTRACTOR to coordinate all necessary requirements with the General Contractor.

2. Horizontal piping lines shall be run at the highest possible elevation and not less than 6” above the floor, through equipment where possible.

3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks or more than one thread at the fitting.

4. Steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.

5. Provide suitable pressure-reducing valves for equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions, including but not limited to dishwashers, booster heaters, coffee urns, steam boilers, etc.

C. Provide and install complete refrigeration systems—charged, started, and operating properly—including, but not limited to:

- Compressors, condensers, racks, coils, vibration eliminators, sight glasses (moisture indicating type), expansion valves, filters, oil separators, thermostats, defrost time clocks, all controls and control wiring, liquid line driers, piping, and refrigeration grade copper tubing with all sweat joints using Safety-Silv No. 1200 or equivalent silver solder (with as few joints as possible)

1. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications which set forth standards for this type of work or in conformity with the requirements of the Board of Fire Underwriters or ASHRAE Standards, whichever is the greater.

2. Mechanically refrigerated cold pans shall have a normally closed liquid line electric solenoid valve installed before the expansion valve and wired to a silent-type toggle switch complete with an “on-off” red neon light indicator and both mounted in a terminal box on a removable access panel. This switch shall be fed by a separate control circuit and shall not to be wired into the compressor circuit so that it shall stop the flow of refrigerant to the cold pan and not turn off the compressor. The compressor shall then pump down and turn off through the action of the pressure control.

3. Each refrigeration item specification is written to provide minimum specifications and scope of work. Refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

<table>
<thead>
<tr>
<th>Refrigeration Item</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Walk-In Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>b. Walk-In Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>c. Reach-In Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>d. Reach-In Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>e. Undercounter Refrigerators</td>
<td>1.7°C / 35°F</td>
</tr>
<tr>
<td>f. Undercounter Freezers</td>
<td>-23.3°C / -10°F</td>
</tr>
<tr>
<td>g. Cold Pan</td>
<td>-17.8°C / 0°F</td>
</tr>
<tr>
<td>h. Work Rooms</td>
<td>10°C / 50°F</td>
</tr>
</tbody>
</table>

4. Provide electrical and refrigeration components needed by the completed system and complete all connections of and to said components.

5. Provide evaporator coil defrost system on all walk-in refrigerator and freezer rooms where the refrigeration systems are designed to operate at room temperature of less than 35°F.
6. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.

7. Verify and provide manufacturer’s certification (or certification by manufacturer’s authorized agent) that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).

8. During check-out and initial operation, make sure that:

   a. Controls are properly adjusted, including refrigeration circuits, room air temperature controls, etc.
   b. Condensers will carry an overload protector.
   c. A competent service mechanic is available during the first eight (8) hours of operation.
   d. Switches, starters, and controls are identified as to function.

9. Unless otherwise specified, thermometers for walk-in units will be furnished with suitable length armored capillary tubes to allow the sensing bulb to be installed in the incoming air stream to the blower coil with runs fastened to the walk-in walls to prevent it from damage. This identical requirement applies to alarm systems when specified.

2.5 PRODUCT SPECIFICATIONS

   A. Refer to Part 4 for complete itemized product specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Begin installing the equipment at the time the building is ready to receive the equipment and in accordance with the schedule.

   B. Provide a competent foreman or supervisor for erection of equipment and to coordinate with other trades regarding connections, installation, and inspection. Coordinate delivery schedule to ensure adequate openings in the building to receive the equipment.

   C. Refrigeration work shall be accomplished in an approved manner, using first quality fittings, controls, valves, etc. Refrigeration items shall be started up, tested, adjusted, and turned over to the Architect in first-class condition and left operating in accordance with the manufacturer’s specifications.

   D. Equipment that rests on masonry bases shall be set level onto a bed of silicone rubber sealant.

   E. Equipment that butts to a wall or against other equipment shall be sealed with silicone rubber sealant. Trim strips or other items requiring fasteners shall be set in a bed of silicone rubber sealant and fastened with suitable stainless steel fasteners 48” or less on centers. Prior to the application of sealant, surfaces shall be thoroughly cleaned and degreased.

   F. Install and interconnect electrical controls, switches, or other units which are separately furnished for field installation in or on equipment provided, unless otherwise specified.

   G. Refrigeration systems shall be installed and wired in strict conformance with the manufacturer’s instructions and recommendations. Ensure that all refrigeration-condensing units are ventilated properly and are accessible for repair, maintenance, and inspection.

   H. Hang blower coils per the manufacturer’s recommendation at the locations as shown on the drawings. Unit shall be mounted sloping such that the drain pans are pitched to the drain lines. The coils shall be hung using nylon or other approved non-conductive, non-corrosive fasteners. Coils
shall be installed 4” from the interior walk-in ceiling. Furnish #12 gauge galvanized steel fish plates of suitable size and shape on the exterior ceiling of the walk-in to spread the weight of the coils adequately. The coils shall be connected to the condensing unit and the installation shall constitute a complete working system capable of maintaining the interior temperatures specified regardless of the heavy usage the walk-in units may receive.

I. Furnish and install a copper drain line from each coil outlet to a point 1’’ above the floor drain. Drainlines shall be trapped immediately above the floor drain. The freezer drainline shall be wrapped with a continuous electrified heater tape.

J. Refrigeration tubing shall be the Type L, ACR hard drawn degreased, sealed copper and shall be installed with horizontal runs sloped 1’’ per 20 feet toward the condensing units. Refrigerant piping shall be properly supported by adjustable hangers spaced and adjusted to the drop required. Where vertical runs of more than 5’’ occur in the suction line, the risers shall be trapped at the bottom. Piping is to be installed so that refrigerant or oil cannot drain back into the coils from the suction line.

K. Suction and refrigerant lines shall be insulated with minimum ½” Armstrong armaflex or equal cellular type insulation. Metal pipe sleeves shall be provided where piping passes through a wall, ceiling, or floor. Space around the tubing shall be filled with mastic insulating compound. Install a permanent suction line filter in each compressor suction line with pressure fitting ahead of the filter to facilitate checking of pressure drop through the filter. Penetrations through walk-in cooler or freezer structures shall be fully insulated and sealed to be vapor tight to prevent condensation within any light fixtures, switch boxes, junction boxes, or any other fittings. Refrigeration and drain lines shall be fully sealed and provided with escutcheon plates by the installer.

L. Furnish and completely install a thermostat to control the refrigeration temperatures for each individual compartment.

M. The condensing units shall be mounted on a welded steel rack. The rack shall contain accessories and components necessary to form a complete condensing unit package. Each condensing unit shall have a factory mounted, pre-wired control panel/disconnect switch complete with circuit breakers, contactors, and time clocks as required.

N. The refrigeration systems shall be furnished with a one-year refrigeration service contract, covering all parts and labor, with service available seven days per week, 24-hours per day. Continuation of the service contract after the first year shall be an option. The refrigeration system shall be warranted for one year and the compressors shall carry the manufacturer’s extended five-year warranty.

O. Furnish four (4) copies of complete remote refrigeration system control wiring and piping diagrams. One (1) copy shall be framed in plexiglass and mounted at compressor location.

P. Coordinate the equipment work with the respective trades so that electrical and mechanical components built into the equipment will conform and/or adapt to the type, materials, and characteristics of the building components.

Q. Install heated and motor-driven equipment so as to operate efficiently. Provide additional vents, guards, deflectors, and other accessories as needed at no additional cost. Note such additions or modifications on the shop drawings and bring to Architect’s attention by special accompanying letter.

3.2 FABRICATION

A. Items of fabricated equipment shall be fabricated in the same factory and shall be similar in construction details, materials, methods, and appearance to similar types of items so fabricated under this contract.
B. Each fabricated item of equipment shall include necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and doors and drainboards shall be constructed of a single sheet of metal. Except where required to be removable, flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate buckle, warp, rattle, and wobble. Equipment not braced in a rigid manner and which is subject to rattle and wobble shall be unacceptable, and the Contractor shall add additional bracing in an approved manner to achieve acceptance.

C. Suitable pipe slots shall be provided on fabricated equipment to accommodate service and utility lines and mechanical connections. These slots shall be of proper size and shall be neatly made with turned up edges around to eliminate cutting or defacing of equipment on the job. Cabinet bases shall be provided with an inner panel duct at the ends or rear of the cabinet allowing adequate space to conceal vertical piping. Such work, when performed at the job site, shall be of the same quality as similar work performed in the shop.

D. Exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands or wiping cloths, they shall be capped with a stainless steel acorn nut and stainless steel lock washer.

E. Where screw threads are not visible or readily accessible, they shall be assembled with stainless steel lock washers and nuts. Wherever bolts or screws are welded to the underside of trim or tops, the reverse side of the weld shall be finished uniformly with the adjoining surfaces. Depressions at these points shall not be acceptable.

F. Rivets shall not be permitted in any location.

G. Welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces. Welds shall be free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.

1. Spot welds shall have a maximum spacing of 3". Tack welds shall be of at least ¼” length of welding material at a maximum space of 4” from center to center. Weld spacing at the ends of the channel battens shall not exceed 2” centers.

2. In no case shall soldering be considered as a replacement for welding, nor shall any soldering operation be done where dependence is placed on stability and strength of the joint.

3. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building as one piece shall be constructed so that the field joints can be welded at the job site.

4. Exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been sunk or depressed by welding operation, such depression shall be suitably hammered and peened flush with the adjoining surface and, if necessary, again ground to eliminate low spots. In all cases, the grain of rough grinding shall be removed by successive fine polishing operations.

5. Unexposed welded joints on undershelves of tables or counters in stainless steel construction shall be suitably coated at the factory with an approved metallic-based paint.

6. After galvanized steel members have been welded, welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with U.S. Government Military Specification Number MIL-P-26915.

H. Butt joints and contact joints, wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudance and shall not be flaky,
scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, such marks shall be removed by suitable grinding, polishing, and finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and be finished to obviate danger of cutting or laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed corners occur.

I. The grain of polishing shall run in the same direction on horizontal and on vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge. Where sinks and adjacent drainboards are equipped with backsplash, the grain of polishing shall be consistent in direction throughout the length of the backsplash and sink compartment.

J. Component parts, whether fabricated by the Contractor or purchased for building into the fabricated equipment, shall conform to the following.

   Bolts, screws, nuts, and washers shall be of steel, except where brass or stainless steel is fastened, in which case they shall be of brass or stainless steel, respectively. Where dissimilar metals are fastened, bolts, screws, nuts, and washers shall be of the higher grade metal. The spacing and extent of bolts and screws shall be such as to ensure suitable fastening and prevent buckling of the metals fastened.

3.3 START-UP AND TESTING

A. Supply a trained person who shall start up equipment, test, and make adjustments as necessary, resulting in each item of equipment performing in accordance with the manufacturer’s specifications.

B. Gas-fired equipment shall be checked by the local gas company as to calibration, air adjustments, etc., and adjustments made as required. Arrange and coordinate such visit.

3.4 CLEAN-UP

A. At completion of the installation, clean up, lubricate, and adjust where necessary items of equipment provided and turn them over in first-class condition.

   1. Where stainless steel surfaces are disturbed by the installation or fabricating process, such surface shall be finished to match adjoining undisturbed surfaces.
   2. At the completion of the installation work, stainless steel shall be gone over with a portable polishing machine and buffed to perfect surfaces. Painted surfaces shall be carefully gone over and retouched as required.

3.5 OPERATION INSTRUCTIONS AND WARRANTIES

A. Arrange for demonstrations and instructions for operating the equipment as requested and at times selected by the Architect. Furnish to the Architect instructions and service manuals for items of equipment that are mechanically operated or that require periodic service. Provide a list of such equipment showing the manufacturer’s warranty for equipment at jobsite location and how warranty service will be provided when necessary.

3.6 SEISMIC RESTRAINTS

A. The Contractor will be required to install items so designated in these contract documents according to the “SMACNA Guidelines for Seismic Restraint of Kitchen Equipment” in any State, province, or jurisdiction that has legislated this requirement as necessary for acceptance.

The Contractor will be responsible for:
1. Identifying these items on his submittal drawings, Plans, Elevations, and Sections.
2. Showing required SMACNA methods of restraint on his submittal drawings.
3. Referencing the appropriate detail(s).

B. If no SMACNA detail exists for a particular situation, the Contractor is responsible for preparing and obtaining approval for a special attachment detail:

1. Detail must be prepared by an engineer licensed by the State having jurisdiction over the project and accompanied by the supporting calculations used in the design.
2. Contractor is responsible for ensuring that the restraint design is appropriate to the building’s structural conditions and the surfaces to which the equipment will be secured.

PART 4 – ITEM SPECIFICATIONS

All items listed on the contract drawings under the heading "Foodservice Equipment Schedule" shall be furnished by the kitchen equipment contractor, unless indicated otherwise, in strict accordance with the foregoing specifications and with the following detailed item specifications.

ITEM #S1 PICK-UP COUNTER W/ WORK SINK – ALTERNATE #1
Manufacturer: Custom Fabricated
Model: -

1) STAINLESS STEEL STATIONARY COUNTERS
   a) APPROVALS
      i) Counters shall be NSF approved.
      ii) Counters shall be UL listed for electric when applicable.
   b) FRAMING:
      i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
      ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.
   c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
      i) General:
         (1) Constructed using 300 series stainless steel.
      ii) Stainless Steel Faces:
         (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
      iii) Doors:
         (1) Stainless Steel Doors
            (a) All stainless steel doors shall be double pan construction.
            (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
            (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
            (d) Door handles on hinged doors are to be CHG model number P63-1012.
            (e) Door handles on sliding doors are to be CHG model number P62-1010.
            (f) Door hinges are flag hinges CHG model number M75-1002.
            (g) Drawer face handles are to be CHG model number P63-1012.
         (2) Millwork Doors
            (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
            (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

iv) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

vii) Shelves:
     1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
     2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

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   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
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   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vii) Shelves:
     1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
     2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Drawers:
   1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.
i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange
       integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by
       fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All
       foodservice equipment and convenience outlets to be prewired to sub panel by fabricator.
       Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor
       prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout
       information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet
       information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S2          OPEN NUMBER

ITEM #S3          POS TERMINAL
Manufacturer: NIKEC/By Owner  
Model: -

ITEM #S4          BAKERY DISPLAY CASE - ALTERNATE #1
Manufacturer: Structural Concepts or equivalent  
Model: HOU4852R

Encore® Service/Self-Service Combo Merchandiser, 50"L, upper:
curved lift-up front glass, clear glass rear sliding doors w/o lock, lighted
glass shelf in upper display w/center glass divider, convertible
refrigeration, lower: open self-service refrigerated, top light, sheet
metal deck(2) full end panels w/mirror,
Breeze™ w/EnergyWise refrigeration system
Stainless Steel Interior Finish
Stainless Steel Exterior Finish
Night Curtain

ITEM #S5          OPEN NUMBER

ITEM #S6          REFRIGERATED WORK TOP - ALTERNATE #1
Manufacturer: Continental Refrigerator or equivalent  
Model: SW36

Work Top Refrigerator, 36" wide, two-section, stainless steel flat top, (2) field rehingable doors,
stainless steel front, aluminum sides & interior, 5" casters, rear mounted self-contained
Self-Contained refrigeration, 1/5 hp, standard

Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor

Casters, swivel, with brakes, (3" diameter rubber tired) set of 4 (3-5/8" height)

ITEM #S7 DESSERT COUNTER - ALTERNATE #1
Manufacturer: Custom Fabricated
Model: -

STAINLESS STEEL STATIONARY COUNTERS

1) APPROVALS
   i) Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

m) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

n) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knock joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvers. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
      (2) Millwork Doors
         (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
         (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
         (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.
   iv) Drawers:
      (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
      (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
      (3) Drawer face handles are to be CHG model number P63-1012.
   v) Shelves:
      (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
      (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

o) BASE SUPPORT:
TCNJ – T-Dubs Dining Hall Renovation

October 29, 2013

13-017

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Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.

Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

Tops:

Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.

Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

Sneeze Guards

Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC.

Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.

Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

Millwork Facing:

Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.

Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

Drop-ins:

All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.

Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.

When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

Sinks:

Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.

Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished

Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

Electrical:

All outlets are to be mounted in removable access panels.

All pre-wiring by fabricator is to be UL approved and tested before shipment.

Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

Plumbing
i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S8 BLENDER - ALTERNATE #1
Manufacturer: Hamilton Beach or equivalent
Model: HMD900
Mix 'N Chill® Drink Mixer, pre-programmed cycles, Smart-Start™ one hand motor activation, on/off rocker; rotary dial with variable speed selections, includes base, spindle with agitator, splash shield and removable stainless steel pan.
Provide six (6) 110E Container, 32 oz., for all drink mixers, universal, stainless steel
96000 Foot Activator, for drink mixer
928 Cone Agitator, fits models: HMD200, HMD400, HMD900 & 94950
929 Frozen Dessert Impeller, for spindle drink mixer, stainless steel, mixes pre-ground candies, cookies and fruit flavors into milkshakes, for use with 936, 950 and 94950
930 Frozen Dessert Impeller, for hard ice cream, stainless steel, for use with 94950

ITEM #S9 SNEEZEGUARD - ALTERNATE #1
Manufacturer: BSI or equivalent
Model: XG3500
XGuard Food Shield, single combo service, fully adjustable, 14” wide tempered glass, 1” diameter aluminum tubing single supports, NSF
3/8” tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S13 DROP-IN HOT FOOD PAN - ALTERNATE #1
Manufacturer: Atlas Metal or equivalent
Model: WIH-1
Hot Food Drop-In Well Unit, electric, individual pan design, wet or dry type, one-pan size for 12” x 20” pan, control panel with individual thermostatic controls, stainless steel top & wells, galvanized outer liner, with fiberglass insulation
Provide with drain
Remote On/Off Switch, for counter mounting, mounted in counter apron
ITEM #S14  SNEEZEGUARD - ALTERNATE #1
Manufacturer: BSI or equivalent
Model: XG3500

XGuard Food Shield, single combo service, fully adjustable, 14" wide tempered glass, 1" diameter aluminum tubing single supports, NSF

3/8" tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S15  SPARE NO.

ITEM #S17  BUN PAN RACK - ALTERNATE #1
Manufacturer: Metro or equivalent
Model: RD13N

Tray Rack, mobile, end load, single section, pass-thru, 21-1/4" W, 68-1/4" H, 26-1/2" D, pass-thru, open sides with slides for (40) 18"x26" pans, slides on 1-1/2" centers, riveted aluminum construction

ITEM #S18  SOFT SERVE MACHINE - ALTERNATE #1
Manufacturer: Taylor Co. or equivalent
Model: 161

Taylormate® Soft Serve Freezer, counter model, self-contained, compact twin twist, (2) 8qt. hoppers, (2) 1.5qt. freezing cylinders, indicator lights, electronic controls, standby, air filter, s/s finish, (1)
Air-cooled

ITEM #S18.1  SOFT SERVE MACHINE - ALTERNATE #1
Manufacturer: Existing Relocated
Model:

ITEM #S19  HAND SINK - ALTERNATE #1
Manufacturer: Eagle Group or equivalent
Model: HSA-10-FA

Hand Sink, wall model, 14-3/4" x 18-7/8" with 7-1/2" backsplash, stainless steel construction, 9-3/4" x 13-1/2" x 6-3/4" deep bowl, splash mount gooseneck faucet, P-trap and tail piece, basket drain, deep-drawn seamless design-positive drain, NSF
Extra Heavy Duty Gooseneck Faucet, splash-mounted, 4" O.C., NSF
Skirt Assembly
Left and right side splashes
ITEM #S23  REFRIGERATED SANDWICH UNIT
Manufacturer: Continental Refrigerator or equivalent
Model: DL48-18M-FB

Designer Line Mighty Top Sandwich Unit, Front Breather, 48" wide, two-section, (18) 1/6 size x 4" deep pans with 10" cutting board, (2) field rehingable doors, stainless steel top, front, sides & interior, 3-5/8"casters, rear mounted self-contained refrigeration, 1/5 hp
Self-Contained refrigeration, 1/5 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Stainless steel flat cover, Mighty Top
10" cutting board, rear mounted (NOTE: Must use stainless steel flat cover)
Stainless steel finished back

ITEM #S24  INDUCTION WARMER
Manufacturer: NIKEC/Existing To Relocated
Model:

ITEM #S25  SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3500

XGuard Food Shield, single combo service, fully adjustable, 14" wide tempered glass, 1" diameter aluminum tubing single supports, NSF

3/8" tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S26  SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3930

XGuard Food Shield, single self service, fully adjustable, 14" wide tempered glass top & lower sneeze guard, 1" diameter stainless steel tubing double supports, NSF, UL Listed

3/8" tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S26.1  Heat Lamp w/ Light
Manufacturer: Hatco or equivalent

Model: GRAHL-30

Glo-Ray® Infrared Foodwarmer, high wattage, tubular metal heater rod w/lights, single heater rod housing, aluminum construction, 780 watts
Built in toggle control, separate for each heat and light
Mount in sneeze guard, Item 26

ITEM #S27 HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: WCM-HP-2

Hot/Cold Drop In Unit, single tank with thermostat switch for hot or cold operation, with self-contained refrigeration system and immersion type heating element, 2 pan size, stainless steel top and inner liner,
galvanized outer liner
A 3/4" diameter drain & valve, separator channels are provided, units are wired to prevent simultaneous operation, water must be used for hot mode operation

ITEM #S29 CUTTING BOARD
Manufacturer: Tomlinson Industries or equivalent
Model: 1930221

Richlite® Cutting Board, size per plan by 1/2" thick, full sheet, heat resistant, NSF
Other size sheets available; call for details

ITEM #S33 HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: WCM-HP-2

Hot/Cold Drop In Unit, single tank with thermostat switch for hot or cold operation, with self-contained refrigeration system and immersion type heating element, 2 pan size, stainless steel top and inner liner,
galvanized outer liner

ITEM #S34 GRILL COUNTER
Manufacturer: Custom
Model: -

STAINLESS STEEL STATIONARY COUNTERS
a) APPROVALS
i) Counters shall be NSF approved.
ii) Counters shall be UL listed for electric when applicable.
b) FRAMING:
i) Framing shall be fully welded 1 ¼" square 300 series stainless steel tubing.
ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c) STAINLESS STEEL FACE AND SHELF CONTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvers. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
      (2) Millwork Doors
         (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
         (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
         (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.
   iv) Drawers:
      (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
      (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
      (3) Drawer face handles are to be CHG model number P63-1012.
   v) Shelves:
      (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
      (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.
   d) BASE SUPPORT:
      i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
      ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.
   e) TOPS:
      i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
i) All outlets are to be mounted in removable access panels.
ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S35 ROLL-IN FREEZER, 2 SECTIONS
Manufacturer: Continental Refrigerator or equivalent
Model: DL2FI

Designer Line Freezer, roll-in, two-section, self-contained refrigeration, aluminum exterior & interior, stainless steel front, standard depth cabinet, full-height solid doors, exterior digital thermometer, removable stainless steel ramp, 1 hp
Self-Contained refrigeration, 1 hp, standard
Both doors hinged on left
Provide two (2) Metro model RF3N or equivalent roll-in refrigerator racks

ITEM #S36 WORK COUNTER
Manufacturer: Custom Fabricated
Model: -

STAINLESS STEEL STATIONARY COUNTERS
a) APPROVALS
   i) Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.
b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.
c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
      (2) Millwork Doors
         (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
         (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
         (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.
   iv) Drawers:
      (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
      (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
      (3) Drawer face handles are to be CHG model number P63-1012.
   v) Shelves:
      (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
      (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

d) BASE SUPPORT:
Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.

Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

e) TOPS:
   i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
   ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
   i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
   ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
   iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
   i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
   ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
   iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S37 EXHAUST HOOD
Manufacturer: Captive-Aire or equivalent
Model: 2454 ND-SPS-2

Provide complete operational UL listed hood per Plan and Specifications. Provide Ansul R102, UL 300 List fire protection system per equipment layout. Provide mechanical gas shut of valve for installation by plumbing contractor. Provide and install stainless steel, 20 ga., wall panel from bottom of hood to floor below exhaust hood. Provide stainless steel wrapper panel to ceiling as required.

ITEM #S38 FRYER BATTERY, GAS
Manufacturer: Pitco Frialator or equivalent
Model: 2-SG14RSSTC-S/FD

Solstice Prepackaged Fryer System with Solstice Filter Drawer System, High Power, gas, (2) 50 lb oil cap.
full tanks, solid state control, boil out, drain valve interlock, melt cycle, matchless ignition,
stainless steel tank, front & sides, under-fryer drawer filtration, total 244,000 BTU (-FF)
Gas to be determined
Casters, 9" adjustable swivel non-lock rear & lock front casters, for battery of (2) Solstice gas and electric fryers, batteries and retherms
Bread & Batter Cabinet, with BNB dump station, fryer match design, approximately 15-5/8" wide,
standard finish, stainless steel front, sides & door, for prepackage system SG 14 gas fryers
1st Position location for Bread & Batter dump station (BFF)
Food Warmer, built-in
Gas Connector Hose, 1" connection, for castered equipment, 36" long, with quick disconnect couplings,
restraining device & thermal shut-off, for multiple units 390,000 BTU capacity
Tank cover, 18 gauge light duty, for models: SG14/14T/14R, SGBNB14, SSH55/55T/55R/55TR, SSH60/60R (with out basket lifts)

ITEM #S39 REFRIGERATED EQUIPMENT STAND
Manufacturer: Continental Refrigerator or equivalent
Model: DL48G

Refrigerator Griddle Stand, one-section, (2) drawers - accommodates (2) 12" x 20" x 6", dial thermometer stainless steel top with drip guard marine edge, stainless steel exterior, interior and back,
4" casters, self-contained refrigeration, 1/5 hp, 10' cord
Self-Contained refrigeration, 1/5 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Condensing unit on the right, standard
4" Casters, standard

ITEM #S43  COUNTERTOP GRIDDLE
Manufacturer: Southbend or equivalent
Model: HDG-48

Griddle, Gas, Counter Model, 48" wide, 1" thick polished steel plate, spark ignition (battery), (4) thermostatic controls range 150° - 400°F settings, stainless steel front & sides, 4" stainless steel legs,
120,000 BTU, CSA, NSF
Specify Gas Type
Standard one year limited warranty
Plate Landing Shelf, with cutting board, 48"

ITEM #S44  SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3930

XGuard Food Shield, single self service, fully adjustable, 14" wide tempered glass top & lower sneeze guard, 1" diameter stainless steel tubing double supports, NSF, UL Listed

3/8" tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S44.1  Heat Lamp w/ Light
Manufacturer: Hatco or equivalent
Model: GRAHL-30

Glo-Ray® Infrared Foodwarmer, high wattage, tubular metal heater rod w/lights, single heater rod housing, aluminum construction, 780 watts
Build in toggle control, separate for each heat and light
Install in sneeze guard, Item S44

ITEM #S45  HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: WCM-HP-2
October 29, 2013

Hot/Cold Drop In Unit, single tank with thermostat switch for hot or cold operation, with self-contained refrigeration system and immersion type heating element, 2 pan size, stainless steel top and inner liner, galvanized outer liner

ITEM #S46 CUTTING BOARD
Manufacturer: Tomlinson Industries or equivalent
Model: 1930221

Richlite® Cutting Board, size per plan by 1/2" thick, full sheet, heat resistant, NSF
Other size sheets available; call for details

ITEM #S47 HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: WCM-HP-2

Hot/Cold Drop In Unit, single tank with thermostat switch for hot or cold operation, with self-contained refrigeration system and immersion type heating element, 2 pan size, stainless steel top and inner liner, galvanized outer liner

ITEM #S48 MEXICAN COUNTER
Manufacturer: Custom
Model: 

STAINLESS STEEL STATIONARY COUNTERS

a) APPROVALS
   i) Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvered. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
(2) Millwork Doors
   (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
   (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
   (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

iv) Drawers:
   (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   (3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

d) BASE SUPPORT:
   i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
   ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

e) TOPS:
   i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
   ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
   i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
   ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
   iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S49 HAND SINK
Manufacturer: Eagle Group or equivalent
Model: HSA-10-FA

Hand Sink, wall model, 14-3/4" x 18-7/8" with 7-1/2" backsplash, stainless steel construction, 9-3/4" x 13-1/2" x 6-3/4" deep bowl, splash mount gooseneck faucet, P-trap and tail piece, basket drain, deep-drawn seamless design-positive drain, NSF
Extra Heavy Duty Gooseneck Faucet, splash-mounted, 4" O.C., NSF
Skirt Assembly
Left and right side splashes

ITEM #S53 ROLL-IN REFRIGERATOR, 1 SECTION
Manufacturer: Continental Refrigerator or equivalent
Model: DL1RI

Designer Line Refrigerator, roll-in, one-section, self-contained refrigeration, aluminum exterior & interior, stainless steel front, standard depth cabinet, full-height solid door, exterior digital thermometer, removable stainless steel ramp, 1/3 hp
Self-Contained refrigeration, 1/3 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor

13-017 114000 - 29
TCNJ – T-Dubs Dining Hall Renovation
Foodservice Equipment
Door hinged on left
Provide one (1) Metro model RF3N or equivalent roll-in refrigerator racks

ITEM #S54 WORK COUNTER
Manufacturer: Custom Fabricated
Model: -

STAINLESS STEEL STATIONARY COUNTERS
a) APPROVALS
i) Counters shall be NSF approved.
ii) Counters shall be UL listed for electric when applicable.
b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.
c) STAINLESS STEEL FACE AND SHELF CONTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
   iv) Drawers:
      (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
      (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
      (3) Drawer face handles are to be CHG model number P63-1012.
   v) Shelves:
      (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
      (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.
   d) BASE SUPPORT:
      i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

e) TOPS:
   i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.

ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
   i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC

   ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.

   iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.

   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
   i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.

   ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.

   iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.

   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished

   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.

   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.

   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.

   ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S55 HIGH SPEED GRILL  
Manufacturer: Electrolux Professional or equivalent  
Model: 603855  
HSP-USAT-High Speed Sandwich Press, ribbed non-stick top plate & smooth quartz bottom surface, independent temperature for top & bottom plates from 320 to 536°F, stainless steel & painted construction, with ADJUSTABLE TUBE UPPER PLATE CONTACT SURFACE

ITEM #S56 MICROWAVE CONVECTION OVEN  
Manufacturer: NIKEC – Existing/Relocated  
Model: -

ITEM #S57 COUNTERTOP STEAMER  
Manufacturer: Nemco or equivalent  
Model: 6625A  
Fresh-O-Matic Countertop Steamer, electric, electronic control panel, self-contained water reservoir, 30 minute preheat, WearGuard™ coated top, cast aluminum well, s/s exterior

ITEM #S58 REFRIGERATED SANDWICH UNIT  
Manufacturer: Continental Refrigerator or equivalent  
Model: DL72-30M  
Designer Line Mighty Top Sandwich Unit, 72” wide, three-section, (30) 1/6 size x 4” deep pans with 10” cutting board, (3) field rehingable doors, stainless steel top, front, sides & interior, 6” adjustable legs, rear mounted self-contained refrigeration, 1/4 hp
Self-Contained refrigeration, 1/4 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Casters, swivel, with brakes, (3” diameter rubber tired) set of 6 (4” height)

ITEM #S59 ROLL-IN REFRIGERATOR, 1 SECTION  
Manufacturer: Continental Refrigerator or equivalent  
Model: DL1RI  
Designer Line Refrigerator, roll-in, one-section, self-contained refrigeration, aluminum exterior
&

interior, stainless steel front, standard depth cabinet, full-height solid door, exterior digital
thermometer, removable stainless steel ramp, 1/3 hp
Self-Contained refrigeration, 1/3 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year
compressor
Door hinged on right, standard
Provide one (1) Metro model RF3N or equivalent roll-in refrigerator racks

ITEM #S63 SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3500

XGuard Food Shield, single combo service, fully adjustable, 14" wide tempered glass, 1” diameter
aluminum tubing single supports, NSF

3/8” tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S64 REFRIGERATED PIZZA TABLE
Manufacturer: Continental Refrigerator or equivalent
Model: CPA60

Pizza Prep Table, 60" wide, two-section, 19.0 cubic feet, forced air, #300 stainless steel work top with 19" poly cutting board, (2) full & (1) half-height field rehingable doors, stainless steel front & sides, aluminum interior, side-mounted refrigeration, 1/2 hp, cord, NSF, CE, UL
Self-Contained refrigeration, 1/2 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor Condensing unit on the right, standard
Stainless steel finished back
Casters, swivel, with brakes, (3" diameter rubber tired) set of 4 (4" height)

ITEM #S65 HIGH SPEED GRILL
Manufacturer: Electrolux Professional or equivalent
Model: 603855

HSPPUSAT-High Speed Sandwich Press, ribbed non-stick top plate & smooth quartz bottom surface,
independent temperature for top & bottom plates from 320 to 536°F, stainless steel & painted construction, with ADJUSTABLE TUBE UPPER PLATE CONTACT SURFACE
ITEM #S66  HOT/COLD DROP-IN WELL
Manufacturer:  Atlas Metal or equivalent
Model:  RM-HP-2

Hot/Cold Food Drop-In Unit, 2-pan size, 18/304 stainless steel top & liner with 3" recess, holds (2) 12" x 20" pans, immersion-type heating element, self-contained refrigeration, hot/cold selector switch, insulated pan with 22 gauge galvanized outer case, thermostat controls & pilot light included, 3/4" drain with strainer, 6' power cord with twist lock plug, 30-1/4"W x 24-1/2"D cutout required, NSF-7, UL. A 3/4" diameter drain & valve, separator channels are provided, units are wired to prevent simultaneous operation, water must be used for hot mode operation.

ITEM #S67  SNEEZEGUARD
Manufacturer:  BSI or equivalent
Model:  XG3930

XGuard Food Shield, single self service, fully adjustable, 14" wide tempered glass top & lower sneeze guard, 1" diameter stainless steel tubing double supports, NSF, UL Listed
3/8" tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S67.1  Heat Lamp w/ Light
Manufacturer:  Hatco or equivalent
Model:  GRAHL-30

Glo-Ray® Infrared Foodwarmer, high wattage, tubular metal heater rod w/lights, single heater rod housing, aluminum construction, 780 watts
Build in toggle control, separate for each heat and light
Install in Sneeze Guard, Item S67, above hot/cold pan, Item S66

ITEM #S68  PIZZA COUNTER
Manufacturer:  Custom
Model:  -

STAINLESS STEEL STATIONARY COUNTERS
a)  APPROVALS
   i)  Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

b)  FRAMING:
   i)  Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c)  STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
i) General:
   (1) Constructed using 300 series stainless steel.

ii) Stainless Steel Faces:
   (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.

iii) Doors:
   (1) Stainless Steel Doors
      (a) All stainless steel doors shall be double pan construction.
      (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvers. Doors include ¼” x ½” welded frame on rear of door for rigidity.
      (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
      (d) Door handles on hinged doors are to be CHG model number P63-1012.
      (e) Door handles on sliding doors are to be CHG model number P62-1010.
      (f) Door hinges are flag hinges CHG model number M75-1002.
      (g) Drawer face handles are to be CHG model number P63-1012.

   (2) Millwork Doors
      (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
      (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
      (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

iv) Drawers:
   (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
   (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   (3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

   d) BASE SUPPORT:
      i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
      ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

   e) TOPS:
      i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
      ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge
with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC.
ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
i) All outlets are to be mounted in removable access panels.
ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S69 COUNTERTOP HEATED SHELF
Manufacturer: Hatco or equivalent
Model: GRSR-15

Heated Shelf, Free-standing, 15” round, counter top or drop-in, designer colors
Stainless steel side

14” Diameter Perforated Pizza Pan, Qty. 36 Total

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Foodservice Equipment

114000 - 36
ITEM #S73  DECORATIVE LAMP
Manufacturer:  Haco or equivalent
Model:  DL-400-RN

- Decorative Lamp, (1) bulb type, 8-1/2" H x 6-1/8" Dia. shade, adjustable cord mount (31" - 69-1/2")
- Lamp Bulb, clear, coated
- Black cord, standard
- Retractable cord mount with switch on light fixture
- Confirm shade color with architect

ITEM #S74  WORK COUNTER
Manufacturer:  Eagle Group or equivalent
Model:  CBH3096SE-BS

STAINLESS STEEL STATIONARY COUNTERS
a) APPROVALS
   i) Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

b) FRAMING:
   i) Framing shall be fully welded 1 ¾” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
   iii) Doors:
      (1) Stainless Steel Doors
         (a) All stainless steel doors shall be double pan construction.
         (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
         (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
         (d) Door handles on hinged doors are to be CHG model number P63-1012.
         (e) Door handles on sliding doors are to be CHG model number P62-1010.
         (f) Door hinges are flag hinges CHG model number M75-1002.
         (g) Drawer face handles are to be CHG model number P63-1012.
      (2) Millwork Doors
         (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
         (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
         (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.
   iv) Drawers:
Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.

Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.

Drawer face handles are to be CHG model number P63-1012.

Shelves:
(1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
(2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

BASE SUPPORT:
(a) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
(b) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

tops:
(a) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
(b) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

SNEEZE GUARDS
(a) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
(b) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
(c) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

MILLWORK FACING:
(a) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
(b) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

DROP-INS:
(a) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
(b) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
(c) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

SINKS:
(a) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
(b) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished.
iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

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ITEM #S75  ROLL-IN REFRIGERATOR, 1 SECTION
Manufacturer: Continental Refrigerator or equivalent
Model: DL1RI

Designer Line Refrigerator, roll-in, one-section, self-contained refrigeration, aluminum exterior & interior, stainless steel front, standard depth cabinet, full-height solid door, exterior digital thermometer, removable stainless steel ramp, 1/3 hp
Self-Contained refrigeration, 1/3 hp, standard
Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor
Door hinged on left
Provide one (1) Metro model RF3N or equivalent roll-in refrigerator racks

ITEM #S76  WORK TABLE
Manufacturer: Custom Fabricated
Model: -

STAINLESS STEEL STATIONARY COUNTERS

a) APPROVALS
   i) Counters shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
   i) General:
      (1) Constructed using 300 series stainless steel.
   ii) Stainless Steel Faces:
      (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.
iii) Doors:
   (1) Stainless Steel Doors
       (a) All stainless steel doors shall be double pan construction.
       (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvered. Doors include \( \frac{3}{4}\)" x \( \frac{1}{2}\)" welded frame on rear of door for rigidity.
       (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
       (d) Door handles on hinged doors are to be CHG model number P63-1012.
       (e) Door handles on sliding doors are to be CHG model number P62-1010.
       (f) Door hinges are flag hinges CHG model number M75-1002.
       (g) Drawer face handles are to be CHG model number P63-1012.
   (2) Millwork Doors
       (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
       (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
       (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

iv) Drawers:
   (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416G01204.
   (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
   (3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
   (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
   (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

d) BASE SUPPORT:
   i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
   ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

e) TOPS:
   i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
   ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC

ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.

iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
   i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
   ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
   iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished.
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½" wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

ITEM #S77
Manufacturer: Proluxe or equivalent
Model: DP1100

PizzaPro™ Pizza Dough Press, counter model, manual operation with dial-in thickness adjustment, heated upper platen, microprocessor, programmable with digital readout, on/off switch, up to 18” dia.

ITEM #S78
Manufacturer: Continental Refrigerator or equivalent
Model: CPA43

Pizza Prep Table, 43” wide, one-section, 12.0 cubic feet, forced air, #300 stainless steel
work top with 19" poly cutting board, (1) full & (1) half height field rehingable doors, stainless steel front & sides, aluminum interior, 5" swivel casters, side-mounted refrigeration, 1/3 hp, cord, NSF, CE, UL Self-Contained refrigeration, 1/3 hp, standard Standard warranty (for the United States & Canada Only): 3 year parts and labor; 5 year compressor Condensing unit on the right, standard Casters, swivel, with brakes, (3" diameter rubber tired) set of 4 (4" height) Garnish Rack, 28" W x 17-1/2" D x 2" H Double overshelves for 43° models

ITEM #S79  CONVEYOR OVEN
Manufacturer:  Lincoln Impinger or equivalent
Model:  2501/1346

Lincoln Impinger® Countertop Oven, electric, single deck, with extended 50" conveyor, digital controls, 3 wires, NSF, UL, cUL
Extended Conveyor, 50" length (price is applicable only when purchased with oven) (for Lincoln Impinger® Countertop Ovens)
Conveyor End Stop (for Lincoln Impinger® Countertop Ovens)

ITEM #S80  EQUIPMENT STAND
Manufacturer:  Eagle Group or equivalent
Model:  T3072SGS

Griddle Stand, open base with bottom shelf, 72" x 30", 24"H, 16 gauge type 304 stainless steel top, 1-1/4" upturn on back and both ends, adjustable heavy gauge stainless steel undershelf, (6) 1-5/8" dia. stainless steel legs, Bullet Feet, stainless steel, each and all welded construction, legs, undershelf and top

ITEM #S83  EXHAUST HOOD
Manufacturer:  Captive-Aire or equivalent
Model:  2448 ND-2-PSP-F

Provide complete operational UL listed hood per Plan and Specifications. Provide Ansul R102, UL 300 List fire protection system per equipment layout. Provide mechanical gas shut of valve for installation by plumbing contractor. Provide and install stainless steel, 20 ga., wall panel from bottom of hood to floor below exhaust hood. Provide stainless steel wrapper panel to ceiling as required.

ITEM #S84  COOLER DOOR
Manufacturer:  Bally Refrigerated Boxes or equivalent
Model:  -

Included in #S86

ITEM #S85  FREEZER DOOR
Manufacturer:  Bally Refrigerated Boxes or equivalent
Model:  -

Included in #S86
ITEM #S86  WALK-IN COOLER  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model: -  

Provide complete walk-in assembly and refrigeration system per Plans and Specifications.  
Refer to Plan sheet KW-1 for size, shape and finishes  

KEC to provide all refrigeration piping and fully operational walk-in complex  

ITEM #S86.1  EVAPORATOR, +35F  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model:  

Included in #S86  

ITEM #S86.2  CONDENSER, +35F  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model:  

Included in #S86  
Included as part of Package Refrigeration System, Item K19, if Alternate #2 is accepted  

ITEM #S87  WALK-IN COOLER  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model: -  

Included in #S86  

ITEM #S87.1  EVAPORATOR, -10F  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model:  

Included in #S86  

ITEM #S87.2  CONDENSER, -10F  
Manufacturer: Bally Refrigerated Boxes or equivalent  
Model:  

Included in #S86  
Included as part of Package Refrigeration System, Item K19, if Alternate #2 is accepted  

ITEM #S88  SPARE NO.
ITEM #S89  GONDOLA DISPLAY
Manufacturer: Robelan Display Inc. or equivalent
Model: LARGE FULL ROUND GONDOLA OVERALL FOOT PRINT 150". UNIT MADE INTO (2) SEPARATE UNITS
THIRTY (30) GONDOLA SHELVES WITH FRONT PLEXI LIP ON ADJUSTABLE SHELF BRACKETS
ALL SHELVES/BASES/HORIZONTAL SURFACES FINISHED IN FORMICA BLACK 919-42
ALL SLATWALL/VERTICAL SURFACE IS FINISHED FORMICA ASHER WOOD 8839-58
ALL GONDOLAS ARE MOBIL & COME EQUIPPED WITH LOCKABLE HEAVY DUTY CASTERS.

ITEM #S93  GONDOLA DISPLAY
Manufacturer: Robelan Display Inc. or equivalent
Model: FULL ROUND GONDOLA UNITS (4) SIDED WITH (16) ADJUSTABLE SHELVES WITH PLEXI FRONT LIPS. 80" W X 36" D X 56" H
ALL SHELVES/BASES/HORIZONTAL SURFACES FINISHED IN FORMICA BLACK 919-42
ALL SLATWALL/VERTICAL SURFACE IS FINISHED FORMICA ASHER WOOD 8839-58
ALL GONDOLAS ARE MOBIL & COME EQUIPPED WITH LOCKABLE HEAVY DUTY CASTERS.

ITEM #S94  GONDOLA DISPLAY
Manufacturer: Robelan Display Inc. or equivalent
Model: FULL ROUND GONDOLA UNITS (4) SIDED WITH (12) ADJUSTABLE SHELVES WITH PLEXI FRONT LIPS. ALSO EACH UNIT INCLUDES (24) 6" LONG SLATWALL DISPLAY HOOKS FOR BAGGED ITEMS. 66" W X 36" D X 56" H
ALL SHELVES/BASES/HORIZONTAL SURFACES FINISHED IN FORMICA
ALL SLATWALL/VERTICAL SURFACE IS FINISHED FORMICA ASHER WOOD 8839-58
ALL GONDOLAS ARE MOBIL & COME EQUIPPED WITH LOCKABLE HEAVY DUTY CASTERS.

ITEM #S95 HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: RM-HP-4

Hot/Cold Food Drop-In Unit, 4-pan size, 18/304 stainless steel top & liner with 3” recess, holds (4) 12” x 20” pans, immersion-type heating element, self-contained refrigeration, hot/cold selector switch, insulated pan with 22 gauge galvanized outer case, thermostat controls & pilot light included, 3/4” drain with strainer, 6’ power cord with twist lock plug, 57-3/4”W x 24-1/2”D cutout required, NSF-7, UL A 3/4” diameter drain & valve, separator channels are provided, units are wired to prevent simultaneous operation, water must be used for hot mode operation

ITEM #S96 HOT/COLD DROP-IN WELL
Manufacturer: Atlas Metal or equivalent
Model: RM-HP-4

Hot/Cold Food Drop-In Unit, 4-pan size, 18/304 stainless steel top & liner with 3” recess, holds (4) 12” x 20” pans, immersion-type heating element, self-contained refrigeration, hot/cold selector switch, insulated pan with 22 gauge galvanized outer case, thermostat controls & pilot light included, 3/4” drain with strainer, 6’ power cord with twist lock plug, 57-3/4”W x 24-1/2”D cutout required, NSF-7, UL A 3/4” diameter drain & valve, separator channels are provided, units are wired to prevent simultaneous operation, water must be used for hot mode operation

ITEM #S97 SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3930

XGuard Food Shield, single self service, fully adjustable, 14” wide tempered glass top & lower sneeze guard, 1” diameter stainless steel tubing double supports, NSF, UL Listed

3/8” tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code
ITEM #S98 BEVERAGE/SOUP/SALAD COUNTER  
Manufacturer: Custom  
Model: -  

STAINLESS STEEL STATIONARY COUNTERS  

a) APPROVALS  
i) Counters shall be NSF approved.  
ii) Counters shall be UL listed for electric when applicable.  

b) FRAMING:  
i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.  
ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.  

c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:  
i) General:  
(1) Constructed using 300 series stainless steel.  
ii) Stainless Steel Faces:  
(1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.  
iii) Doors:  
(1) Stainless Steel Doors  
(a) All stainless steel doors shall be double pan construction.  
(b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louvered. Doors include ¼” x ½” welded frame on rear of door for rigidity.  
(c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.  
(d) Door handles on hinged doors are to be CHG model number P63-1012.  
(e) Door handles on sliding doors are to be CHG model number P62-1010.  
(f) Door hinges are flag hinges CHG model number M75-1002.  
(g) Drawer face handles are to be CHG model number P63-1012.  
(2) Millwork Doors  
(a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.  
(b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.  
(c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.  
iv) Drawers:  
(1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.  
(2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.  
(3) Drawer face handles are to be CHG model number P63-1012.  
v) Shelves:  
(1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.  
(2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.  

d) BASE SUPPORT:  
i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.  
ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.
e) TOPS:
   i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
   ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
   i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
   ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
   iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
   i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
   ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
   iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.
ITEM #S26  SNEEZEGUARD
Manufacturer: BSI or equivalent
Model: XG3930

XGuard Food Shield, single self service, fully adjustable, 14" wide tempered glass top & lower sneeze guard, 1" diameter stainless steel tubing double supports, NSF, UL Listed

3/8” tempered glass
Rounded corners
Brushed aluminum and stainless steel finish
Below countertop mounting with heavy duty flange, extend post to mount to cabinet base where possible
End panels as required by code

ITEM #S103  DROP-IN HOT WELL
Manufacturer: Wells or equivalent
Model: SS-10TDU

Food Warmer, top-mount, built-in, electric, for 11-quart round inserts, drain, wet/dry operation, thermostatic controls, non-insulated, stainless steel interior, Wellslok, UL, cULus, NSF
Limited 2 year parts & 1 year labor warranty, standard
Drain Screen
72" Wiring (thermostatically controlled warmers) per well
Four (4) total 21057 11 qt. round inset with lid
Two (2) 21860 soup ladle

ITEM #S104  DISPENSER, ICE/BEVERAGE
Manufacturer: NIKEC/By Vendor
Model:

ITEM #S105  F’REAL FREEZER
Manufacturer: F’real or equivalent
Model: 07-CSGF-X1-FRL2

ITEM #S106  F’REAL BLENDER
Manufacturer: F’real or equivalent
Model: FRLB4
ITEM #S107  DISPENSER, ICE/BEVERAGE
Manufacturer: NIKEC/By Vendor
Model:

ITEM #S108  OPEN MERCHANDISER
Manufacturer: Federal Industries or equivalent
Model: RSSM-678SC

Specialty Display High Profile Self-Serve Refrigerated Merchandiser (71"L x 35"W x 78"H), self contained refrigeration with condensate evaporator, energy saving night curtain, top light, four tiers of adjustable black metal shelves, stainless steel display deck, black interior, tempered glass ends, choice of laminate, designed for continuous lineups, UL safety and UL sanitation approved, 1 HP
One year parts & labor warranty
Self-contained refrigeration standard
120/1 hp, 3-wire plus ground supply
Five year compressor warranty  (for self-contained units only)
Stainless steel in lieu of laminate
Sound deadening kit, foam insulated base
Stainless steel interior back
Stainless steel shelves, per tier
Lights below shelves
Casters (includes cord & plug) (for self-contained units only)

ITEM #S109  COFFEE BREWER
Manufacturer: NIKEC/By Vendor
Model:

ITEM #S113  ICE TEA BREWER
Manufacturer: NIKEC/By Vendor
Model: -

ITEM #S114  ICE TEA DISPENSER
Manufacturer: NIKEC/By Vendor
Model: -
ITEM #S115  ICED COFFEE BREWER
Manufacturer: NIKEC/By Vendor
Model: 

ITEM #S116  AIRPOT
Manufacturer: NIKEC/By Vendor
Model: 

ITEM #S117  CONDIMENT DISPLAY
Manufacturer: NIKEC/By Operator
Model: -

ITEM #S118  DISPLAY CUBE
Manufacturer: NIKEC/By Operator
Model: -

ITEM #S119  TEA RACK
Manufacturer: NIKEC/By Operator
Model: -

ITEM #S123  COFFEE COUNTER
Manufacturer: Custom Fabricated Stainless Steel
Model: 

STAINLESS STEEL STATIONARY COUNTERS
  a)  APPROVALS
      i)  Counters shall be NSF approved.
      ii) Counters shall be UL listed for electric when applicable.
b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

   c) STAINLESS STEEL FACE AND SHELF CONTRUCTION:
      i) General:
         (1) Constructed using 300 series stainless steel.
      ii) Stainless Steel Faces:
         (1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.

         iii) Doors:
             (1) Stainless Steel Doors
                 a) All stainless steel doors shall be double pan construction.
                 b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
                 c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
                 d) Door handles on hinged doors are to be CHG model number P63-1012.
                 e) Door handles on sliding doors are to be CHG model number P62-1010.
                 f) Door hinges are flag hinges CHG model number M75-1002.
                 g) Drawer face handles are to be CHG model number P63-1012.

              (2) Millwork Doors
                 a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
                 b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
                 c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

         iv) Drawers:
             (1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
             (2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
             (3) Drawer face handles are to be CHG model number P63-1012.

      v) Shelves:
         (1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
         (2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

   d) BASE SUPPORT:
      i) Legs: Unless otherwise specified, counters shall include adjustable 6” legs. Legs are attached with using welded nuts to metal frame for easy on and off during counter installation.
      ii) Kick Plates: When specified 6” high kick plates are telescoping construction for field adjustment and made from 18 gauge 304 stainless steel. KEC to supply accurate field conditions for quarry tile and electrical and plumbing stub ups including floor drains, water supply lines, circuit or main electrical supply run, etc.

   e) TOPS:
      i) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber
grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.

ii) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) SNEEZE GUARDS
i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) MILLWORK FACING:
i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) DROP-INS:
i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) SINKS:
i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished
iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) ELECTRICAL:
i) All outlets are to be mounted in removable access panels.
ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) PLUMBING
i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
ii) Overflows shall be installed by fabricator.
iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

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ITEM #S124 MILK CARAFE
Manufacturer: NIKEC/By Operator
Model: -
ITEM #S125  GONDOLA DISPLAY
Manufacturer: Robelan Display Inc. or equivalent
Model: -

FULL ROUND GONDOLA UNITS (4) SIDED WITH (16) ADJUSTABLE SHELVES WITH PLEXI FRONT LIPS. 80" W X 36" D X 56" H

   ALL SHELVES/BASES/HORIZONTAL SURFACES FINISHED IN FORMICA BLACK 919-42

   ALL SLATWALL/VERTICAL SURFACE IS FINISHED FORMICA ASHER WOOD 8839-58

   ALL GONDOLAS ARE MOBIL & COME EQUIPPED WITH LOCKABLE HEAVY DUTY CASTERS.

ITEM #S126  GONDOLA DISPLAY
Manufacturer: Robelan Display Inc. or equivalent
Model: -

FULL ROUND GONDOLA UNITS (4) SIDED WITH (12) ADJUSTABLE SHELVES WITH PLEXI FRONT LIPS. ALSO EACH UNIT INCLUDES (24) 6" LONG SLATWALL DISPLAY HOOKS FOR BAGGED ITEMS. 66" W X 36" D X 56" H

   ALL SHELVES/BASES/HORIZONTAL SURFACES FINISHED IN FORMICA BLACK 919-42

   ALL SLATWALL/VERTICAL SURFACE IS FINISHED FORMICA ASHER WOOD 8839-58

   ALL GONDOLAS ARE MOBIL & COME EQUIPPED WITH LOCKABLE HEAVY DUTY CASTERS.

ITEM #S127  CASHIER COUNTER
Manufacturer: Custom
Model: -

STAINLESS STEEL STATIONARY COUNTERS

a) APPROVALS
   i) Counter shall be NSF approved.
   ii) Counters shall be UL listed for electric when applicable.

b) FRAMING:
   i) Framing shall be fully welded 1 ¼” square 300 series stainless steel tubing.
   ii) Cross members shall be provided to sufficiently support and brace the completed counter to prevent movement and flex.

c) STAINLESS STEEL FACE AND SHELF CONSTRUCTION:
TCNJ – T-Dubs Dining Hall Renovation

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Foodservice Equipment

i) General:
(1) Constructed using 300 series stainless steel.

ii) Stainless Steel Faces:
(1) Unless otherwise specified in the itemized specification or drawings, all stainless steel fronts shall be knuckle joint construction to NSF approved standards.

iii) Doors:
(1) Stainless Steel Doors
   (a) All stainless steel doors shall be double pan construction.
   (b) Stainless steel louvered doors shall be constructed using 18 gauge and are bent style louver. Doors include ¼” x ½” welded frame on rear of door for rigidity.
   (c) Door catches are heavy duty magnetic catches and mounted on the apron at top of door. Magnetic catch profile is approximately 1” square. Doors supplied with custom 430 stainless steel welded plate for magnetic catch are to be CHG model number M30-5920.
   (d) Door handles on hinged doors are to be CHG model number P63-1012.
   (e) Door handles on sliding doors are to be CHG model number P62-1010.
   (f) Door hinges are flag hinges CHG model number M75-1002.
   (g) Drawer face handles are to be CHG model number P63-1012.

(2) Millwork Doors
   (a) Millwork doors used in stainless steel framed counters shall be constructed using 18 mm 13-ply plywood.
   (b) Millwork doors shall utilize BlumMotion self closing hinges. Doors are to be laminated front and back. No unfinished surfaces.
   (c) Unless otherwise specified in itemized specification or drawings, door pulls for millwork doors shall be 4” OC wire pulls.

iv) Drawers:
(1) Manual cash drawers are to be supplied by fabricator MMF model number 22613416C01204.
(2) Drawer faces are double-pan construction. All drawers are to be supplied with removable pan liners.
(3) Drawer face handles are to be CHG model number P63-1012.

v) Shelves:
(1) Shelves on knuckle-joint constructed counters shall be made from 18 gauge 304 stainless steel.
(2) If welded front facing is required, shelves on welded front faces shall be constructed using 16 gauge 304 stainless steel.

vi) Tops:
(1) Stainless Steel Tops: To be constructed using 14 gauge 304 stainless steel and properly braced with “C” channels for support and mounted using welded studs with NSF sound deadening material. Unless otherwise specified in the itemized description or indicated in design drawings, non-obstructed edges shall be turned down 90 degrees 1 ½” with a ½” return tight to cabinet body. Total overhand is ½” where not adjacent to wall or butted equipment. Unless otherwise specified in the itemized description or indicated in design drawings wall adjacent edges shall include a back splash with 6” turn up and include a 2” thick back splash that is made on a 45 degree angle on return to wall. All corners shall be coved to NSF standards. All back splashes include end caps. Grommet holes are supplied with rubber grommets by fabricator. Waste and post holes are die stamped according to NSF requirements. KEC shall seal top to wall where applicable.
(2) Quartz Tops: Quartz tops are 1 ¼” or 3 cm thick and NSF approved materials. Quartz tops shall be properly supported with 1 ¼” tubular framing. Unless otherwise specified in the itemized description or indicated in design drawings, edge finish detail shall be eased edge...
with 1” overhang where not adjacent to wall or butted equipment. Wall adjacent edges shall include 4” back splash made from matching top material. Seams shall be no more than 1/8” in width. Seam adhesive must be a color matching and approved by quartz manufacturer.

f) **SNEEZE GUARDS**
   i) Shipping and Installation: KEC to ship sneeze guards to fabricator for shop installation to ensure proper. Final installation and fit by KEC
   ii) Posts: When possible, sneeze guard posts to run through the countertop and supported by angled framing below. Supports supplied and installed by fabricator. KEC to supply all sneeze guard information to fabricator in a timely manner.
   iii) Electrical: Lighting ballasts for sneeze guard lighting mounted by fabricator below the top and provided with easy access and chases when necessary. Junction boxes provided when needed for sneeze guard electrical leads.

g) **MILLWORK FACING:**
   i) Millwork front faces shall be constructed using 13-ply birch plywood, minimum of 18mm thick when applicable.
   ii) Millwork faces shall be attached to stainless steel framing with metal clips. Metal clips shall be tacked to frame to prevent shifting in transit and site handling.

h) **DROP-INS:**
   i) All drop-ins are shipped to fabricator by KEC in a timely manner to ensure proper fit.
   ii) Drop-ins and buy-outs are installed by fabricator when applicable. Final connections by KEC.
   iii) When installed in solid surface materials, all equipment requiring insulation including drop-in cold pans and heated shelves are to be insulated as recommended by the solid surface material and component manufacturer.

i) **SINKS:**
   i) Fabricated sinks shall be constructed from 14 gauge 304 stainless steel.
   ii) Sinks mounted in stainless steel tops are integrally welded, ground smooth and polished.
   iii) Sinks mounted in quartz tops are under-mounted include a 12 gauge 1 ½” wide flange integrally welded to a 14 gauge sink body. Sink clips are 12 gauge. Sinks installed by fabricator when possible.

j) **ELECTRICAL:**
   i) All outlets are to be mounted in removable access panels.
   ii) All pre-wiring by fabricator is to be UL approved and tested before shipment.
   iii) Fabricator to provide integral electrical subpanel as part of the fabricated cabinet. All foodservice equipment and convenience outlets to be prewired to sub panel by fabricator. Fabricator to provide panel schedule and coordinate electrical loads with electrical contractor prior to fabrication.

k) **PLUMBING**
   i) Drains shall be supplied by the fabricator, installed and prepped for field plumbing by others.
   ii) Overflows shall be installed by fabricator.
   iii) Access holes for waste lines to floor shall be supplied by the fabricator when cutout information is provided by the KEC.
   iv) Fabricator shall provide faucet holes, faucets supplied by KEC. KEC to supply faucet information to fabricator for cutouts. All faucets to be T&S brand or equivalent.

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**ITEM #S128**
**DISPLAY SHELF**
Manufacturer: Custom Fabricated Stainless Steel
Model: -

**ITEM #S129**
**POS TERMINAL**
Manufacturer: NIKEC/By Owner

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TCNJ – T-Dubs Dining Hall Renovation
Foodservice Equipment
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Super Erecta®, MetroMax Q™ Top-Track Track Set, 10' L, includes: necessary sections of track for assembling track runs (only (1) track set is required between stationary units)

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ITEM #K7.2 CONDENSER, +35F - ALTERNATE #2
Manufacturer: Custom
Model:

ITEM #X178 WALK-IN REFRIGERATOR
Manufacturer: NIKEC/Existing to Remain
Model:

ITEM #K8.1 EVAPORATOR, +35F - ALTERNATE #2
Manufacturer: Custom
Model:

ITEM #K8.2 CONDENSER, +35F - ALTERNATE #2
Manufacturer: Custom
Model:

ITEM #K9 BUN PAN RACK
Manufacturer: Metro
Model: RD13N

Tray Rack, mobile, end load, single section, pass-thru, 21-1/4"W x 68-1/4"H, 26-1/2"D, pass-thru, open sides with slides for (40) 18"x26" pans, slides on 1-1/2" centers, riveted aluminum construction Corner bumpers

ITEM #K12 TILTING KETTLE, 40 GAL
Manufacturer: Southbend
Model: KTLG-40

Tilting Kettle, Gas, 40-gallon capacity, two-thirds jacket, thermostatic control, electronic ignition, 316
stainless steel interior liner, stainless steel exterior, stainless steel console with crank tilt, 1-5/8" diameter stainless steel legs with flanged feet, 100,000 BTU
Standard one year limited warranty
3" tangent draw off valve added to tilting kettle
Perforated Strainer, for 3" draw-offs
Solid Strainer, for 3" draw-offs
18" single pantry faucet
Spring assist cover for 40 gallon kettle
Contour measuring strip 20-100 gallon
3" Dairy Draw-off Valve
Pour Strainer

ITEM #K13  CONVECTION OVEN
Manufacturer:  Garland/US Range
Model:  MCO-GD-20

Master Series Convection Oven, gas, double-deck, deep depth 43", (2) speed fan, Master 450 solid state digital control with Cook 'n' Hold, electric ignition, dependent 60/40 doors with windows, stainless steel front, sides & top, porcelain cavity, 6-1/2" legs, EnerLogic Technology, 120,000 BTU (Garland), CE, cUL, NSF (2) year limited parts & (1) year labor warranty, Door warranty (5) year limited parts except window, covers products purchased and installed in the USA & Canada only, standard Low profile casters with front brakes (set of four) double deck ovens only Gas Flex Hose with quick disconnect includes restraining device, 3/4" N.P.T. x 60" (verify gas connection)

ITEM #K14  CONVECTION STEAMER
Manufacturer:  Cleveland Range
Model:  24CGA10.2ES

Steamcraft® Gemini™ 10 Convection Steamer, pressureless, gas, 2 compartments with individual generators, (5) 12 x 20 x 2-1/2 pans/compartment capacity, electro-mechanical 60 minute timers, 1 standard treated & tap water connection, stainless steel construction, 6" adjustable legs with flanged feet, twin 50,000 BTU, total 100,000 BTU, ENERGY STAR® 1-year limited warranty, standard Claris Water Treatment System, includes (1) pre-filter, (1) Claris X-large steam system, (1) Claris flow meter and (1) water test kit (see water quality requirements in price list)
Claris X-Large Filter Cartridge
(VOS115) 2-wire (DO NOT connect to GFI outlet)

ITEM #K15  FRYER BATTERY, GAS
Manufacturer:  Pitco Frialator
Model:  2-SG14RSSTC-S/FD

Solstice Prepackaged Fryer System with Solstice Filter Drawer System, High Power, gas, (2) 50
lb oil cap. full tanks, solid state control, boil out, drain valve interlock, melt cycle, matchless ignition, stainless steel tank, front & sides, under-fryer drawer filtration, total 244,000 BTU (-FF)
Bread & Batter Cabinet, with BNB dump station, fryer match design, approximately 15-5/8" wide, standard finish, stainless steel front, sides & door, for prepackage system SG 14 gas fryers
1st Position location for Bread & Batter dump station (BFF)
Food Warmer, built-in
Gas Connector Hose, 36" long, with quick disconnect couplings, restraining device & thermal shut-off, for multiple units 390,000 BTU capacity, posi set wheel placement device for casters

ITEM #K16 WORK TABLE
Manufacturer: Eagle Group
Model: T3048SE-BS

Spec-Master® Work Table, 48"W x 30"D, 14/304 stainless steel top with 4-1/2" backsplash, rolled front edge, square turndown ends, Uni-Lok® gusset system, heavy gauge s/s undershelf, (4) 1-5/8" diameter heavy gauge s/s legs with 1" adjustable s/s feet, NSF

ITEM #K17 RANGE, 36", 6 OPEN BURNERS
Manufacturer: Southbend
Model: 4361D

Ultimate Restaurant Range, Gas, 36", 6 Non-Clog burners with standard grates, standard oven base, standing pilot, 22-1/2" flue riser with heavy duty shelf, stainless steel front, sides and shelf, 6" adjustable legs, 243,000 BTU, CSA, NSF
Standard one year limited warranty (range)
NOTE: 22.5" high flue riser, with heavy duty shelf, standard
Specify Gas Type
Casters, 2 locking & 2 standard, in lieu of legs
3/4" quick disconnect with 3' hose

ITEM #K18 WORK TABLE
Manufacturer: Eagle Group
Model: T3048SE-BS

Spec-Master® Work Table, 48"W x 30"D, 14/304 stainless steel top with 4-1/2" backsplash, rolled front edge, square turndown ends, Uni-Lok® gusset system, heavy gauge s/s undershelf, (4) 1-5/8" diameter heavy gauge s/s legs with 1" adjustable s/s feet, NSF

ITEM #K19 SPARE NO.
ITEM #K21  SPARE NO.

ITEM #K22  SPARE NO.

ITEM #K23  SPARE NO.

ITEM #K24  SPARE NO.

ITEM #K25  SPARE NO.

ITEM #K25.1  SPARE NO.

ITEM #K26  SPARE NO.

ITEM #K27  SPARE NO.

ITEM #K28  SPARE NO.

ITEM #K29  REACH-IN REFRIGERATOR, 3 SECTIONS
Manufacturer: Continental Refrigerator
Model: 3R

Refrigerator, reach-in, three-section, self-contained refrigeration, aluminum interior & exterior, stainless steel front & doors, standard depth cabinet, narrow full-height doors, exterior dial-type thermometer, electric condensate evaporator, 5" casters, 1/2 hp, ENERGY STAR®

Standard warranty (for the United States & Canada Only): 3 year parts and labor
Refrigerator: Self-Contained refrigeration, 1/2 hp, standard
Compressor warranty: 5 year compressor (self-contained units only)
All doors hinged on left
Casters, swivel, with brakes (5" diameter rubber tired) set of 6 (6" height)

ITEM #K33  TWO (2) COMPARTMENT SINK
Manufacturer: Select Stainless Products
Model: 2B24-2D30-14
Sink, 2-compartment, with 30" left & right hand drainboards, 24" front-to-back x 24" wide x 14" deep, 14/300 stainless steel bowls, 9" high backsplash, 1-1/2" raised rolled edge, stainless steel H-frame legs with adjustable stainless steel feet, NSF
- Heavy Duty Faucet, splash-mount, 8" centers, 10" long
- Pre-Rinse Faucet, wall mount, includes: wall bracket
- Add-A-Faucet
- Twist Handle Lever drain, 1-1/2" drain outlet
- Overshelf, 14" wide, cantilevered through splash (priced per ft.)

ITEM #K34 WORK TABLE
Manufacturer: Eagle Group
Model: T36120SE

Spec-Master® Work Table, 120"W x 36"D, 14/304 stainless steel top with rolled edges front & back, square turndown ends, Uni-Lok® gusset system, 18 gauge stainless steel undershelf, (6) 1-5/8" diameter heavy gauge s/s legs with 1" adjustable stainless steel feet, NSF
- Flex-Master® OverOvershelf, Table Mounted, posts sold separately, 12"W x 10 feet long, 16 gauge 304 stainless steel, Uni-Lok® system, NSF
- Utility Rack, to be used with flex-master overshel, table mounted, 120"L, chrome plated, NSF

ITEM #K35 WIRE SHELVING
Manufacturer: Metro
Model: 2448BR

Super Erecta® Shelf, wire, 48"W x 24"D, Bright (zinc) finish, plastic split sleeves are included in each carton, NSF
- Super Erecta® Post, special cut length, 74-3/4"H, for use with stem casters, chrome plated finish
- Stem Caster, brake (foot operated), 5" diameter, 1-1/4" face, resilient wheel tread, 200 lb. capacity, brakes are foot operated

ITEM #K38 ELECTRIC FOOD CUTTER
Manufacturer: Existing, Relocated
Model:

ITEM #K39 WORK TABLE
Manufacturer: Eagle Group
Model: T3684SE
Spec-Master® Work Table, 84"W x 36"D, 14/304 stainless steel top with rolled edges front & back, square turndown ends, Uni-Lok® gusset system, 18 gauge stainless steel undershelf, (4) 1-5/8" diameter heavy gauge s/s legs with 1" adjustable stainless steel feet, NSF

**ITEM #K43 FOOD PROCESSOR**
Manufacturer: Robot Coupe
Model: CL60 BULK

Bulk D-Series Commercial Food Processor, vegetable prep attachment with stainless steel bulk feed and external ejection (no bowl), 28058 1/8" (3mm) grating & 28064 1/8" (3mm) slicing disc, two disc rack, stainless steel base & stand, two speed 425 & 850 RPM, 5.3/3 HP, ETL electrical and sanitation, cETL
1 year parts & labor warranty
Julienne Disc, 8x8mm (5/16")
Dicing Kit, 14x14mm (9/16"), includes: slicing disc 28131 & dicing grid 28120
Food Cart, delivered without container, 4 casters, stainless steel
Free Standing 3-position Disc Rack

**ITEM #K44 FOOD CARRIER DOLLY**
Manufacturer: Robot Coupe
Model: R198

Food Tray Cart, pan & lid included

**ITEM #X11 POS TERMINAL**
Manufacturer: Custom
Model: -

**ITEM #X12 POS TERMINAL**
Manufacturer: Custom
Model: -

**ITEM #X13 POS TERMINAL**
Manufacturer: Custom
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TCNJ – T-Dubs Dining Hall Renovation
Foodservice Equipment
ITEM #X41  IMPINGER (TOP)
Manufacturer: Custom
Model: -

Existing to be Relocated

ITEM #X151  SHELF, WALL MOUNTED
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X152  SHELF, WALL MOUNTED
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X153  DISHTABLE W/ THREE COMPARTMENT SINK
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X154  CABINET WORK TABLE
Manufacturer: Custom
Model: -

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ITEM #X162 WORK TABLE W/ OVERSHELF
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X164 WIRE SHELVING
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X170 GRIDDLE, GAS
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X171 CHARBROILER, GAS
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X173 KETTLE, STEAM JACKETED, DIRECT STEAM, PEDESTAL
Manufacturer: Custom
Model: -

Existing to Remain
ITEM #X177  HAND SINK, WALL MOUNTED
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X183  EXHAUST HOOD
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X183.1  ANSUL SYSTEM
Manufacturer: Ansul R102
Model: R102

Kitchen equipment contractor to modify existing fire system to provide protection to new equipment layout and hood and plenum as required by NFPA 96 and UL300.

ITEM #X184  EXHAUST HOOD
Manufacturer: Custom
Model: -

Existing to Remain

ITEM #X184.1  ANSUL SYSTEM
Manufacturer: Ansul R102
Model: R102

Kitchen equipment contractor to modify existing fire system to provide protection to new equipment layout and hood and plenum as required by NFPA 96 and UL300.

ITEM #X201  CONVECTION OVEN
Manufacturer: Custom
Model: -
Existing to be Relocated

ITEM #X205          CO2 TANKS
Manufacturer:       NIKEC/By Vendor
Model:              -

Existing to be Relocated

ITEM #X206          BAG IN BOX
Manufacturer:       NIKEC/By Vendor
Model:              -

Existing to be Relocated

ITEM #X207          BAG IN BOX
Manufacturer:       NIKEC/By Vendor
Model:              -

Existing to be Relocated

ITEM #X208          ICE MACHINE
Manufacturer:       NIKEC – Existing to Remain
Model:              -

**END OF SECTION**
SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Quartz agglomerate countertops and backsplashes.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

   1. Front: Straight, slightly eased at top.
   2. Backsplash: Straight, slightly eased at corner.

B. Countertops: 3/4-inch (19-mm) thick, quartz agglomerate with front edge built up with same material.

C. Backsplashes: 3/4-inch (19-mm) thick, quartz agglomerate.

2.2 COUNTERTOP MATERIALS

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.

   1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equivalent:
a. Cambria.

2. Colors and Patterns: As indicated by manufacturer's designations. Refer to finish schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 123661
SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Mechanical sleeve seals.
   3. Sleeves.
   4. Escutcheons.
   5. Grout.
   6. Fire-suppression equipment and piping demolition.
   7. Equipment installation requirements common to equipment sections.
   8. Painting and finishing.

1.3 DEFINITIONS

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

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

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

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

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

F. CPVC: is the industry abbreviation for Chlorinated polyvinyl chloride plastic materials.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Mechanical sleeve seals.
   2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

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

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

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

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

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

2.3 JOINING MATERIALS

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

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

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

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

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

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

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

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

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

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.
3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

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

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

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

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

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

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

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

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

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed-rivet hinge and spring clips.
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C. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
D. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
E. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
F. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
G. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
H. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed-rivet hinge and set screw.
I. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
J. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw.
K. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.
N. Permanent sleeves are not required for holes formed by removable PE sleeves.
O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

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

1. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

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

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

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

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

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

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

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.4 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

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

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

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
B. Clean surfaces that will come into contact with grout.
C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.
G. Place grout around anchors.
H. Cure placed grout.

END OF SECTION 210500
SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Isolation mounts.
   2. Restrained elastomeric isolation mounts.
   3. Restraining braces.

1.3 DEFINITIONS
C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS
A. Seismic-Restraint Loading:

1.5 SUBMITTALS
A. Product Data: For the following:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES that is acceptable to the local authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.
B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

2. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES that is acceptable to the local authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Qualification Data: For the professional engineer and testing agency.

1.6 QUALITY ASSURANCE
   A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
   C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

2.2 SEISMIC RESTRAINT DEVICES

2.3 FACTORY FINISHES
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES that is acceptable to the local authorities having jurisdiction.
B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
B. Piping Restraints:
C. Install cables so they do not bend across edges of adjacent equipment or building structure.
D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that is acceptable to the local authorities having jurisdiction providing required submittals for component.
E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
H. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACcommodation of Differential Seismic Motion

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 13 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

3.5 Fire Suppression Vibration Control and Seismic Restraint Device Schedule

A. Supported or Suspended Equipment:

1. Equipment Location:

2. Pads:
   a. Material:
   b. Thickness:
   c. Number of Pads:

3. Isolator Type:

4. Minimum Deflection:

5. Component Importance Factor:

6. Component Response Modification Factor:

7. Component Amplification Factor:

END OF SECTION 210548
SECTION 211000 – WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

a. Design, modification, and installation of the following:
   1) Wet pipe sprinkler system.

1.02 DEFINITIONS

a. As established by NFPA for materials used in fire protection systems.

1.03 SUBMITTALS: ALL SUBMITTALS SHALL BEAR APPROVAL FROM OWNER’S INSURANCE CARRIER PRIOR TO REVIEW. MAKE ALL SUBMITTALS AT ONE TIME. PARTIAL SUBMISSIONS WILL NOT BE ACCEPTED.

a. Shop Drawings: As a minimum, show:
   1) Piping drawings.
   2) Location and rating of sprinklers.
   3) Risers, drops and offsets required to avoid interference with other construction.
   4) Source of water supply and design pressure.
   5) Provision for flushing, draining and testing, including locations and sizes of drains, vents and flow test stations.

b. Product Data: Describe each product specified.

c. Informational Submittals:
   1) Proposed flushing and testing procedures.
   2) Certificates; Sprinkler Systems: Certify that field tests have been performed and that work meets or exceeds specified requirements.
      a) Installer's NFPA Material and Test Certificate.
   3) Start-up report.
   4) Project Record Documents.
   5) Operation and Maintenance Data.
   6) Hydraulic calculations signed and sealed by a Professional Engineer registered in the State of New Jersey

1.04 QUALITY ASSURANCE: COMPLY WITH:

a. FM Approval Guide and Loss Prevention Data.

b. Owner’s Insurance Carrier Requirements.


d. UL Fire Protection Equipment List.
1.05 QUALIFICATIONS
   a. Supplier/Installer: Company specializing in sprinkler systems specified, with five years experience.

1.06 REGULATORY REQUIREMENTS: COMPLY WITH:
   a. Building Code as adopted by the State of New Jersey.
   c. NFPA 14: Standard for the Installation of Standpipe and Hose Systems.
   g. Local Water Company Requirements.

1.07 MAINTENANCE MATERIAL: FOLLOW SECTION 017700.
   a. Spare sprinklers of each type and temperature rating used. Comply with NFPA 13 as to number required.
   b. One sprinkler wrench for each type of sprinkler head.

1.08 COORDINATION
   a. Prior to layout and detailing of sprinkler systems contractor must obtain completed and signed Owner’s Certificate as per NFPA 13 requirements. See form attached at the end of this Section.
   b. Shop drawings of acoustical panel ceilings are required by other Sections. Advise ceiling installer as to sprinkler head locations. Review and approve shop drawings as to head locations in relationship to ceiling pattern.

2.00 PART 2 - PRODUCTS

2.01 MANUFACTURERS
   a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
      1) Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2.02 ABOVE GROUND STANDPIPE AND WET PIPE SPRINKLER SYSTEM

a. Pipe:
   1) 2 Inch Diameter and Smaller: UL listed FMG approved schedule 40 electric resistance welded (ASTM A135) or seamless steel, black; ASTM A53 Grade B.
      a) Joints: Threaded, welded or grooved (rolled or cut).
      b) Fittings:
         (1) Class 125 cast iron threaded; ANSI B16.4.
         (2) Class 150 malleable iron threaded; ANSI B16.3.
   2) 2 1/2 Inch Through 5 Inch: UL listed FMG approved light wall, schedule 10 electric resistance welded (ASTM A135) or seamless steel, black; ASTM A53.
   3) 6 Inch: Light wall, 0.134 inch wall thickness electric resistance welded (ASTM A135) or seamless steel, black; ASTM A53.
   4) 8 Inch Through 10 Inch: Light wall, 0.188 inch wall thickness electric resistance welded (ASTM A135) or seamless steel, black; ASTM A53.
   5) Joints: Welded or grooved (rolled only).
   6) Fittings: Steel, welded ends, or ductile or malleable iron, mechanical joint; ASTM A536/ASTM A47.
      a) Forged steel threaded or grooved; ANSI B16.11.
      b) Forged steel socket welded.
      c) Cast iron grooved; ASTM A536.
      d) Malleable iron grooved; ASTM A47.
   7) Couplings ( Victaulic) 8 Inch and Smaller: Ductile iron housing, ASTM A536, Grade E, EPDM type A gasket. Victaulic Style 005 Firelock rigid coupling for fire protection services Or equivalent.
   8) Couplings ( Victaulic) 10 Inch and Larger: Ductile iron housing, ASTM A536, Grade E, EPDM type A gasket. Victaulic Zero-Flex Style 07 Or equivalent.

2.03 ABOVE GROUND GATE VALVES

a. Gate Valves:
   1) 2 Inch and Smaller: 175 psi, OS&Y bronze, threaded ends, Nibco T-104-0.
   2) 2 1/2 Inch and Larger: 250 psi resilient wedge, epoxy coated interior and exterior OS&Y.
      a) Grooved Ends: NIBCO G-607-RW Or equivalent.
      b) Flanged Ends: NIBCO F-607-OTS Or equivalent.

b. Check Valves:
   1) 2 Inch and Smaller: Class 125, 200 working water pressure, bronze swing disc, threaded ends, Nibco KT-403-W Or equivalent.
   2) 2 1/2 Inch and Larger: 175 psi, IBBM, flanged ends, Nibco F-908-W Or equivalent.

c. Butterfly Valves: Grooved end, mechanical style, ductile iron body, stainless steel stem, ductile iron EPDM encapsulated disc; with built-in supervisory switches; Nibco GD-4765-8N or Victaulic Firelock Series 708 Or equivalent.

2.04 ALARM PRESSURE SWITCHES

a. UL listed, FMG approved pressure switch for initiating a sprinkler flow alarm per NFPA 72 in conjunction with alarm check valves and dry-pipe or pre-action sprinkler systems.

b. DPDT alarm contacts rated 24V DC at 1A minimum, adjustable to operate from 0 to 20 psi.

c. Furnish with SPDT tamper contacts rated 24V DC at 1A minimum, actuated by removal of cover.

d. Potter Electric Co. Model PS10-2 Or equivalent.

2.05 PRESSURE SUPERVISORY SWITCH

a. UL listed, FM approved pressure switch for initiating a supervisory alarm per NFPA 72 upon the occurrence of high and low air pressure conditions in dry-pipe or pre-action sprinkler systems.

b. Two SPDT alarm contacts rated 24V DC at 1A minimum, independently adjustable to operate between 20 and 200 psi. Set one contact to operate on low air pressure and one to operate on high pressure.

c. Furnish with SPDT tamper contacts rated 24V DC at 1A minimum, actuated by removal of cover.


2.06 POST INDICATOR VALVE AND BUTTERFLY VALVE SUPERVISORY SWITCH.

a. UL listed, FM approved valve position switch for initiating a supervisory alarm per NFPA 72 when a post indicator valve is moved from open position.

b. SPDT alarm contacts rated 24V DC at 1A minimum, actuated by movement of valve and by removal of switch cover.


2.07 OS&Y VALVE SUPERVISORY SWITCH

a. UL listed, [FM approved] valve position switch for initiating a supervisory alarm per NFPA 72 when OS&Y sprinkler valve is moved from open position.

b. SPDT alarm contacts rated 24V DC at 1A minimum, actuated by movement of valve and by removal of switch cover.

c. Potter Electric Co. Model OSYSU-A1 or OSYS-B depending on valve size Or equivalent.

2.08 WATERFLOW DETECTOR
2.09 PRESSURE GAUGE

a. UL listed, cast aluminum or black phenolic case, with back flange, 3-1/2 inch diameter glass face and snap ring with a UL listed shut-off valve to isolate gauge.

b. Phosphor-bronce Bourdon tube, stainless steel pinion and nylon-faced stainless steel segments; adjustable movement for linearity.

2.10 SPRINKLERS

a. Available Manufacturers:
   1) Reliable Automatic Sprinkler Co.
   2) Tyco, Fire & Building Products; Gem Sprinkler, Globe Fire Spinkler and Star Sprinkler Corp.
   3) Viking Corp.
   4) Victaulic Company of America.
   5) Or equivalent.

b. UL listed and FMG approved: Type as shown on drawings.

c. Use sprinklers having 1/2 inch orifice with "K" factor between 5.3 and 5.8 unless shown otherwise.

d. Temperature Rating: 155 to 165 degrees F, except where sprinklers are subject to abnormal heating conditions and of sufficient rating to prevent accidental discharge when no fire is present.

e. Sprinkler Escutcheons: Type suitable for sprinkler head used and manufactured by sprinkler manufacturer.

f. Sprinkler Guards: Type suitable and listed for specific sprinkler used and manufactured by sprinkler manufacturer.

2.13 EXTENDED PENDANT SPRINKLER ESCUTCHEONS

a. Available Manufacturers:
   1) ARGCO.
   2) Heiter Industries, LLC.
   3) Other Substitutions are not permitted.
b. Extended pendant 1 piece sprinkler escutcheon manufactured of chrome plated steel. Length as required.

2.14 SPRINKLER CABINETS

a. Surface mounted cabinets for storing spare sprinklers and wrenches.
b. Cabinet and Door: 22 gauge minimum sheet steel with concealed hinge and recessed handle.
c. Finish: Prime coat and baked enamel in color selected.

2.15 SIGNS

a. Identification signs as specified under Section 15075 and as required by NFPA 13.
b. Where there is more than one control valve, provide identification signs indicating portion of system controlled by each valve.

3.00 PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL REQUIREMENTS

a. Install the work following Article "Regulatory Requirements".

3.02 PIPING, VALVES, FITTINGS AND ACCESSORIES:

a. Use ball type valves for main riser drain, auxiliary drains and inspector's test connections.
b. Provide drain connection for sectional or floor control valves, piped to a floor drain, mop receptor or as indicated.
c. Pipe 3/4 inch and larger auxiliary drains to floor drain, sump, mop receptor or other approved discharge location. Verify location has sufficient capacity to handle anticipated flow without creating a nuisance.
d. Install detector check valve assembly and accessories in compliance with local water company requirements.
e. Install water flow detector on top side of horizontal pipe or on vertical pipe. Install minimum 6 inches from fitting or 24 inches from a valve.
f. All piping and fittings protruding through outside walls of the building (drains and inspector’s test connections) shall be galvanized inside and outside.

3.03 SPRINKLER SYSTEMS

a. Include a 10 psig safety factor between the available pressure and the required pressure at the required flow in the hydraulic calculations submitted for approval.
b. Water velocities shall be shown in the calculations and shall not exceed 20 feet per second for inside piping.

c. Sprinkler piping load shall include an additional 250 pound load applied at point of hanging as required by NFPA.

d. Providing means of draining sprinkler systems, following NFPA 13, and as specified.

e. Where change in pipe direction prevents drainage through main drain valve, provide auxiliary drains following NFPA 13.

f. Size drain piping following NFPA 13.

g. Locate sprinklers at center of ceiling units, unless otherwise shown. Use "U" bends if necessary.

h. Install sprinkler guards at locations where sprinklers may be subject to mechanical injury, or where required by authority having jurisdiction.

i. Protect concealed sprinkler cover plates where ceilings will receive field paint finish.

j. Provide inspector’s test connections on wet systems in an easily accessible location as indicated on drawings. For dry systems locate inspector’s test connections in an easily accessible location piped from the hydraulically most remote location on each floor. Provide drain to an approved location.

3.04 FLUSHING

a. Flush underground mains and lead-in connections to system risers before making connections to sprinkler piping.

b. Install drainage plugs, taps and valves required for flushing.

c. Dispose of flushing water to Owner approved locations.

d. Repair damage caused by leaks, flooding or draining during flushing.

e. Submit notification of flushing operations two weeks in advance.

3.05 FIELD TESTING

a. General Requirements:
   1) Test new wet sprinkler system. Follow NFPA 13.
   2) Measure hydrostatic pressure at low point of individual system, zone or main being tested.
   3) Should leaks occur during testing, stop test, repair leaks, and repeat entire test from beginning.
   4) Repair damage caused by leaks, flooding or draining during testing.
   5) Submit notification of testing two weeks in advance.

b. For New Wet Sprinkler System:
1) Hydrostatically test new wet sprinkler system at not less than 200 psi for 2 hours, or at 50 psi for 2 hours above maximum static pressure when maximum static pressure is greater than 150 psi. No leakage allowed.

2) After hydrostatic test, pneumatically test new pre-action pipe sprinkler systems with 40 psi air pressure for 24 hours. Repair leaks that allow loss of pressure over 1 1/2 psi for 24-hour period, and repeat test from beginning. If weather does not permit hydrostatic test, test pre-action systems pneumatically, and conduct hydrostatic test when weather permits.

c. For Existing Piping:

   1) Do not test existing sprinkler piping.
   2) Do not test existing underground fire main.

3.06 SYSTEM START-UP:

   a. Provide services of manufacturer's representative for a minimum of 8 hours.

END OF SECTION 211000
DIVISION 220000 - PLUMBING SPECIFICATIONS

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| SECTION 220500                  | COMMON WORK RESULTS FOR PLUMBING                  |
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|SECTION 224000                  | PLUMBING FIXTURES                                 |

END OF SECTION
SECTION 220500 - GENERAL PROVISION FOR PLUMBING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. Plumbing demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Supports and anchorages.

1.3 DEFINITIONS

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

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

1.5 QUALITY ASSURANCE
   A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
   B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
      1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
      2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
   C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
   B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION
   A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
   B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

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

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

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

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

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

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, NSF 61 Certified, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
   g. Or equivalent.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.

3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.

4. Aboveground Pressure Piping: Pipe fitting.

B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Available Manufacturers:
   b. Fernco, Inc.
   d. Plastic Oddities, Inc.
   e. Or equivalent.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
g. Or equivalent.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   e. Or equivalent.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Available Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.
   c. Or equivalent.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Available Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Victaulic Co. of America.
   e. Or equivalent.
2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

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

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

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

E. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

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

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

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

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

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

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

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

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

2. Existing Piping: Use the following:
   a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed-rivet hinge and spring clips.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
   f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.

h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed-rivet hinge and set screw or spring clips.

i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.

k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

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

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

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

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

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

   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

   b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.

   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

   1) Seal space outside of sleeve fittings with grout.

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

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


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

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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

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

I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

L. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
C. Field Welding: Comply with AWS D1.1.
3.8  **ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9  **GROUTING**

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 220500
SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following general-duty valves:

1. Bronze angle valves.
2. Cast-iron angle valves.
3. Copper-alloy ball valves.
4. Ferrous-alloy ball valves.
5. Ferrous-alloy butterfly valves.
6. High-pressure butterfly valves.
7. Bronze check valves.
8. Gray-iron swing check valves.
10. Spring-loaded, lift-disc check valves.
12. Cast-iron gate valves.
15. Cast-iron plug valves.

B. Related Sections include the following:

1. Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
3. Division 22 piping Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. TFE: Tetrafluoroethylene plastic.
1.4 SUBMITTALS
   A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE
   A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
   B. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Prepare valves for shipping as follows:
      1. Protect internal parts against rust and corrosion.
      2. Protect threads, flange faces, grooves, and weld ends.
      3. Set angle, gate, and globe valves closed to prevent rattling.
      4. Set ball and plug valves open to minimize exposure of functional surfaces.
      5. Set butterfly valves closed or slightly open.
      6. Block check valves in either closed or open position.
   B. Use the following precautions during storage:
      1. Maintain valve end protection.
      2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
   C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
      1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Gear Drive: For quarter-turn valves NPS 8 and larger.
   2. Handwheel: For valves other than quarter-turn types.
   3. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
   4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.


I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE ANGLE VALVES

A. Available Manufacturers:
   1. Type 2, Bronze Angle Valves with Nonmetallic Disc:
      a. American Valve, Inc.
      b. Cincinnati Valve Co.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Crane Co.; Crane Valve Group; Jenkins Valves.
      e. Crane Co.; Crane Valve Group; Stockham Div.
      f. Grinnell Corporation.
      g. Hammond Valve.
      h. NIBCO INC.
i. Powell, Wm. Co.

B. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 2, Class 200, Bronze Angle Valves: Bronze body with nonmetallic PTFE or TFE disc and union-ring bonnet.

2.4 CAST IRON ANGLE VALVES

A. Available Manufacturers:

1. Type II, Cast-Iron Angle Valves with Metal Seats:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Div.
   d. NIBCO INC.
   e. Or equivalent.

B. Cast Iron Angle Valves, General: MSS SP-85, Type II.

C. Class 250, Cast Iron Angle Valves: Bronze mounted with gray iron body and bronze seats.

2.5 COPPER ALLOY BALL VALVES

A. Available Manufacturers:

1. One Piece, Copper Alloy Ball Valves:
   a. American Valve, Inc.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. DynaQuip Controls.
   f. Grinnell Corporation.
   g. Jamesbury, Inc.
   h. Kitz Corporation of America.
   i. Legend Valve & Fitting, Inc.
   j. NIBCO INC.
   k. Watts Industries, Inc.; Water Products Div.
   l. Or equivalent.

2. Two Piece, Copper Alloy Ball Valves:
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. DynaQuip Controls.
f. Flow-Tek, Inc.
g. Grinnell Corporation.
h. Hammond Valve.
i. Honeywell Braukmann.
j. Jamesbury, Inc.
k. Jomar International, LTD.
l. Kitz Corporation of America.
m. Legend Valve & Fitting, Inc.
n. Milwaukee Valve Company.
o. Nexus Valve Specialties.
p. NIBCO INC.
q. R & M Energy Systems (Borger, TX).
r. Red-White Valve Corp.
s. Richards Industries; Marwin Ball Valves.
u. Or equivalent.

3. Three Piece, Copper Alloy Ball Valves:

b. DynaQuip Controls.
c. Grinnell Corporation.
d. Hammond Valve.
e. Jamesbury, Inc.
f. Kitz Corporation of America.
g. NIBCO INC.
h. PBM, Inc.
i. Red-White Valve Corp.
j. Worcester Controls.
k. Or equivalent.

4. Safety Exhaust, Copper Alloy Ball Valves:

b. DynaQuip Controls.
c. Grinnell Corporation.
d. Hammond Valve.
e. Jamesbury, Inc.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Or equivalent.

B. Copper Alloy Ball Valves, General: MSS SP-110.

C. One Piece, Copper Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 600-psig CWP rating.

D. Two Piece, Copper Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
E. Three Piece, Copper Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.6 FERROUS-ALLOY BALL VALVES

A. Available Manufacturers:

1. American Valve, Inc.
3. Cooper Cameron Corp.; Cooper Cameron Valves Div.
4. Crane Co.; Crane Valve Group; Stockham Div.
5. Flow-Tek, Inc.
6. Foster Valve Co.
8. Jamesbury, Inc.
10. Kitz Corporation of America.
11. KTM Products, Inc.
14. NIBCO INC.
15. PBM, Inc.
16. Richards Industries; Marwin Ball Valves.
17. Worcester Controls.
18. Or equivalent.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 150, full port.

D. Ferrous-Alloy Ball Valves: Class 300, full port.

2.7 FERROUS-ALLOY BUTTERFLY VALVES

A. Available Manufacturers:

1. Flangeless, Ferrous-Alloy Butterfly Valves:
   a. American Valve, Inc.
   b. Bray International, Inc.
   c. Cooper Cameron Corp.; Cooper Cameron Valves Div.
   d. Crane Co.; Crane Valve Group; Center Line.
   e. Crane Co.; Crane Valve Group; Stockham Div.
   f. Dover Corp.; Dover Resources Company; Norriseal Div.
   g. General Signal; DeZurik Unit.
   h. Grinnell Corporation.
   i. Hammond Valve.
   j. Kitz Corporation of America.
   k. Legend Valve & Fitting, Inc.
l. Metraflex Co.
m. Milwaukee Valve Company.
n. Mueller Steam Specialty.
o. NIBCO INC.
q. Red-White Valve Corp.
r. Techno Corp.
s. Tyco International, Ltd.; Tyco Valves & Controls.
u. Or equivalent.

2. Single Flange, Ferrous-Alloy Butterfly Valves:

a. American Valve, Inc.
b. Bray International, Inc.
c. Cooper Cameron Corp.; Cooper Cameron Valves Div.
d. Crane Co.; Crane Valve Group; Center Line.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Div.
g. Dover Corp.; Dover Resources Company; Norriseal Div.
h. General Signal; DeZurik Unit.
i. Grinnell Corporation.
j. Hammond Valve.
k. Kitz Corporation of America.
l. Legend Valve & Fitting, Inc.
m. Metraflex Co.
n. Milwaukee Valve Company.
o. Mueller Steam Specialty.
p. NIBCO INC.
q. Process Development & Control.
r. Red-White Valve Corp.
s. Techno Corp.
v. Or equivalent.

3. Flanged, Ferrous-Alloy Butterfly Valves:

b. Cooper Cameron Corp.; Cooper Cameron Valves Div.
c. Grinnell Corporation.
d. Mueller Steam Specialty.
e. Tyco International, Ltd.; Tyco Valves & Controls.
f. Or equivalent.

4. Grooved-End, Ductile-Iron Butterfly Valves:

a. Central Sprinkler Co.; Central Grooved Piping Products.
b. Grinnell Corporation.
c. Hammond Valve.
d. McWane, Inc.; Kennedy Valve Div.
B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

C. Flangeless, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem.

D. Single Flange, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one or two piece stem.

E. Flanged, 150-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one or two piece stem.

F. Grooved End, 175-psig CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile iron or steel body with grooved or shouldered ends.

2.8 BRONZE CHECK VALVES

A. Available Manufacturers:

1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Walworth Co.
   f. Or equivalent.

2. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Red White Valve Corp.
   e. Or equivalent.

3. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
   a. Grinnell Corporation.
   b. Kitz Corporation of America.
   c. Milwaukee Valve Company.
   d. Or equivalent.

4. Type 3, Bronze, Swing Check Valves with Metal Disc:
a. American Valve, Inc.
b. Cincinnati Valve Co.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Jenkins Valves.
e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.
g. Hammond Valve.
h. Kitz Corporation of America.
i. Legend Valve & Fitting, Inc.
j. Milwaukee Valve Company.
k. NIBCO INC.
l. Powell, Wm. Co.
m. Red-White Valve Corp.
n. Walworth Co.
o. Watts Industries, Inc.; Water Products Div.
p. Or equivalent.

5. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
   a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation.
f. Hammond Valve.
g. McWane, Inc.; Kennedy Valve Div.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Red-White Valve Corp.
k. Walworth Co.
l. Watts Industries, Inc.; Water Products Div.
m. Or equivalent.

B. Bronze Check Valves, General: MSS SP-80.

C. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

D. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

E. Type 2, Class 150, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

F. Type 2, Class 150, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

G. Type 2, Class 200, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
H. Type 2, Class 200, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

I. Type 3, Class 125, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

J. Type 3, Class 150, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

K. Type 3, Class 200, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

L. Type 4, Class 125, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

M. Type 4, Class 150, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

N. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.9 GRAY IRON SWING CHECK VALVES

A. Available Manufacturers:

1. Type I, Gray-Iron Swing Check Valves with Metal Seats:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Flomatic Valves.
   f. Grinnell Corporation.
   g. Hammond Valve.
   h. Kitz Corporation of America.
   i. Legend Valve & Fitting, Inc.
   j. Milwaukee Valve Company.
   k. Mueller Co.
   l. NIBCO INC.
   m. Powell, Wm. Co.
   n. Red-White Valve Corp.
   o. Walworth Co.
   q. Or equivalent.

2. Type II, Gray-Iron Swing Check Valves with Composition to Metal Seats:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Div.
   c. Mueller Co.
   e. Or equivalent.
3. Grooved-End, Ductile-Iron Swing Check Valves:
   a. Grinnell Corporation.
   b. Mueller Co.
   c. Victaulic Co. of America.
   d. Or equivalent.


C. Type I, Class 125, gray-iron, swing check valves with metal seats.

D. Type I, Class 250, gray-iron, swing check valves with metal seats.

E. Type II, Class 125, gray-iron, swing check valves with composition to metal seats.

F. Type II, Class 250, gray-iron, swing check valves with composition to metal seats.

G. 175-psig CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or
shouldered ends.

H. 300-psig CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or
shouldered ends.

2.10 FERROUS-ALLOY WAFER CHECK VALVES

A. Available Manufacturers:

1. Single Plate, Ferrous-Alloy, Wafer Check Valves:
   a. Gestra, Inc.
   b. McWane, Inc.; Kennedy Valve Div.
   c. Mueller Co.
   d. Techno Corp.
   e. Tyco International, Ltd.; Tyco Valves & Controls.
   f. Wheatley Gaso, Inc.
   g. Or equivalent.

2. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Div.
   c. Flomatic Valves.
   d. Gestra, Inc.
   e. Grinnell Corporation.
   f. Gulf Valve Co.
   g. Metraflex Co.
   h. Mueller Steam Specialty.
   i. NIBCO INC.
   j. Red-White Valve Corp.
   k. SSI Equipment, Inc.
l. Techno Corp.
m. Val-Matic Valve & Mfg. Corp.
n. Valve and Primer Corp.
o. Watts Industries, Inc.; Water Products Div.
p. Or equivalent.

3. Dual-Plate, Ferrous-Alloy, Wafer-Lug Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Gulf Valve Co.
   c. Valve and Primer Corp.
   d. Or equivalent.

4. Dual-Plate, Ferrous-Alloy, Double-Flanged-Type Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Gulf Valve Co.
   c. Techno Corp.
   d. Or equivalent.

B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

C. Single-Plate, Class 125 or 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

D. Single-Plate, Class 250 or 300, Ferrous-Alloy, Wafer Check Valves: Flangeless body.


G. Single-Plate, Class 125 or 150, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.

H. Single-Plate, Class 250 or 300, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.

I. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

J. Dual-Plate, Class 250 or 300, Ferrous-Alloy, Wafer Check Valves: Flangeless body.

K. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Wafer-Lug Check Valves: Single-flange body.


M. Dual-Plate, Class 125 or 150, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.

N. Dual-Plate, Class 250 or 300, Ferrous-Alloy, Double-Flanged Check Valves: Flanged-end body.
2.11 SPRING LOADED, LIFT DISC CHECK VALVES

A. Available Manufacturers:

1. Type I, Wafer Lift Disc Check Valves:
   a. Mueller Steam Specialty.
   b. Or equivalent.

2. Type II, Compact Wafer, Lift Disc Check Valves:
   a. Durabla Fluid Technology, Inc.
   b. Flomatic Valves.
   c. GA Industries, Inc.
   d. Grinnell Corporation.
   e. Hammond Valve.
   f. Metraflex Co.
   g. Milwaukee Valve Company.
   h. Mueller Steam Specialty.
   i. Multiplex Manufacturing Co.
   j. NIBCO INC.
   k. SSI Equipment, Inc.
   m. Valve and Primer Corp.
   n. Or equivalent.

3. Type III, Globe Lift Disc Check Valves:
   a. Durabla Fluid Technology, Inc.
   b. Flomatic Valves.
   c. GA Industries, Inc.
   d. Grinnell Corporation.
   e. Hammond Valve.
   f. Metraflex Co.
   g. Milwaukee Valve Company.
   h. Mueller Steam Specialty.
   i. Multiplex Manufacturing Co.
   j. NIBCO INC.
   k. SSI Equipment, Inc.
   m. Valve and Primer Corp.
   n. Or equivalent.

4. Type IV, Threaded Lift Disc Check Valves:
   a. Check-All Valve Mfg. Co.
   b. Durabla Fluid Technology, Inc.
   c. Grinnell Corporation.
   d. Legend Valve & Fitting, Inc.
   e. Metraflex Co.
   f. Milwaukee Valve Company.
   g. Mueller Steam Specialty.
h. NIBCO INC.
i. Watts Industries, Inc.; Water Products Div.
j. Or equivalent.

B. Lift Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

C. Type I, Class 125, Wafer Lift Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.

D. Type I, Class 250, Wafer Lift Disc Check Valves: Wafer style with cast iron shell with diameter matching companion flanges.

E. Type II, Class 125, Compact Wafer, Lift Disc Check Valves: Compact wafer style with cast-iron shell with diameter made to fit within bolt circle.

F. Type II, Class 250, Compact Wafer, Lift Disc Check Valves: Compact wafer style with cast iron shell with diameter made to fit within bolt circle.

G. Type III, Class 125, Globe Lift Disc Check Valves: Globe style with cast iron shell and flanged ends.

H. Type III, Class 250, Globe Lift-Disc Check Valves: Globe style with cast iron shell and flanged ends.

I. Type IV, Class 125, Threaded Lift Disc Check Valves: Threaded style with bronze shell and threaded ends.

J. Type IV, Class 150, Threaded Lift Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.12 BRONZE GATE VALVES

A. Available Manufacturers:

1. Type 1, Bronze, Nonrising-Stem Gate Valves:
   a. American Valve, Inc.
   b. Cincinnati Valve Co.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Crane Co.; Crane Valve Group; Jenkins Valves.
   e. Crane Co.; Crane Valve Group; Stockham Div.
   f. Grinnell Corporation.
   g. Hammond Valve.
   h. Kitz Corporation of America.
   i. Legend Valve & Fitting, Inc.
   j. Milwaukee Valve Company.
   k. NIBCO INC.
   l. Powell, Wm. Co.
   m. Red-White Valve Corp.
n. Walworth Co.
o. Watts Industries, Inc.; Water Products Div.
p. Or equivalent.

2. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
   a. American Valve, Inc.
   b. Cincinnati Valve Co.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Crane Co.; Crane Valve Group; Jenkins Valves.
   e. Crane Co.; Crane Valve Group; Stockham Div.
   f. Grinnell Corporation.
   g. Hammond Valve.
   h. Kitz Corporation of America.
   i. Milwaukee Valve Company.
   j. NIBCO INC.
   k. Powell, Wm. Co.
   l. Red-White Valve Corp.
   m. Walworth Co.
   n. Or equivalent.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 200, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

D. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.13 CAST IRON GATE VALVES

A. Available Manufacturers:

1. Type I, Cast Iron, Non-rising Stem Gate Valves:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Grinnell Corporation.
   f. Hammond Valve.
   g. Kitz Corporation of America.
   h. Legend Valve & Fitting, Inc.
   i. Milwaukee Valve Company.
   j. NIBCO INC.
   k. Powell, Wm. Co.
   l. Red-White Valve Corp.
   m. Walworth Co.
   o. Or equivalent.
2. Type I, Cast Iron, Rising Stem Gate Valves:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Grinnell Corporation.
   f. Hammond Valve.
   g. Kitz Corporation of America.
   h. Legend Valve & Fitting, Inc.
   i. Milwaukee Valve Company.
   j. NIBCO INC.
   k. Powell, Wm. Co.
   l. Red-White Valve Corp.
   m. Walworth Co.
   o. Or equivalent.

B. Cast Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125, NRS, Bronze Mounted, Cast Iron Gate Valves: Cast iron body with bronze trim, non-rising stem, and solid wedge disc.

D. Class 125, OS&Y, Bronze-Mounted, Cast Iron Gate Valves: Cast iron body with bronze trim, rising stem, and solid wedge disc.

E. Class 125, NRS, All-Iron, Cast Iron Gate Valves: Cast iron body with cast iron trim, non-rising stem, and solid wedge disc.

F. Class 125, OS&Y, All Iron, Cast Iron Gate Valves: Cast iron body with cast iron trim, rising stem, and solid wedge disc.

G. Class 250, NRS, Bronze-Mounted, Cast Iron Gate Valves: Cast iron body with bronze trim, non-rising stem, and solid wedge disc.

H. Class 250, OS&Y, Bronze Mounted, Cast Iron Gate Valves: Cast iron body with bronze trim, rising stem, and solid wedge disc.

I. Class 250, NRS, All Iron, Cast Iron Gate Valves: Cast iron body with cast iron trim, non-rising stem, and solid wedge disc.

J. Class 250, OS&Y, All Iron, Cast Iron Gate Valves: Cast iron body with cast iron trim, rising stem, and solid wedge disc.

2.14 BRONZE GLOBE VALVES

A. Available Manufacturers:
   1. Type 1, Bronze Globe Valves with Metal Disc:
a. Cincinnati Valve Co.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Grinnell Corporation.
f. Hammond Valve.
g. Kitz Corporation of America.
h. Legend Valve & Fitting, Inc.
i. Milwaukee Valve Company.
j. NIBCO INC.
k. Powell, Wm. Co.
l. Red-White Valve Corp.
m. Walworth Co.
n. Or equivalent.

2. Type 2, Bronze Globe Valves with Nonmetallic Disc:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Div.
   e. Grinnell Corporation.
   f. Hammond Valve.
   g. Kitz Corporation of America.
   h. McWane, Inc.; Kennedy Valve Div.
   i. Milwaukee Valve Company.
   j. NIBCO INC.
   k. Powell, Wm. Co.
   l. Red-White Valve Corp.
   m. Walworth Co.
   n. Or equivalent.

B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 200, Bronze Globe Valves: Bronze body with bronze disc and union ring bonnet.

D. Type 2, Class 200, Bronze Globe Valves: Bronze body with nonmetallic PTFE or TFE disc and union ring bonnet.

2.15 CAST IRON GLOBE VALVES

A. Available Manufacturers:

   1. Type I, Cast-Iron Globe Valves with Metal Seats:

      a. Cincinnati Valve Co.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Jenkins Valves.
      d. Crane Co.; Crane Valve Group; Stockham Div.
      e. Grinnell Corporation.
f. Hammond Valve.
g. Kitz Corporation of America.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell, Wm. Co.
k. Red-White Valve Corp.
l. Walworth Co.
m. Or equivalent.


C. Type I, Class 125, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

D. Type I, Class 250, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

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

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service: Angle, ball, butterfly, or globe valves.
B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

C. Domestic Water Piping: Use the following types of valves:

1. Angle Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
5. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
7. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal, bronze.
8. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
9. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
11. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS, bronze-mounted cast iron.
12. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

D. Sanitary Waste and Storm Drainage Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
3. Swing Check Valves, NPS 2 and Smaller: Type 3 or 4, Class 125 or 150, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, gray iron.
5. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 and Larger: 175-psig minimum CWP rating.
6. Gate Valves, NPS 2 and Smaller: Type 1 or 2, Class 125 or 150, bronze.
7. Gate Valves, NPS 2-1/2 and Larger: Type I, Class 125, NRS bronze-mounted cast iron.
8. Globe Valves, NPS 2 and Smaller: Type 1 or 2, Class 125 or 150, bronze.
9. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, cast iron.
10. Plug Valves, NPS 2 and Larger: Class 125 or 150, nonlubricated-type, cast iron.

E. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Grooved-End, Copper Tubing: Valve ends may be grooved.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water flushable, lead free flux; ASTM B 32, lead free alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

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

END OF SECTION 220523
SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.

1.2 DEFINITIONS

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

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.
5. Pipe positioning systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.
15. Or equivalent.
C. Galvanized, Metallic Coatings:  Pre-galvanized or hot dipped.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   3. GS Metals Corp.
   5. Thomas & Betts Corporation.
   6. Tolco Inc.
   7. Unistrut Corp.; Tyco International, Ltd.
   8. Or equivalent.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.
   7. Or equivalent.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.
   c. Masterset Fastening Systems, Inc.
   d. MKT Fastening, LLC.
   e. Powers Fasteners.
   f. Or equivalent.

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

1. Available Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.
   g. Or equivalent.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   - a. Light (MSS Type 31): 750 lb.
   - b. Medium (MSS Type 32): 1500 lb.
   - c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING
A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING
A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
SECTION 220548 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

A. Vibration isolation elements for piping and equipment.

B. Equipment isolation bases.

C. Piping flexible connections.

D. Seismic restraints for isolated piping, equipment.

E. Seismic restraints for non-isolated piping, equipment, tanks etc.

1.03 SUBMITTALS

A. Submit product data, drawings and/or test reports for the following items per the provisions of Division 1 and this division's General Provisions:

1. Catalog cuts and data sheets on specific vibration isolators and restraints to be utilized showing compliance with the specifications.

2. An itemized list showing the items of equipment or piping to be isolated, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawings showing base and construction where applicable.

3. Seismic restraint calculations with structural or civil engineers stamp verifying design and calculations for seismic restraining system used.

4. Drawings showing equipment base construction for each piece of equipment, including dimensions, structural member sizes and support point locations.

5. Drawing showing methods of suspension, support guides for piping.

6. Drawings showing methods for isolation of pipes piercing walls and slabs.

7. Concrete and steel details for bases including anchor bolt locations.

8. Number and location of seismic restraints and anchors for each piece of equipment.

9. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and or pipe.
1.04 QUALITY ASSURANCE

A. Refer to Section 220500: General Provisions for Plumbing Work.

B. Reference Standards.

1. State and local authorities having jurisdiction.

2. SMACNA Guidelines for Seismic Restraints of Mechanical Systems (California projects only).

C. It is the objective of this Specification to provide the necessary design for the seismic restraint and control of excessive noise and vibration in the buildings due to the operation of machinery or equipment, and/or due to interconnected piping. The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer’s representatives.

1. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

2. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50 percent above the design deflection.

3. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as whole by more than plus or minus 10 percent.

4. All neoprene mountings shall have a shore hardness of 30 to 60 plus or minus 5, after minimum aging of 20 days or corresponding oven aging.

1.05 MANUFACTURER RESPONSIBILITIES

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.

2. Provide piping and equipment isolation systems and seismic restraints as scheduled or specified.


4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.

5. Purchased and/or fabricated equipment must be designed to safely accept external forces of one-half "G load in any direction for all rigidly and resiliently supported equipment and piping without failure and permanent displacement of the equipment. Life safety
equipment such as fire pumps, sprinkler piping and machinery must be capable of safely accepting external forces up to one “G” load in any direction without permanent displacement of the supported equipment. Substitution of “Internally Isolated” mechanical equipment in lieu of the specified isolation of this Section must be approved for individual equipment units and is acceptable only if above accelerations are certified in writing by equipment manufacturer and stamped by a licensed civil or structural engineer.

2.00 PRODUCTS

2.01 GENERAL

A. All vibration isolation and seismic devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with the design intent performance, deflection and structural design of the base manufacturer.

2.02 MANUFACTURERS

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

1. Seismic bracing:
   a. Mason Industries Inc.
   b. Midland-Ross Superstrut.
   c. Pipe Shields Inc.
   d. Or equivalent.

2.03 SEISMIC RESTRAINT TYPES

A. General:

1. Shall be capable of safely accepting one-half “G” external forces without failure, or one “G” for life safety equipment. Shall maintain equipment and piping in a captive position. Shall not short circuit vibration isolation systems or transmit objectionable vibration or noise. Shall be provided on all equipment as scheduled on drawings. Calculations by registered Civil or Structural Engineer shall be submitted to verify snubber capacities for each isolated piece of equipment.

   a. Spring Seismic Restraint, Type I:

      1) Shall comply with general characteristics of spring isolators. Shall incorporate snubbing restraint in all directions. Shall be capable of supporting equipment at a fixed elevation during equipment erection. Cast or aluminum housings are not acceptable. System shall be field bolted to deck with 1 G acceleration capability.

      2) Similar to Mason type SSLF or as approved equal.
b. **Seismic Restraint, Type III:**

1) Metal cable type with approved end fastening devices to equipment and structure. Refer to details. System shall be field bolted to deck or overhead structural members on deck on air aircraft cable and clamps.

2) Mason Type Ace Seismic Restraining System or as approved equal.

**B. Vibration Isolator Types:**

1. **Type A:** Spring isolators shall incorporate the following:

   a. Minimum diameter of 0.8 of the loaded operating height.

   b. Corrosion resistance where exposed to corrosive environment with:

   1) Springs cadmium plated or electro-galvanized.

   2) Hardware cadmium plated.

   3) All other metal parts hot-dip galvanized.

   c. Reserve deflection (from loaded to solid height) of 50 percent of rated deflection.

   d. Minimum ¼ inch thick neoprene acoustical base pad on underside, unless designated otherwise.

   e. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

   f. Non-resonant with equipment forcing frequencies or support structure natural frequencies.

   g. Spring isolators to be Mason Type SLF, or as approved equal.

   h. This isolator must be accompanied by seismic isolator Type II.

2. **Type B:** spring isolators shall be same as Type A, except:

   a. Provide built-in vertical limit stops with minimum ¼ inch clearance under normal operation.

   b. Tapped holes in top plate for bolting to equipment when subject to wind load.

   c. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.

   d. Adjustable and removable spring pack with separate neoprene pad isolation.

   e. Housing shall be designed to accept 1 G of acceleration.
f. Mason Type SLR, or as approved equal.

3. Type C: Spring hanger rod isolators shall incorporate the following:
   a. Spring element seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
   b. Steel retainer box encasing the spring and neoprene cup.
   c. Requires seismic restraint Type III.
   d. Mason Type HS, or as approved equal.

4. Type D: Seismic Restraint, Type IV: Double deflection neoprene isolator encased in ductile iron casing minimum .30 static deflection. System shall be field bolted to deck with 1 G acceleration capacity.
   a. Mason Type BR or approved equal.

5. Type E: Elastomer hanger rod isolators shall be incorporate the following:
   a. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
   b. Neoprene element shall be minimum 1¾ inch thick.
   c. Steel retainer box encasing neoprene mounting.
   d. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8 inch.
   e. Minimum static deflection of 0.35 inch.
   f. Requires seismic restraint Type III.
   g. Mason Type HD, or as approved equal.

6. Type F: Combination spring/elastomer hanger rod isolators to incorporate the following:
   b. Characteristics of spring and neoprene as described in Type A and Type E isolators.
   c. Requires seismic restraint Type III.
   d. Mason Type DNHS, or as approved equal.

7. Type G: Pad type elastomer mountings to incorporate the following:
a. 0.750 inch minimum thickness.
b. 50 psi maximum loading.
c. Ribbed or waffled design.
d. 0.10 inch deflection per pad thickness.
e. 1/16 inch galvanized steel plate between multiple layers or pad thickness.
f. Suitable bearing plate to distribute load.
g. Mason Type Super W, or as approved equal.

8. Type H: Pad type elastomer mountings to incorporate the following:
   a. Laminate canvas duck and neoprene.
   b. Maximum loading 1000 psi.
   c. Suitable bearing plate to distribute load.
   d. Minimum thickness, ½ inch.
   e. Mason Type HL, or as approved equal.

9. Type I: Isolated Clevis:
   a. Vibration isolation manufacturer shall provide an isolated clevis hanger for pipe support that combines a unit clevis or rod roller hanger and a Type (C, E or F) isolation hanger into one assembly. System shall be precompressed to allow for rod insertion and standard leveling. Deflections and type shall be as listed in section 3.03 paragraph 5.
   b. Requires seismic restraint Type III.
   c. Mason Type CIH or approved equal.

10. Type J: Rail type spring isolators:
    a. Rail type spring isolators shall provide steel members of sufficient strength to prevent flexure with equipment operation.
    b. Springs shall be the same as Type A with seismic restraint Type II or seismic restraint Type I or IV isolation.
    c. Mason Type ICS, or approved equal.

11. Type K: Pipe anchors:
    a. Vibration isolator manufacturer shall provide an all directional acoustical pipe
anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material.

b. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.

c. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

d. Mason Type ADA, or as approved equal.

2.04 EQUIPMENT BASES

A. Integral Structural Steel Base, Type B-1:

1. Reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units.

2. Shall be utilized with seismic restraint Type I, II, or IV.

3. Mason Type M, WF, or as approved equal.

B. Concrete Inertia Base, Type B-2:

1. Vibration isolator manufacturer shall furnish rectangular structural concrete forms for floating foundation.

2. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells.

3. The base depth shall be a minimum of 1/10 of the longest span, but not less than 6 inches or greater than 14 inches.

4. Forms shall include minimum concrete reinforcement consisting of ½ inch bars or angles welded in place on 6 inch centers running both ways and a layer 1/12 inch above the bottom and a top layer of reinforcing steel as above for all bases exceeding 120 inches in one direction.

5. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain a 1 inch clearance below the base.

6. Bases shall be furnished with templates and anchor bolt sleeves as part of this system. Bases shall be type KIPWF as manufactured by Mason Industries, Inc.

7. Must be utilized with seismic restraint Type I, II, IV.

8. Mason Type K, BMK, KIPWF, or as approved equal.
2.05 FLEXIBLE CONNECTORS

A. Elastomer Type FC-1:
   1. Manufactured of nylon tire cord and EPDM both molded and cured with hydraulic presses.
   2. Straight connectors shall have two spheres reinforced with a molded-in external ductile iron ring between spheres.
   3. Elbow shall be long radius reducing type.
   4. Rated 250 psi at 170°F. dropping in a straight line to 170 psi at 250°F for sizes 1½ inch to 12 inch elbows. Elbows shall be rated no less than 90 percent of straight connections.
   5. Sizes 10 inches and 12 inches to employ control cables with neoprene end fittings isolated from anchor plates by means of ½ inch bridge bearing neoprene bushings.
   6. Minimum safety factor, 4 to 1 at maximum pressure ratings.
   7. Submittals shall include test reports.
   8. Mason Type MFTNC Superflex or as approved equal.

B. Flexible Stainless Hose, Type FC-2:
   1. Braided flexible metal hose.
   2. 2 inch pipe size and smaller with male nipple fittings.
   3. 2½ inch and larger pipe size with fixed steel flanges.
   4. Suitable for operating pressure with 4 to 1 minimum safety factor.
   5. Length as required or shown on drawings.
   6. Mason Type BSS, or as approved equal.

3.00 EXECUTION

3.01 GENERAL

A. All equipment whether isolated or not shall be bolted to structure to allow for minimum ½ G of acceleration. Bolt points and diameter of inserts shall be submitted and verified as part of the contractors submission for each piece of equipment and certified by a licensed civil or structural engineer.

B. All structurally suspended overhead equipment isolated or non-isolated shall be four point independently braced within Type III seismic restraining system.
C. Install seismic restraining system Type III: Taut for overhead suspended non-isolated equipment, piping and slack with ½ inch cable deflection for isolated systems.

D. Seismically restrain all piping and ductwork with Type III restraining system in accordance with guideline as outlined below.

1. Piping to be braced at 40 foot intervals and at turns of more than 4 feet.

E. Seismic restraints are not required for the following:

1. Piping in Boiler and Mechanical Equipment rooms less than 1¼ inch I.D.
2. All other piping less than 2½ inch I.D.
3. All piping suspended by individual hangers 12 inches in length or less from the top of the pipe to the bottom of the support for the hanger.

F. Where base anchoring is insufficient to resist seismic forces supplementary restraining such as seismic restraint system Type III shall be used above systems center of gravity to suitable resist "G" force levels. Vertically mounted tanks may required this additional restraint.

G. For overhead supported equipment, overstress of the building structure must not occur. Bracing can occur from:

1. Flanges of structural beams.
2. Upper or lower truss chords in bar joist construction at the panel points.
3. Cast in place inserts on drilled and shielded inserts in concrete structures.

3.02 SEISMIC RESTRAINTS FOR NON-ISOLATED EQUIPMENT

A. All ceiling suspended piping not excluded by diameter or distance requirement from support:

1. Seismic Restraint type III.

B. All ceiling mounted equipment:

1. Seismic Restraint Type III.

C. All floor mounted equipment, including but not limited to tanks, domestic water heaters, etc.

1. Seismic Restraint Type V.
### SEISMIC ISOLATION SELECTION

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<th>Above Grade</th>
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<td>Mounted up to 10 HP</td>
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<td>Air Compressor or vacuum Tank</td>
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<tr>
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**NOTE:** SR = SEISMIC RESTRAINT

### FIELD QUALITY CONTROL

A. Inspection by manufacturer’s representative of bracing devices.

B. Submit written report to Architect.

1. Include manufacturer’s report indicating required corrections.

2. Include report on steps to properly complete isolation work.

END OF SECTION 220548
SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.
2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Reinforced grommet and wire or string.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
1. Identification Paint: Use for contrasting background.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   b. Hot Water: 1-1/2 inches, square.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553
SECTION 220700 - PLUMBING SYSTEM INSULATION

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

A. Insulation for plumbing/piping and equipment.

1.03 SUBMITTALS

A. Submit product data, drawings and/or test reports for the following items per the provisions of Division 1 and this division's General Provisions:

1. Manufacturers' model numbers, sizes, and types only need be submitted as "Shop Drawings" when base specification material and equipment will be furnished. Submit shop drawings for insulation materials including adhesives (manufacturers' specifications).

2. Submit a schedule listing the work to be insulated and description of insulation and finishing procedures and a certificate indicating compliance with local code.

1.04 QUALITY ASSURANCE

A. Refer to Section 220500: General Provision for Plumbing Work.

B. Reference Standards:

1. Comply with all applicable national, state and local codes and refer to Section GENERAL PROVISION FOR PLUMBING WORK for additional Reference Standards.


3. NFPA 255.

4. Underwriters Laboratories Inc. Label or a Certified Test Report from an independent testing laboratory.

2.00 PRODUCTS

2.01 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements,
manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified

B. Insulating Materials Available Manufacturers:

1. Schuller International.
2. Owens Corning Fiberglas Corp.
5. Zeston 2000 PVC.
7. Or equivalent.

C. Adhesives – Available Manufacturers:

1. Foster Products Division H.B. Fuller Co.
3. Childers Corp.
5. Or equivalent.

2.02 INSULATION

A. Insulation, jackets, adhesives, coatings and accessories shall have a flamespread rating with a maximum of 25 and smoke developed rating with a maximum of 50.

B. Piping insulation shall consist of 3 lb. density fiberglass, one piece molded sectional pipe-covering complying with ASTM C547-95, Type 1, with a maximum K factor of 0.23 at 75°F mean temperature. Where noted, flexible elastomeric thermal insulation having a maximum K factor of 0.27 at 75°F mean temperature, similar to AP Armaflex may be used.

C. Fire retardant all service or all purpose type jacket with a laminate of white kraft paper facing, glass scrim reinforcing and aluminum foil with a self sealing lap for all piping installed within the building. Provide a weatherproof type jacket, for all piping exposed to the weather. The jacket shall consist of aluminum, with a minimum 0.016 in. thickness or stainless steel, with a minimum 0.010 in. thickness. All longitudinal joints shall be provided with lock seams, and circumferential joints shall have butt strips with integral sealant, secured with outer holding band.
2.03 ADHESIVES AND COATINGS

A. Adhesives for laps shall be 85-75, or self-sealing laps may be used. Coating for fittings valves and equipment shall be 30-35 for cold water and 30-36 for hot water. For outdoor aluminum finish, use 60-39 mastic.

2.04 FASTENING DEVICES

A. Copper clad annealed steel wire having a minimum 16 gauge thickness or a pressure sensitive type tape.

3.00 EXECUTION

3.01 INSTALLATION

A. Adhere jackets with adhesive and butt sections of insulation tightly together and adhere 3 in. butt strips of jacket material over joints. At fittings and valves, overlap mastic and fiberglass reinforcing cloth 2 in. onto pipe insulation. Field adhere seams and overlaps with overlap toward wall or ceiling and do not use staples on vapor sealed insulation.

B. Extend insulation, unbroken, through hangers and sleeves, except sleeves through exterior walls. Apply to clean dry surfaces and only after piping has been tested. No hangers will be allowed embedded in insulation.

C. Insulate all water piping at fixtures and equipment, including concealed branch piping in pipe chases, except do not insulate exposed chrome plated water piping at fixtures and equipment.

D. Replace normal insulation inside hanger shields with incompressible insulating block similar to Schuller T-12 Gold inside jacket, or use longer shields at hangers. Refer to General Provisions Section on Piping Supports.

E. Install elastomeric insulation in accordance with manufacturer’s recommendations using fabricated fittings from miter cut insulation. Seal butt joints and seams with contact adhesive applying adhesive to both surfaces. Do not stretch or compress insulation. No additional vapor barrier over insulation is required.

F. Provide 1 inch thick insulation with a vapor barrier jacket on cold water piping. Omit when installed underground. Provide 1 inch thick insulation on chilled water and chilled water circulating piping and 1 inch thick on dead leg branches. On cold surfaces where a vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

G. Hot water, hot water return piping:

1. ½ in. to 1½ in. diameter 1 in. thick.

2. 2 in. to 4 in. diameter 1½ in. thick.
3. 5 in. and larger diameter 2 in. thick.

4. For dead leg branches, provide ½ in. thick fiberglass or elastomeric insulation.

H. For hot water piping with a temperature maintenance electric heating strip, the following insulation thickness apply:

1. For 105°F systems:
   - ½ in. to 2 in. dia. ½ in. thick
   - 2½ in. to 4 in. dia. 1 in. thick

2. For 120°F systems:
   - ½ in. to 1½ in. dia. ½ in. thick
   - 2 in. to 2½ in. dia. 1 in. thick
   - 3 in. and larger 2 in. thick

3. For 140°F systems:
   - ½ in. to ¾ in. dia. ½ in. thick
   - 1 in. to 1½ in. dia. 1 in. thick
   - 2 in. to 2½ in. dia. 1½ in. thick
   - 3 in. and larger 2 in. thick

4. Install insulation on hot water piping only after temperature maintenance heating strip has been tested.

I. Provide frost proofing on piping indicated to be wrapped together with adjacent heating piping with 1½ lb. density flexible blanket with wired on flame resistant reinforced foil, scrim, kraft jacket. Insulate exposed piping provided with heating tracer pipe with 1½ in. thick fiberglass and oversized to fit over pipe and heating tracer. Insulate piping exposed to freezing temperatures as noted for cold water using 4 in. thick fiberglass. Insulate piping with electric heating cable for freeze protection as noted for cold water except with 1½ in. thick fiberglass and oversized to fit over pipe and heating element.

J. Provide sweatproofing, as noted. For insulation on cold water, using the next larger diameter covering over hubs for (exposed) horizontal storm water drainage piping (including vertical up to drain), and chilled water drainage piping between fixture and stack or house drain. For piping 10 in. and larger, a 1 in. thick semi-rigid fiberglass board with vapor sealed jacket may be used.

K. Soundproof piping in walls and ceilings of as noted for insulation on respective service, except with a minimum 2 in. thick fiberglass.

L. Insulate concealed valves with 1 in. thick fiberglass 1 lb. density insulation wired or taped on and
vapor seal cold water and chilled water insulation. Insulate fire hose valves requiring frostproofing as noted for cold water valves, except with 2 in. thick fiberglass. If valves are exposed to weather, finish insulation with outdoor mastic.

M. Insulation for strainers, expansion joints, fittings and accessories requiring servicing or inspection shall be removable and replaceable without damage. Enclose within two-piece, No. 18 gauge aluminum covers fastened with cadmium-plated bolts and nuts. Insulation shall be of same thickness as adjacent piping insulation.

N. Insulate water preheaters, heaters and hot water tanks with 2 in. thick calcium silicate or fiberglass 6.0 lb. density, rigid insulation, secured with wire, pointed up with insulating cement, coat of mastic, wrapping of fiberglass reinforcing cloth, and a finish coat of mastic. Insulate instantaneous water heaters with 3 in. thick fiberglass, as noted for hot water piping.

O. Insulate exposed portion of metal hot water heater flues with 1 in. thick calcium silicate sectional covering with field adhered jacket. Fittings shall be built up to full thickness with insulating cement, coat of mastic, wrapping of fiberglass reinforcing cloth, and a finish coat of mastic.

P. Insulate hydropneumatic pressure tanks with 1 in. thick fiberglass 6.0 lb. density rigid insulation secured with wire, coated with insulating cement, coat of mastic, wrapping of fiberglass reinforcing cloth, and a finish coat of mastic.

Q. Wrap domestic water meter assembly and backflow preventers with 1 in. thick fiberglass, 1 lb. density insulation, wired or taped on, coat of insulating cement, coat of mastic, wrapping of fiberglass reinforcing cloth, and a finish coat of mastic.

3.02 FIELD QUALITY CONTROL

A. Repair separation of joints of insulation due to thermal movement or poor workmanship.

END OF SECTION 220700
SECTION 220800 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. OPR, BoD, and BoD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

C. Specification Division 23 Section 230800 Commissioning of Mechanical Systems

1.2 SUMMARY

A. Refer to Division 23 Section 230800 for the requirements for commissioning the Plumbing system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

2. Division 23 Section 230800 Commissioning of Mechanical Systems

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BoD: Basis of Design.

C. BoD-Plumbing: Plumbing systems basis of design.

D. CxA: Commissioning Authority.

E. OPR: Owner's Project Requirements.

F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."
B. Each Contractor:

1. Attend procedures meeting for TAB Work.

C. Plumbing and Mechanical Contractor:

1. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."

B. BoD Plumbing: Owner will provide BoD-Plumbing documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA shall develop test checklists for Plumbing systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences.
4. Electrical demand or power input at specified conditions.
5. Power quality and related measurements.
6. Expected performance of systems, subsystems, and equipment at each step of test.
7. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
8. Interaction of auxiliary equipment.
9. Issues log.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."
B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed.

E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

G. Corrective Action Documents: CxA shall submit corrective action documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Refer to Division 23 Section 230800.

END OF SECTION 22080
SECTION 221116 - DOMESTIC WATER SUPPLY SYSTEMS

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

A. Work in this Section includes the providing of labor, materials, equipment and services necessary for a complete and safe installation in accordance with the contract documents and all applicable codes and authorities having jurisdiction for the following:

1. Extension of existing domestic water systems to accommodate the new layout including required final connections to plumbing fixtures and equipment.

1.03 QUALITY ASSURANCE

A. Refer to Section 220500: General Provision for Plumbing Work.

B. Reference Standards.


2. American Society of Sanitary Engineering:

a. ASSE 1001: Pipe Applied Vacuum Breakers.


c. ASSE 1010: Water Hammer Arrestors.

d. ASSE 1011: Vacuum Breakers, Hose Connection.

e. ASSE 1013: Reduced Pressure Zone Device.

f. ASSE 1015: Double Check Valve Assembly.

g. ASSE 1017: Thermostatic Mixing Valves, Self Activating for Primary Domestic Use.

h. ASSE 1018: Trap Seal Primer Valves.

i. ASSE 1019: Wall Hydrants Frostproof Automatic Drainage Anti-Backflow Type.

j. ASSE 1020: Vacuum Breakers, Anti Siphon Pressure Type.
k. ASSE 1024: Dual Check Valve Type Back Flow Preventers.
l. ASSE 1028: Automatic Flow Restrictors.
m. ASSE 1029 Water Supply Mixing Valves and Single Control Mixing Valves.
n. ASSE 1032: Dual Check Valve Type Back Flow Preventer for Carbonated Beverage Dispenser.
o. ASSE 1034: Fixed Flow Restrictors.
p. ASSE 1046: Thermal Expansion Relief Valve.


4. Plumbing and Drainage Institute (PDI).

1.04 SUBMITTALS

A. Submit product data, drawings and/or test reports for the following items per the provisions of Division 1 and this division's General Provisions:

1. Pipe and fittings, valves and shock absorbers.
2. Air gaps.
3. Vacuum breakers.
5. Trap seal primer valves.
7. Pressure reducing valves.
8. Thermometers.
9. Auto air relief valves.
10. Thermostatic tempering valves.
11. Thermostatic mixing valves.

B. Manufacturers' model numbers, sizes, and types only need to be submitted as "Shop Drawings" for items marked with an *, when base specification material and equipment will be provided.

C. Submit shop drawings for the following:
2.00 PRODUCTS

2.01 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified

B. Gate and check valves (interior):

1. Available Manufacturers:
   a. Stockham Valves and Fittings
   b. Crane Co.
   c. Wm. Powell Valve Co.
   d. Nibco, Lunkenheimer Co.
   e. Milwaukee Valve Co.
   f. Or equivalent.

C. Valves (underground only):

1. Available Manufacturers:
   a. Kennedy Valve Co.
   b. Mueller Co.
   c. Clow Corp.
   d. American Darling Valve Co.
   e. Or equivalent.

D. Noiseless Check Valves:

1. Available Manufacturers:
   a. Williams Gauge Co. (Clow).
   b. Smolensky Valve Co.
   c. Mueller Steam Specialty Co.
d. Mission Valve and Pump Co.

e. Or equivalent.

E. Butterfly Valves:

1. Available Manufacturers:
   a. Crane Co.
   b. Victaulic Co.
   c. Stockham Valves & Fittings.
   d. Milwaukee Valve Co.
   e. De Zurik.
   f. Or equivalent.

F. Ball Valves:

1. Available Manufacturers:
   a. Lunkenheimer.
   b. Crane Co.
   c. Nibco.
   d. Stockham Valves & Fittings.
   e. Watts Regulator Co.
   f. Apollo (Conbraco Industries, Inc.).
   g. Or equivalent.

G. Shock Absorbers:

1. Available Manufacturers:
   b. Zurn Industries Inc.
   c. Wade Div. Tyler Pipe.
   d. Or equivalent.
H. Pressure Gauges:

1. Available Manufacturers:
   a. Ashcroft Amer. Gauge Co.
   b. U.S. Gauge Co.
   c. Weksler Instruments Corp.
   d. H.O. Trerice Co.
   e. Or equivalent.

I. Backflow Preventers:

1. Available Manufacturers:
   a. Watts Regulator Co.
   b. Febco Sales Inc.
   c. Conbraco.
   d. Or equivalent.

J. Branch Pressure Reducing Valves:

1. Available Manufacturers:
   a. Watts Regulator Co.
   c. Honeywell Braukmann Inc.
   d. Wilkins Regulator Co.
   e. Conbraco.
   f. Or equivalent.

K. Strainers:

1. Available Manufacturers:
   a. Sarco Co.
   b. Mueller.
c. Watts Regulator Co.
d. Conbraco.
e. Or equivalent.

L. Automatic Air Relief Valves:
   1. Available Manufacturers:
      a. Hoffman Specialty ITT.
      c. Sarco Co.
      d. APCO Valve.
      e. Primer Co.
      f. Or equivalent.

M. Grooved MI fittings and couplings for grooved pipe:
   1. Available Manufacturers:
      a. Gruvlok
      b. Victaulic Co.
      c. Or equivalent.

2.02 PIPING

I. Service: Incoming water service below grade.

   A. Maximum Design:
      1. Pressure: 100 psig.
      2. Temperature: 200 degrees F.

   B. Pipe: Ductile iron pressure pipe; Class 52, bituminous coated outside; AWWA C151/ANSI A21.51. All components of system for water service shall conform to NSF-61.

   C. Lining: Cement-mortar; AWWA C104/ANSI A21.4, Fusion-Bonded epoxy; AWWA C116, or Ceramic epoxy; American Pipe Protecto 401, NSF-61. To match site water piping.

   D. Joints: Mechanical, or push-on type; AWWA C111/ANSI A21.11.
E. Fittings: Mechanical joint, ductile iron, bituminous coated outside; AWWA C110/ANSI A21.10. Cement lined; ANSI A21.4, Fusion-Bonded epoxy; AWWA C116 or Ceramic epoxy; American Pipe Protecto 401. To match site water piping.

F. Gaskets: Molded rubber compression type for push on joint, ANSI A21.11 and/or full face for flanged joints, 1/8 inch thick rubber, gasket ID must match pipe ID.

G. Bolting: Tee-head bolts and hex nuts, material and threading, ANSI A21.11.

H. Lubricant, If Required: ANSI A21.11.

I. Mechanical Joint Installation: ANSI A21.11.

II. Service: Domestic use water above grade 4 inch and smaller.

A. Maximum Design:
   1. Pressure: 150 psig.
   2. Temperature: 150 degrees F.

B. Pipe: Type L hard drawn seamless copper tubing, ASTM B88. All components of system shall conform to NSF-61.

C. Joints: Soldered with grade HB lead-free solder (lead content not more than 0.1 percent); ASTM B32, ANSI/AWS A5.8, NSF-61 Certified; J. W. Harris, Bridgit.

D. Fittings: Wrought copper, soldered ends; ANSI B16.22.

E. Flanges: 150 psi, cast bronze, flat face; ANSI B16.18.

F. Gaskets: Full face, 1/8 inch thick rubber, gasket ID must match pipe ID.

G. Ball Valves, 2 Inch and Smaller: 600 psi WOG, two piece bronze body, full port, soldered connections, chrome plated ball, TFE seats and packing, extended lever handle; MSS SP-110. Nibco Figure S-585-70.

H. Keylock Valves: Same as ball valve except with locking handle.

I. Check Valves:
   1. 2 Inch and Smaller: Class 125, 200 psi, bronze, horizontal, wye pattern swing check, renewable bronze disc, soldered connections. MSS SP-80; Nibco Figure S-413-B.
   2. 3 Inch and 4 Inch: Class 125, 200 psi, bronze, horizontal swing check, renewable bronze disc and plugs, flanged ends, MSS SP-71 Type 1; Nibco Figure F-918-B.

J. Butterfly Valves, 3 Inch and 4 Inch: 200 psi ductile iron body lug style, aluminum bronze disc, EPDM seat, multi-position locking handle. MSS SP-67 Nibco Figure LC2000.

K. Globe Valves: Class 150, 300 psi, bronze, soldered ends, union bonnet, renewable seat and disc. MSS SP-80; Nibco Figure S-235.
L. Drain Valves: 1/2 Inch and 3/4 inch: 600 psi WOG, two piece bronze body, full port, soldered connection on one end and 3/4 inch hose connection with cap and chain on the other, chrome plated [stainless steel] ball, TFE seats and packing, extended lever handle; MSS SP-110. Nibco Figure S-585-70-HC.

M. Dielectric fittings: Unions; Female threaded by solder ends, zinc plated steel, brass and copper; Watts Regulator Series 3000. OR Flanges: Female iron pipe thread by solder connections, grey iron, steel, brass and copper, complete with gasket, insulating washers, bolt insulators and hardware; Watts Regulator Series 3100. OR Waterways: Zinc electroplated steel pipe with high temperature stabilized polyethylene liner, threaded or grooved ends; Victaulic Style 47.

III. Service: Domestic use water below grade 2 inch and smaller.

B. Maximum Design:

1. Pressure: 150 psig.
2. Temperature: 150 degrees F.

C. Pipe: Type K soft annealed seamless copper tubing; ASTM B88. All components of system shall conform to NSF-61.

D. Joints: Soldered with grade HB lead-free solder (lead content not more than 0.1 percent); ASTM B32, ANSI/AWS A5.8, NSF-61 Certified; J. W. Harris, Bridgit.


F. Ball Valves, 2 Inch and Smaller: 600 psi WOG, two piece bronze body, full port, soldered connections, chrome plated ball, TFE seats and packing, extended lever handle; MSS SP-110. Nibco Figure S-585-70.

G. Check Valves: 125 psi, bronze, swing check, renewable bronze disc, soldered connections; MSS SP-80. Nibco Figure S-413-B

2.03 FLOW BALANCING VALVES AND METERS (INDICATORS)

A. Available Manufacturers:

1. Armstrong, Series CBV.
2. Bell & Gossett, Model CB Circuit Setter.
3. Illinois, Series 6000.
4. Or equivalent.

B. Balance Valve: Calibrated brass or bronze construction with provisions for connecting a portable differential pressure meter.

1. Provide meter connection with built-in check valves.
2. An integral pointer shall register degree of valve opening.

3. Construct valves with internal seals to prevent leakage around rotation element.

4. Calibrated curve and determine flow rate by means of pressure drop and valve setting.

5. Construct valves for 300 psi working pressure at 250 degrees. Provide insulation suitable for use on heating and cooling systems.

C. Meter: Bell and Gossett Model RO-3 portable differential meter, with provisions for hanging and that will indicate readings in feet of water.

   1. Accuracy + 1.0 percent full scale.
   2. Provide necessary shutoff valves and purge valves.
   3. Provide hoses (10 feet long) with leak proof threaded connections, suitable for working pressure for 125 psi at 250 degrees.

D. Provide on hot water return piping and where noted.

2.04 DRAIN VALVES

A. On all low points in water piping. Provide ¾ inch bronze ball valves. Valve shall be 600 psig wog, chrome plated ball, teflon seat, and shall be similar to Apollo No. 70-804. Valve shall be provided with a ¾ inch garden hose end for connection to a non-removable vacuum breaker, similar to Watts No. 8A or Conbraco Model No. 38-304.

2.05 WATER HAMMER ARRESTERS

A. Provide water hammer arresters on individual water branches to equipment and/or with solenoid valves and with fixtures with single control or quick shut-off capabilities.

B. Water hammer arrestors shall have a threaded stainless steel casing, and stainless steel or neoprene bellows, similar to Smith Series No. 5000. Certification, sizing and placement shall be in accordance with the Plumbing and Drainage Institute (P.D.I.) standards and meet ASSE requirements. Sizing and placement data for selecting proper arrestor shall be submitted as a shop drawing for each application. For concealed installation, provide with access panel.

2.06 AIR GAPS

A. Brass body, threaded inlet and oversized threaded outlet, similar to Smith No. 3950 (up to ¼ inch) and Smith No. 3951 (larger than ¼ inch), in accordance with ANSI Standard A112.1.2.

2.07 VACUUM BREAKERS

A. For plumbing fixtures, provide as specified under Plumbing Fixtures Section.

B. Hose outlets, unless otherwise noted shall have cast brass body with rubber or flap type valve, ¼ inch female hose thread inlet and ¼ inch male hose threaded outlet, similar to Watts No. NF8 or No. 8A, similarly plated as hose outlet, and in accordance with ASSE Standard No. 1011.
C. On water lines where there is non-continuous pressure and where the water lines are not subject to back pressure, provide a cast brass body, with full size orifice, atmospheric type, similar to Watts No. 288A in accordance with ASSE Standard No. 1001.

D. On water lines that are subject to pressure, provide complete with double spring loaded check valves, atmospheric vacuum breaker, test cocks, and inlet and outlet rising stem gate valves, 150 psig wwp, galvanized or epoxy-lined cast iron with bronze or stainless steel trim, similar to Febco No. 805, 805Y. Provide pressure types in accordance with ASSE Standard No. 1015.

2.08 BACKFLOW PREVENTERS

A. As Specified on drawings.

2.09 TRAP SEAL PRIMER VALVES

A. As specified on drawings.

2.10 BRANCH PRESSURE-REDUCING VALVES

A. 250 psig class with renewable stainless steel or nickel seat, adjustable direct acting single seat spring-actuated diaphragm type with sealed cage. Valves 2½ inches and smaller shall be threaded bronze body; valves three inches and larger shall be flanged, coated-iron body. Valves shall be capable of reducing a varying inlet pressure to a constant-flowing outlet pressure with pressures, as noted, similar to Conbraco Model No. 36H or Watts No. 223 and No. SC-N223 and listed under ASSE Standard No. 1003.

2.11 STRAINERS

A. For strainers two (2) inches and smaller, provide threaded bronze body with type 304 stainless steel screen, similar to Sarco Type BT or Conbraco 59 Series.

B. For strainers 2½ inches and larger, provide flanged cast iron body with type 304 stainless steel screen, 125 psig wsp, similar to Sarco IF-125, or 250 psig wsp, similar to Sarco AF-250.

C. Provide for master pressure-reducing valves and as noted.

2.12 AUTOMATIC AIR RELIEF VALVES

A. Provide ¾ inch, cast brass construction, 150 psig wwp, similar to Hoffman Specialty No. 78. Locate on all high points in hot water and hot water return piping and where noted.

2.13 THERMOSTATIC MIXING VALVES

A. Refer to Thermostatic Valve Schedule on drawings.

2.14 PRESSURE GAUGES

A. Provide 4 inch diameter, black enamel cast aluminum case, black epoxy coated steel ring with shatterproof glass, stainless steel movement with bronze pinion and segment shaft, similar to Ashcroft Type 1010, having dial with suitable range, brass pressure snubber and brass tee-handle cock.
B. Provide 4 inch diameter, black enamel cast iron or cast aluminum case, threaded aluminum ring with shatterproof glass, phosphor bronze single spring bourdon tube, stainless steel rotary precision movement, micrometer adjustment pointer, similar to Ashcroft Duraguage Type 1379, having dial with suitable range, brass pressure snubber and brass tee-handle cock.

C. Locate pressure gauges on water services, inlet and outlet of each master pressure reducing valve assembly, suction and discharge of pumps, and as noted. Select dial so that operating range falls in the middle of the dial selected.

3.00 EXECUTION

3.01 GENERAL

A. Piping shall be run concealed in all finished areas where possible and so arranged that it can be drained at low points.

B. Plumbing piping systems and equipment shall be installed to resist seismic loads and forces. Refer to specific paragraphs pertaining to seismic piping supports, hangers and equipment anchorage in Section 220500: GENERAL PROVISION FOR PLUMBING WORK and Section 220548: SEISMIC RESTRAINTS - PLUMBING.

C. Water piping shall be supported so there is no sagging or noise due to vibration.

D. The run and arrangement of all pipes shall be approximately as shown on the Drawings. Contractor shall adjust location of runs, if required, due to interferences with structure or other trades. Installation shall be as straight and direct as possible, evenly spaced, forming right angles or parallel line with building walls and other pipes. All risers shall be erected plumb and true. The work under this Section shall be coordinated with the work of the other Sections in order to avoid interferences of piping and unnecessary cutting of floors and walls. All roughing, underground piping or concealed in floors or walls, shall be installed and tested before the construction is closed up.

E. All horizontal runs of piping, except where concealed in partitions, shall be kept as high as possible and close to walls. Other trades shall be consulted so that grouped lines will not interfere with each other. Where Drawings call for offsets, they shall be kept close to underside of beams and slabs and run alongside beams, girders or partitions.

F. Provide all bases and supports not part of the building structure and not specifically indicated to be provided under other Divisions.

G. Provide access doors for all concealed valves, equipment and cleanouts located in wall, ceiling or column construction. Furnish and install cleanouts located in wall, ceiling or column construction. Turn all access doors over to the General Contractor for installation.

H. No pipes or devices shall be installed in such a manner as to interfere in any way with the full swing of doors or maintenance access to equipment.

I. Should it be necessary to correct piping improperly installed, this Contractor shall be held liable for any and all damage to other work resulting from the improper piping conditions.
J. The Contractor is responsible for accurately laying out the work. Should it be found that any work is so laid out that interference will occur, he shall report such interference to the Engineer prior to installing work.

K. Pitch all hose bibb water supply piping to low points to allow complete drainage of piping system in winter (freezing climates only).

L. Connections between ferrous and non-ferrous pipe shall be made with dielectric adapter fittings.

M. Protect all plumbing fixtures against damage. Damaged fixtures shall be replaced.

N. For any exposed, uninsulated piping located in finished areas:
   1. Provide chrome-plated pipe.
   2. Where piping passes through walls, floor or ceiling provide chrome-plated escutcheons.

3.02 PRESSURE PIPING DETAILS

A. Whether or not specifically shown on the Drawings, valves shall be provided at the following locations:
   1. All branches and risers off mains.
   2. All divisions of mains.
   3. Supply connections to fixtures or other apparatus.
   4. To and from all equipment.
   5. Any locations required by Ordinances, Codes or Regulations.

B. Unions shall be used at connections to fixtures and other apparatus.

3.03 TESTS AND ADJUSTMENTS

A. Per local codes.

B. Test all portions of the domestic hot, cold and recirculating water piping with water at 150 PSIG. Test shall remain on system for three (3) hours without drop in pressure.

C. Test all piping system valves for leak-tight closure when subjected to normal operating pressures.

D. Test all concealed or buried piping before closing in construction or backfilling. All tests shall be performed before applying insulation.

E. Test all equipment controls for proper performance and make all necessary adjustments in the presence of a factory-authorized representative of the equipment manufacturer.

F. Perform any additional tests required by the local Plumbing Inspector. All tests on the plumbing system shall be performed to the satisfaction of the local Plumbing Inspector and the Owner's
representative.

3.04 DISINFECTION

A. Per local codes.

B. Disinfect all potable water piping systems at the completion of the project prior to building occupancy as follows:

1. Flush thoroughly with potable water.

2. Fill system with a water-chlorine solution containing 50 parts per million of chlorine and allow to stand for 24 hours or fill system with a water-chlorine solution containing 200 parts per million of chlorine and allow to stand for three hours.

3. Flush system with potable water to remove all chlorine. Perform any additional tests or treatments as required by the local authority.

END OF SECTION 221116
SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

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 domestic water piping specialties:
   1. Vacuum breakers.
   2. Backflow preventers.
   5. Temperature-actuated water mixing valves.
   7. Outlet boxes.
   8. Hose bibbs.
   9. Wall hydrants.
  10. Drain valves.
  12. Air vents.
  13. Trap-seal primer valves.
  14. Trap-seal primer systems.

B. Related Sections include the following:
   1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.
1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

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

   a. Ames Co.
   b. Conbraco Industries, Inc.
   d. Or equivalent.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

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

   a. Arrowhead Brass Products, Inc.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. Legend Valve.
   e. MIFAB, Inc.
   f. Prier Products, Inc.
   g. Watts Industries, Inc.; Water Products Div.
   h. Woodford Manufacturing Company.
   i. Or equivalent.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   e. Or equivalent.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
   a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   c. Or equivalent.

3. Operation: Continuous-pressure applications.
   a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   c. Or equivalent.

2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
5. End Connections: Solder joint.
6. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   d. Or equivalent.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

C. Double-Check Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   c. Or equivalent.

3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
a. **Valves:** Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

**D. Beverage-Dispensing-Equipment Backflow Preventers:**

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   c. Or equivalent.

2. **Standard:** ASSE 1022.
3. **Operation:** Continuous-pressure applications.
4. **Size:** NPS 1/4 or NPS 3/8.
5. **Body:** Stainless steel.
6. **End Connections:** Threaded.

**E. Dual-Check-Valve Backflow Preventers:**

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   b. Legend Valve.
   c. Mueller Co.; Water Products Div.
   e. Or equivalent.

2. **Standard:** ASSE 1024.
3. **Operation:** Continuous-pressure applications.
4. **Body:** Bronze with union inlet.

**F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:**

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cash Acme.
   b. Lancer Corporation.
   d. Or equivalent.

2. **Standard:** ASSE 1032.
3. **Operation:** Continuous-pressure applications.
4. **Size:** NPS 1/4 or NPS 3/8.
5. **Body:** Stainless steel.

G. Reduced-Pressure-Detector, Fire-Protection Backflow-Preventer Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. Ames Co.
   b. Conbraco Industries, Inc.
   d. Or equivalent.

2. Standard: ASSE 1047 and FMG approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved or Stainless steel.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
   
   a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
   c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Hose-Connection Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. Conbraco Industries, Inc.
   c. Woodford Manufacturing Company.
   d. Or equivalent.

3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

I. Backflow-Preventer Test Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. Conbraco Industries, Inc.
b. FEBCO; SPX Valves & Controls.
d. Or equivalent.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   e. Or equivalent.

4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Flo Fab Inc.
   c. ITT Industries; Bell & Gossett Div.
   d. NIBCO INC.
   e. TAC Americas.
   f. Taco, Inc.
   g. Watts Industries, Inc.; Water Products Div.
   h. Or equivalent.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
b. Flo Fab Inc.
c. ITT Industries; Bell & Gossett Div.
d. NIBCO INC.
e. TAC Americas.
g. Or equivalent.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.

3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corp.
i. Or equivalent.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.

3. Pressure Rating: 400-psig minimum CWP.

4. Size: NPS 2 or smaller.

5. Body: Copper alloy.

6. Port: Standard or full port.

7. Ball: Chrome-plated brass.

8. Seats and Seals: Replaceable.

9. End Connections: Solder joint or threaded.


E. Primary, Thermostatic, Water Mixing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.
   d. Powers; a Watts Industries Co.
   e. Symmons Industries, Inc.
   f. Or equivalent.

4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

F. Individual-Fixture, Water Tempering Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. Honeywell Water Controls.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company.
   f. Powers; a Watts Industries Co.
   g. Watts Industries, Inc.; Water Products Div.
   h. Or equivalent.

3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.

3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

4. Screen: Stainless steel with round perforations, unless otherwise indicated.

5. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch
   c. Strainers NPS 5 and Larger: 0.125 inch.

2.6 OUTLET BOXES

A. Clothes Washer Outlet Boxes:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Guy Gray Manufacturing Co., Inc.
      c. Symmons Industries, Inc.
      e. Whitehall Manufacturing; a div. of Acorn Engineering Company.
      f. Or equivalent.
   3. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic or Stainless-steel box and faceplate.
   4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
   5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
   6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
   7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
   8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

2.7 HOSE BIBBS

A. Hose Bibbs:
   4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
   5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   c. Tyler Pipe; Wade Div.
   d. Watts Drainage Products Inc.
   e. Woodford Manufacturing Company.
   f. Or equivalent.

4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Chrome plated.
12. Operating Keys(s): One with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

2. Pressure Rating: 400-psig minimum CWP.
4. Body: Copper alloy.
5. **Ball:** Chrome-plated brass.
6. **Seats and Seals:** Replaceable.
7. **Handle:** Vinyl-covered steel.
8. **Inlet:** Threaded or solder joint.
9. **Outlet:** Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

**B. Stop-and-Waste Drain Valves:**

1. **Standard:** MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. **Pressure Rating:** 200-psig minimum CWP or Class 125.
3. **Size:** NPS 3/4.
4. **Body:** Copper alloy or ASTM B 62 bronze.
5. **Drain:** NPS 1/8 side outlet with cap.

### 2.10 WATER HAMMER ARRESTERS

**A. Water Hammer Arresters:**

1. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   e. Tyler Pipe; Wade Div.
   f. Or equivalent.
2. **Standard:** ASSE 1010 or PDI-WH 201.
3. **Type:** Metal bellows.
4. **Size:** ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

**B. Welded-Construction Automatic Air Vents:**

1. **Body:** Stainless steel.
2. **Pressure Rating:** 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.

2.12 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   e. Or equivalent.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Or equivalent.


PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

J. Install water hammer arresters in water piping according to PDI-WH 201.

K. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

L. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
5. Carbonated-beverage-machine backflow preventers.
7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
13. Primary water tempering valves.
15. Hose stations.
17. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.
B. Set field-adjustable flow set points of balancing valves.
C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119
SECTION 221316 – SANITARY WASTE AND VENT PIPING

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

A. Soil, waste, and vent systems inside building and to points indicated.

1.03 QUALITY ASSURANCE

A. Refer to Section 220500: GENERAL PROVISION FOR PLUMBING WORK.

1.04 SUBMITTALS

A. Submit product data and drawings for the following items per the provisions of Division 1 and this division's General Provisions:

1. Pipe and fittings.
2. Valves.*
3. Cleanouts.*
4. Drains.*
5. Backwater valves.*
6. Electric temperature maintenance cable.*

B. Manufacturers' model numbers, sizes, and types only need be submitted as "Shop Drawings" for items marked with a * when base specification material and equipment will be provided.

2.00 PRODUCTS

2.01 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.02 FITTINGS – Available Manufacturers
A. Floor and Roof Drains, CO Deck Plates, and Backwater Valves:
   3. Or equivalent.

B. Shut-off Valves:
   1. Crane Co.
   2. Stockham Valves and Fittings.
   5. Or equivalent.

C. Backwater valves:
   2. Zurn.
   3. Wade Tyler.
   4. Or equivalent.

D. Noiseless Check Valves:
   1. Williams Gauge Co. (Clow).
   2. Smolensky Valve Co.
   5. General Filter Co.
   6. Or equivalent.

E. Heavy-Duty No Hub Couplings:
   1. Clamp All 125.
   2. Husky SD4000.
3. Tyler WB.
4. Or equivalent.

F. No Hub Couplings:
   1. Anaco.
   2. Tyler.
   4. M.G. Coupling.
   5. Or equivalent.

G. Grooved MI Fittings and Couplings for Grooved Pipe:
   1. Gruvlok Co.
   3. Victaulic Co.
   4. Or equivalent.

H. Electric Self-Regulating Temperature Maintenance Cable:
   1. Raychem Corporation.
   2. Thermon Commercial Products Division.
   3. Or equivalent.

2.03 PIPING

A. The following materials are acceptable for sanitary and vent except as noted:

B. Service:

I. Sanitary waste below grade.
   1. Maximum Design:
      a. Pressure: Gravity Vented.
      b. Temperature: 140 degrees F (60 degrees C).
   2. Pipe: Bell and spigot, extra heavy weight cast iron soil pipe; ASTM A74, CISPI Standard 301 and NSF International listed.

4. Fittings: Bell and spigot, cast iron; ASTM/ANSI A74, CISPI Standard 301 and NSF International listed.

C. Service:

I. Sanitary waste above grade.

1. Maximum Design:
   a. Pressure: Gravity Vented.
   b. Temperature: 140 degrees F.

2. Pipe: 8 inch and smaller; hubless, cast iron soil pipe; ASTM A888, CISPI 301 and NSF International listed.


4. Fittings: Hubless, cast iron; ASTM A888, CISPI 301 and NSF International listed.

D. CP brass piping for all hospital equipment including sinks, exposed sterilizers, and fixtures and equipment exposed in finished areas.

2.04 TRAPS

A. Provide fixture type as noted under Section 224000: Plumbing Fixtures. In other locations provide deep seal P or running type as noted. For running traps provide one cleanout; for house traps provide two cleanouts. Provide traps for floor, area, and funnel drains and connections to fixtures and equipment.

2.05 CAST IRON TEST TEE EXPANSION JOINTS

A. Provide expansion joints every 150 ft. on vertical drainage and vent lines and where noted or required.

2.06 EXPANSION JOINTS

A. Provide expansion joints with galvanized cast iron parts, bolted packing gland and bronze sleeve similar to Smith No. 1710.

2.07 ADAPTERS

A. Provide tile-cast iron adapters with extra heavy cast iron hub and spigot type, similar to Josam Series 88700.

2.08 VALVES

A. Provide valves as noted under Section 221116: Domestic Water Supply Systems (except for
butterfly valves), and as follows which are listed with an Available Manufacturer – provide listed manufacturer or an approved equal:

1. Shut-off valves 3 in. and smaller: Provide threaded bronze rising stem gate type, 200 PSIG wog, similar to Stockham No. B-107 or Milwaukee No. 105 (NRS) (R.S.) 1152.

2. Shut-off valves four in. and larger: Provide OS&Y flanged IBBM gate type, 200 PSIG wog, similar to Stockham No. G-623 or Milwaukee F2885-M.

3. For underground gravity drainage piping, provide coated cast iron hub end body, brass seat and gate, non-rising stem, cast iron cover and wheel handle, similar to Smith Series 7150, modified with required extension stem and cast iron enclosing pipe up to floor or grade level.

4. Check valves 3 in. and smaller except as noted: Provide threaded bronze swing type, 200 PSIG wog, similar to Stockham No. B-319 or Milwaukee 509.

5. Check valves four in. and larger except as noted: Provide flanged IBBM swing type, 125 PSIG wsp; 200 PSIG wog, shall be similar to Stockham G-931 or Milwaukee F2974-M.

2.09 CLEANOUTS

A. General:

1. Provide cast bronze cleanouts in accordance with ANSI A112.36.2. full size up to four in., and at least-half size for larger pipes, but with four in. minimum.

2. Provide integral flashing flange and clamping ring in floors with built up membrane. Provide four in. wide flange in floors with liquid membrane. Provide four in. wide flange at required depth in floors with elastomeric membrane.

B. In or behind walls and partitions, provide cast bronze plugs with satin finish CP brass, nickel bronze or stainless steel wall plates, similar to Smith No. 4532.

C. Where cleanouts are provided for piping buried in or under floor or in inaccessible hung ceilings, extend piping and terminate with the following type deckplates, except as noted:

1. Provide cleanouts similar to Smith No. 4890.

2. Provide cleanouts in tiled areas recessed for tile, similar to Smith No. 4148.

3. In terrazzo areas, provide round-top cleanouts recessed for terrazzo, similar to Smith No. 4188 and square top recessed for terrazzo, similar to Smith No. 4208.

4. Provide heavy duty type cleanouts with secured top in wheeled traffic areas, similar to Smith No. 4108 and to Smith No. 4228. Fill adjustment space with hot mastic.

5. Provide cleanouts in elastomeric type floors, similar to Smith No. DX-4890.

6. In membrane waterproofed floors, provide bronze taper thread CO plug and an
adjustable cast extension neck, similar to Smith 4128.

a. In tiled areas, recessed for tile, provide round top, similar to Smith No. 4148 and to Smith No. 4168.

b. Cleanouts in terrazzo areas, provide recessed for terrazzo, round top, similar to Smith No. 4188 and square top, similar to Smith No. 4208.

D. Provide bronze top cleanouts in machinery and storage rooms. Provide satin finish nickel bronze top cleanouts elsewhere. Provide two spanner wrenches of each size used.

E. Provide cleanouts for piping buried in or under floor, and extend piping and terminate with flush cast bronze plugs, similar to Smith No. 4283.

2.10 FLOOR DRAINS

A. General:

1. Provide floor drains in accordance with ANSI A112.21.1 and where required for the following construction types. For built up membrane, provide a flashing clamp. For liquid membrane, provide a four-in. wide flange. For elastomeric type floor, provide a four-in. wide top flange at required height. Provide strainers with a nickel bronze finish except as noted.

2. Provide a coated cast iron body, except as noted, with integral double drainage flange and weep holes, inside caulked outlet or hub outlet for compression gasket connection, or hubless outlet except as noted.

B. Type as specified on drawings

2.12 FIXED AIR GAP

A. Provide a fixed air gap conforming to ANSI A112.1.2. in chromium plated cast bronze, similar to Smith Fig. 3951 or Fig. 3955.

2.13 ELECTRIC SELF REGULATING TEMPERATURE MAINTENANCE CABLE

A. Provide a UL listed Freeze Protection Strip System similar to Raychem HWAT self-regulation heat trace cable for 208 V, single phase power. Specified following temperature must be maintained using only one type cable throughout system, regardless of pipe size:

1. 40°F for freeze protection of exposed drainage piping.

B. Accessories shall include power connection kits with end seals, fiberglass tape, labels, splice and tee kits, as required. System shall be UL listed for the specific purpose of temperature maintenance of exposed drainage piping installed in overhangs, open parking structures and with insufficient ground cover.

C. Installation of cable and power connections shall be by a Licensed Electrician under this section of Plumbing Work.
1. Junction boxes, power wiring and circuit breakers necessary to complete the system, shall be provided under the Electrical Section of work. Circuit breakers shall be of the GLCB ground fault protection type designed to trip if current imbalance exceeds 30 milliamps, similar to Square D Q0-EPD or Westinghouse GFEPD.

D. Self-regulating heater shall consist of flat flexible low heat density electric heater strip of parallel circuit construction, with a radiation cross linked inner core of self-regulating conductive polymer. Core shall be insulated with radiation cross linked polyolefin jacket and a flexible tinned copper braid. The heater bus wires shall be 16 AWG, nickel coated copper. Strip shall be capable of being cut to desired length, teed and spliced (if necessary) in the field. The heater shall respond to varying localized temperature conditions along the pipe by self-regulating its heat output at each point along its length without reliance on thermostatic controls. A constant wattage heater or one which is not radiation cross-linked, is not acceptable.

E. The heater, when exposed to temperatures up to 150°F, shall have power output which will continuously decrease or remain unchanged. An increase in power output with increasing temperature is unacceptable.

F. Cable shall be permanently marked with manufacturer’s batch or serial number for traceability and cable jackets shall be continuously and permanently marked with manufacturer’s name, catalog number and nominal supply voltage. Temporary printing or tags are unacceptable.

G. The manufacturer shall have over five years experience with self-regulating heater cable in the freeze protection application, and shall submit the names, locations, and telephone numbers of five projects that have used their product for five years or more. Each project shall involve at least 2,000 ft. of heater cable.

H. Manufacturer shall warranty the tracing material for a period of twenty four (24) months from date of shipment.

I. Install on all new exposed drainage piping or as indicated on drawings.

3.00 EXECUTION

3.01 INSTALLATION

A. Slope horizontal drainage piping 3 inch and smaller at 1/4-inch per foot minimum.

B. Slope horizontal drainage piping 4 inch and greater at 1/8-inch per foot minimum.

C. Slope outside underground drainage piping as noted or required.

D. Provide hanger supports at starting end of all drainage lines which turn from vertical to horizontal.

E. Hubless piping shall be installed in a rigid, linear and plumb system without any deflection at the joints either horizontally or vertically. The system shall be supported and secured to the building structure to prevent movement induced by a ten-foot head of water and its associated thrust forces.
F. When horizontal hubless CI piping is suspended in excess of 18 in. by means of non-rigid hangers, provide sway bracing to prevent horizontal movement.

G. For all horizontal hubless CI piping 5-in. and larger, provide sway bracing to prevent horizontal movement at every branch opening and change of direction by securing to building structure, or provide pipe clamps and rodding across coupling.

H. For vertical hubless CI piping, support at base of stack and at each floor level. Intermediate joints shall be supported to structure to assure a plumb installation.

I. Perform changes in direction of drainage piping by use of 45 degree wyes, long turn tee wyes, long sweep quarter bends, sixth, eighth or sixteenth bends. Short turn sanitary tees are only permissible on horizontal to vertical where there are inadequate space conditions.

J. Slip joints: Provide on fixture trap inlets or elbows connecting to fixture tailpieces only.

K. Increase wastes and vents smaller than 4 in. extending through roof: to 4 in. below roof.

L. Locate piping through roof at least ten ft. away from any window, door or intake opening, or extend 3 ft. above same. Install piping and roof drains at least 12 in. away from parapet or bulkhead walls and roof drains to allow for flashing.

M. Slope vent piping to drain out condensation and connect at base to prevent accumulation of rust.

N. Offset vent stack and dry soil or waste stack extension offsets of angle of 45 degrees where possible.

O. Provide galvanized steel piping for horizontal offsets of vent headers.

P. Locate cleanouts as follows:
   1. Where required by code.
   2. Changes in direction, at base of leaders, soil and waste stacks and at exit of building wall for all house drains.
   3. Extend cleanouts installed on inaccessible piping to floor area above, for access.

Q. Electric Self-Regulating Temperature Maintenance Cable:
   1. Trace all drainage mains and branch piping to within 10 ft. of enclosed heated space or adequate ground cover, or as indicated on drawings.
   2. Shop drawings shall detail all heat trace circuiting including, circuit number, location of power connection points (circuit start) and end terminations. Alterations of the piping system which increases circuit length, shall be brought to the immediate attention of the engineer for system design review.

R. Plumbing and piping systems and equipment shall be installed to resist seismic loads and
forces. Refer to specific paragraphs pertaining to seismic piping supports, hangers and equipment anchorage in Section 15400: GENERAL PROVISIONS FOR PLUMBING WORK and Section 15480: SEISMIC RESTRAINTS, PLUMBING.

3.02 TESTS

A. Notify building department and perform tests in the presence of an authorized representative or project Architect.

B. Drainage and vent piping inside building and underground metallic piping (including house sewers) shall be tested as follows:

1. Water test: If tested in sections, fill each section with water to overflowing, from ten ft. above or floor-to-floor height, whichever is greater, so that all of each section, except the topmost, is tested with a head of at least ten ft.. For soil and drain lines located above food storage or preparation area, perform a minimum 25-foot standing water test. Water level shall remain constant throughout test without adding water for a minimum of two hours.

2. Smoke test: After drainage connections have been completed and fixtures have been set, fill traps with water and introduce into entire system at base, thick penetrating smoke produced by a smoke machine. Chemical mixtures will not be allowed. As smoke appears at roof openings, close opening tight and apply pressure equivalent to one in. of water. Maintain test for a minimum of one hour.

3. Peppermint test:

   a. A peppermint vapor test for the existing building shall be applied instead of a smoke pressure test. The peppermint vapor shall be applied to the system by introducing, into the roof vent terminal of highest point every line or stack under test, at least 2 ounces of oil of peppermint, followed immediately by the introduction of 10 quarts boiling water. The, the roof vent terminals shall be promptly sealed for the duration of testing. The presence of oil of peppermint or persons in contact with such vapors shall be excluded from the test area inside the building.

C. Make infiltration tests of outside underground piping where soil and groundwater conditions insure a water table above the top of the pipe. Make exfiltration tests of outside underground piping where the water table is below the invert. Loss or gain shall not exceed 250 gallons per day, per mile, per in. diameter.

D. Test sump pump and ejector discharge piping with water at 10 PSIG at base of system.

END OF SECTION 221316
SECTION 224000 - PLUMBING FIXTURES

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

A. Plumbing fixtures and trim, faucets, other fittings, and related components.

1.03 SUBMITTALS

A. Submit product data, drawings and/or test reports for the following items per the provisions of Division 1 and this division's General Provisions:

1. Catalog, data and illustrations of fixtures, sizes, materials, rough-in dimensions, utility sizes, electrical requirements, trim, and finishes.

1.04 QUALITY ASSURANCE

A. Refer to Section 220500: General Provision for Plumbing Work.

B. Reference Standards:

1. Published Specifications' standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section.

2. American National Standards Institute:
   a. A112.6.1M: Supports for Off-The-Floor Plumbing Fixtures for Public Use.
   d. A112.19.4: Porcelain Enameled Formed Steel Plumbing Fixtures.
   e. A112.19.5: Trim for Water Closet Bowls, Tanks and Urinals.
   f. A112.18.1M: Finished and Rough Brass Plumbing Fixture Fittings.
   g. A117.1: Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
   h. A112-11-1: Drinking Fountains and self contained Mechanically Refrigerated Drinking Water Coolers.
3. American Society of Sanitary Engineering:
   a. ASSE 1002: Water Closet Flush Tank Ball Cocks.
   b. ASSE 1010: Water Hammer Arrestors.
   c. ASSE 1014: Handheld Showers.
   d. ASSE 1016: Individual Shower Control Valve, Anti Scald Type.
   e. ASSE 1017: Thermostatic Mixing Valves, Self-Activated for Primary Domestic Use.
   f. ASSE 1021: Air Gap Drains for Domestic Dishwasher.
   g. ASSE 1025: Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications.
   h. ASSE 1028: Automatic Flow Controller for Faucet and Showerheads.
   i. ASSE 1029: Water Supply Valves: Mixing Valves and Single Control Mixing Valves.
   j. ASSE 1034: Fixed Flow Restrictors.
   k. ASSE 1035: Laboratory Faucet Vacuum Breakers.

4. American Society for Testing and Materials:

5. Health, Education and Welfare:

6. Comply with all applicable national, state and local codes and refer to Section GENERAL PROVISIONS FOR PLUMBING WORK for additional Reference Standards.

2.00 PRODUCTS

2.01 BASE BID MANUFACTURERS - Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or the products by one of the manufacturer’s listed herein or a comparable product by one of the following

A. Thermostatic Mixing Valves:
   1. Powers Regulator Co.
2. Lawler.
3. Leonard Valve Co.
4. Or equivalent.

B. Plumbing Fixtures:
   1. American Standard, Inc.
   2. Kohler Co.
   3. Or equivalent.

C. Brassware:
   1. Chicago Faucet Co.
   3. T and S Brass Works, Inc.
   4. Or equivalent.

D. Flushometers:
   1. Sloan Valve Co. (Royal)
   2. Or equivalent.

E. Fixture Carriers:
   4. Or equivalent.

F. Toilet Seats:
   1. Church.
   2. Olsonite.
   4. Or equivalent.
G. Stainless Steel Sinks:
   3. Or equivalent.

H. Combination Pressure Balanced and Thermostat Mixing Valve:
   1. Symmons Engineering Co.
   2. Powers
   3. Lawler.
   4. Leonard Valve Co.
   5. Or equivalent.

2.02 FIXTURES AND TRIM - GENERAL

A. Fixtures:
   1. Refer to schedule on drawings.

B. Exposed Pipe and Accessories:
   1. Provide exposed pipe, fittings, traps, escutcheons, valves, valve handles and accessories, above and below fixtures with CP.
   2. Provide CP cast brass escutcheons with set screws for piping and tubing.
   3. Provide CP cast brass traps with cleanout plugs, unless otherwise noted. CP Type "L" tubing fixture supplies may be used. Covering tubes will not be permitted.
   4. Indirect waste piping from kitchen equipment waste in food service areas shall be chrome plated.

C. Fixture Faucets:
   1. Renewable seats or replaceable internal units.
   2. Composition washers.
   3. All metal indexed handles.
   4. Lockshield integral or built-in stops.
3.00 EXECUTION

3.01 INSTALLATION

A. Install and connect the following items provided under General Construction Work or by the Owner and provide water supply fixtures with stop valves.

1. Kitchen equipment.

B. During the course of construction, cover exposed fittings and fixtures with protection housings. Uncover and thoroughly clean fixtures and fittings when directed and leave fixtures in perfect condition at completion of project. Fixtures that are not in perfect condition shall be replaced by the Contractor without additional cost to the Owner.

C. Lag fixture carrier base plates or feet to slab with lead expansion shields and insert bolts in all bolt holes.

D. Where wall hung water closets are supported adjacent to stud walls, provide rear anchor foot assembly bolted to slab.

E. Seal all spaces between fixtures, and walls or floors, with a non-yellowing or shrinking flexible water sealant.

END OF SECTION 244000
DIVISION 230000 MECHANICAL SPECIFICATIONS

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END OF SECTION
SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Mechanical sleeve seals.
   5. Sleeves.
   7. Grout.
   8. HVAC demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Concrete bases.
   12. Supports and anchorages.

1.3 DEFINITIONS

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

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

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

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

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

F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

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

B. Welding certificates.

1.5 QUALITY ASSURANCE

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

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by the manufacturers specified herein as listed for each product or by an approved equal manufacturer. When an approved equal manufacturer is provided it is the responsibility of the submitting contractor to provide confirmation for each line item in said specification that the submitted manufacturer is, in fact, an equal to the manufacturer(s) listed in the respective specification sections.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

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

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

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

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

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

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

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturer: Eslon Thermoplastics
   2. Or equivalent.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
   1. Manufacturers: Thompson Plastics, Inc.
   2. Or equivalent.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
   1. Manufacturers:
      a. NIBCO INC.
      b. NIBCO, Inc.; Chemtrol Div.
      c. Or equivalent.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
g. Zurn Industries, Inc.; Wilkins Div.
h. Or equivalent.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   e. Or equivalent.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:
   a. Calpico, Inc.
   b. Lochinvar Corp.
   c. Or equivalent.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:
   a. Perfection Corp.
   b. Precision Plumbing Products, Inc.
   c. Victaulic Co. of America.
   d. Or equivalent.
2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

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

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

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

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

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

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

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Type: With set screw and polished chrome-plated finish.

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

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

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

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

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

2.9 GROUT

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


2. Design Mix: 5000-psi, 28-day compressive strength.


PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

5. Equipment to Be Removed: Disconnect and cap services and remove equipment.

6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

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

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

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

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

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

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

J. Install piping to allow application of insulation.

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

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

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

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

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

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

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

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
   b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
   c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      1) Seal space outside of sleeve fittings with grout.

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

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten
bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


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

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

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

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

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

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500
SECTION 230513 – HVAC EQUIPMENT COMMON MOTOR REQUIREMENTS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes general requirements for single and poly-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately for field installation.

1.3 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following: Motor controllers; Torque, speed, and horsepower requirements of the load; Ratings and characteristics of supply circuit and required control sequence; and Ambient and environmental conditions of installation location

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
   A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
   B. Comply with NEMA MG 1 unless otherwise indicated.
   C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS
   A. Description: NEMA MG 1, Design B, medium induction motor.
   B. Efficiency: Energy efficient, as defined in NEMA MG 1.
   C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.
E. Multispeed Motors: Separate winding for each speed.
F. Rotor: Random-wound, squirrel cage.
G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
H. Temperature Rise: Match insulation rating.
I. Insulation: Class F.
J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS
A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS
A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application: Permanent-split capacitor; Split phase; Capacitor start, inductor run; or Capacitor start, capacitor run.
B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
C. Prelubricated, antifriction ball or sleeve bearings suitable for radial and thrust loading.
D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.
PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 230514 VARIABLE FREQUENCY DRIVES

1.00 GENERAL

1.01 GENERAL REQUIREMENTS

A. Drawings and general provisions of Contact, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.02 PRINCIPAL WORK IN THIS SECTION

A. Variable frequency drives.

B. Materials, equipment, fabrication, installation and tests, in conformity with applicable codes and authorities having jurisdiction, for variable frequency drives (VFDs).

1.03 SUBMITTALS

A. Submit product data, drawings and diagrams for the following items per the provisions of Division 1 and this Division’s General provisions:
   1. Product data: Manufacturer’s catalog cuts, ratings and installation instructions.
   2. Drawings: Scale drawings of assembly.
   3. Diagrams: wiring diagrams including all external connections.

1.04 QUALITY ASSURANCE

A. Refer to General Provisions.

B. Manufacturer: Company specializing in manufacture of variable frequency drives and their accessories, with minimum ten years documented product development, testing, and manufacturing experience in the horsepower range required.

C. VFD's shall have a minimum MTBF (mean time between failures) rating of 28 years.

2.00 PRODUCTS

2.01 MANUFACTURERS

A. Variable Frequency Drives – Provide drives by one of the following manufacturer’s or by an approved equal:
   1. Reliance;
   2. Magnetek or Yaskawa;
   3. Allen-Bradley;
   4. Square D;
   5. Or equivalent
2.02 VARIABLE FREQUENCY DRIVES

A. General:

1. Motors shall be provided with UL Listed variable frequency drive (VFD) control systems.
2. Motors shall be provided with a microprocessor based, pulse width modulated (PWM) variable frequency drive (VFD) control systems as specified or noted.
3. The adjustable frequency AC motor drive shall be designed to convert the 60 hertz input power to adjustable frequency output power. The output frequency and voltage of the drive shall be adjustable such that a constant volts/Hz ratio is determined from the design parameters of the driven motor.
4. Drive shall be capable of operating any standard squirrel cage induction motor with load rating within the capacity of the drive. At any time in the future, it shall be possible to substitute a new or rewound motor in the field without requiring modification of the drive.
5. For retrofit projects, Contractor shall be familiar with existing motor conditions. Existing motor must have a 1.15 service factor and Class B insulation. VFD shall be sized for current voltage and HP of existing motor. Any motors not meeting these minimum requirements shall be replaced and provided by the Contractor.
6. For maintenance purposes, drive shall be capable of starting, stopping and running with stable operation with the motor completely disconnected (no load).
7. For retrofit projects, Contractor shall be familiar with existing motor conditions. Existing motor must have a 1.15 service factor and Class B insulation. VFD shall be sized for current voltage and HP of existing motor. Any motors not meeting these minimum requirements shall be replaced and provided by the Contractor.
8. Drive shall automatically adjust the volts/Hz ratio to the motor in proportion to its load without changing speed in order to conserve the maximum amount of energy.
9. Separately adjustable maximum and minimum frequency limits shall be provided.
10. Drive shall automatically adjust the volts/Hz ratio to the motor in proportion to its load without changing speed in order to conserve the maximum amount of energy.

B. Features:

1. Drive enclosure shall be a NEMA Type 3R or equivalent suitable for outdoor installation, unistrut mounted at exhaust air fan, metal cabinet with hinged front access door(s), filtered ventilation system (if required), and controls that are mounted, wired and tested.
2. Fused, interlocked disconnect switch or input line circuit breaker, externally operated, interlocked with enclosure door. Short circuit interrupting rating of 200,000 amps.
3. Internal 115 VAC control power circuit with transformer and primary and secondary protective fuses.
4. One normally open and one normally closed contacts from run relay, wired to terminal for customer use. Contactors to enable control of drive from a central control system for start/stop and load shed operation through remote speed reset.
5. Controlled acceleration and deceleration, separately adjustable, shall be provided from 0.5 to 200 seconds with torque limit override acceleration protection and regeneration protection during deceleration.
6. Drive shall automatically adjust the volts/Hz ratio to the motor in proportion to its load without changing speed in order to conserve the maximum amount of energy.
7. Separately adjustable maximum and minimum frequency limits shall be provided.
8. Low frequency/low voltage start with linearly adjustable ramp up to pre-selected speed.
9. All components shall be accessible from the cabinet door for service. Drive must be designed for side-by-side, back-to-back and against-the-wall installation.
10. Digitally displayed AC ammeter and percent load meter, located on door.
11. Digitally displayed speed control and speed indicator, located on door.
12. Digitally displayed voltmeter, located on door.
13. Hand/off/auto switch with start/stop pushbuttons or switches.
   a. In the "hand" position, the speed is controlled by the door mounted speed control
      and the start/stop commands are controlled by the door mounted start/stop
      pushbuttons or switches.
   b. In the "off" position, the drive cannot be started.
   c. In the "auto" position, the speed is controlled by a remote electronic signal and
      the drive can receive only a remote start command (momentary contact closure).
      The stop command in the auto position can be either remote or from the door
      mounted stop pushbutton or switch (to ensure maximum safety).
   d. To facilitate equipment setup, the drive shall not undergo complete shutdown
      when moving the selector switch from the hand position to the auto position.
14. Drive fault alarm contact for remote indication.
15. Automatic reset of drive to receive start command after any normal shutdown, including
    power outages.
16. Remote electrical input signal for speed control (to be coordinated with control
    Contractor).
17. Critical speed rejection circuit.
18. Drive shall be constructed with integral protection against all normal transients and
    surges in the incoming power line, any grounding or disconnecting of the output power
    line, and any interruption or runaway of the incoming speed reference signal. Protection
    is defined as a normal shutdown or return to original speed with no component damage.
19. Drive shall protect itself against all phase-to-phase and phase-to-ground faults.
20. Drive shall protect itself against any removal of load.
21. Drive shall employ adjustable torque limit control to override the speed command and
    decrease the frequency while maintaining the correct volts/Hz ratio whenever the load
    level surpasses the drive design level.
22. Drive shall protect itself against single-phasing and power outages and shall be
    insensitive to input phase rotation. Drive shall ride through any input power dip of three
    cycles or less. Drive shall go through an orderly shutdown when the incoming voltage
    low limit is surpassed.
23. Drive shall start into a spinning motor or shut down with no component damage.
24. Instantaneous overcurrent trip (IOT) shall continuously monitor peak currents. It shall
    provide instantaneous shutdown without component failure when high limit setting is
    surpassed.
25. Torque limit shall be settable from 50 to 100 percent of full drive rating on variable
    torque loads. When torque limit engages, the output frequency is steadily reduced until
    the load reduces to the design capacity. At that point, the speed will stabilize. If the load
    reduces further, the drive shall re-accelerate to the preset speed.
26. Manual bypass shall be provided when indicated by the schedule. VFD and bypass
    components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired and
    ready for installation as a single UL listed device. Bypass shall include the following:
   a. Input, output, and bypass contactors, to disconnect power to the VFD, when the
motor is running in the bypass mode.

b. 115 V.A.C. control transformer, with fused primary.
c. Thermal overload relay, to protect the motor while operating in the bypass mode.
d. Circuit breaker/disconnect switch, with a “through-the-door” handle mechanism.
e. Control and safety circuit terminal strip.
g. Pilot lights for “Power On” and “Fault”.
h. “Normal/Test” selector switch, to allow testing and adjustment of the VFD while the motor is running in the bypass mode.

27. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

28. A digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

29. Operating conditions:
   a. Line voltage variations: +10 percent, -5 percent.
   b. Line frequency variations: ±2 hertz.
   c. Overload capability of up to 130 percent of full drive rating for variable torque loads.
   d. Ambient temperature: 0°C to 40°C.; Maximum altitude limit: 3,300 feet.
   e. Maximum humidity: 95 percent (non-condensing).
   f. Efficiency in excess of 95 percent at full load/full speed and in excess of 80 percent at half speed on a variable torque load (cubic load).

30. Serial communication.

31. VFD shall be capable of PID (Proportional, Integral, and Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference. In addition, an energy saving sleep function should be used in conjunction with the PID control. The SLEEP function reduces the unnecessary operation of equipment. When the SLEEP function senses a minimal deviation of a sensor (pressure, temperature), the system reacts by removing the run signal from the equipment. Upon receiving an ample sensor signal deviation, the equipment returns the run signal and resumes normal operation.

3.00 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s recommendations.

B. Coordinate drive equipment with motors supplied under Motors and Motor Controllers.

C. Factory representative shall inspect final installation of all drives and connected wiring and make all final adjustments to meet specified performance.

3.02 TESTS
A. Manufacturer shall conduct factory tests to assure conformance to specification requirements. All power components shall be run-tested under specified temperature and load conditions. Complete records of test procedure and results shall be made available at no cost to Owner's representative.

3.03 TRAINING

A. Factory representative shall provide on-site training of operating personnel after the system is fully operational.

3.04 WARRANTY

3.05 MANUFACTURER

A. Shall conduct factory tests to assure conformance to specification requirements. All power components shall be run-tested under specified temperature and load conditions. A three-year warranty from date of first operation.

END OF SECTION 230514
SECTION 230519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

   A. Section Includes:
      1. Thermometers.
      2. Gauges.
      3. Test plugs.
      4. Flowmeters.

1.3 DEFINITIONS

   A. CR: Chlorosulfonated polyethylene synthetic rubber.
   B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

   A. Product Data: For each type of product indicated; include performance curves.
   B. Shop Drawings: Schedule for thermometers, gauges, flowmeters and thermal-energy meters
      indicating manufacturer's number, scale range, and location for each.
   C. Product Certificates: For each type of thermometers, gauges, flowmeters and thermal-energy
      meters, signed by product manufacturer.
   D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in
      emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

   A. For all of the products specified herein, subject to compliance with requirements and the
      specifications, provide products by one of the manufacturers listed or equivalent for each
      product.
2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:
   1. Palmer - Wahl Instruments Inc.
   2. Trerice, H. O. Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
   5. Or equivalent.

B. Case: Brass 9 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type - 180 degrees in vertical plane and 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 DUCT-TYPE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:
   1. Miljoco Corp.
   2. Palmer - Wahl Instruments Inc.
   3. Trerice, H. O. Co.
   4. Weiss Instruments, Inc.
   5. Or equivalent.

B. Case: Die-cast aluminum - 7 inches long.

C. Tube: Red or blue reading, mercury or organic filled, with magnifying lens.

D. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type - 180 degrees in vertical plane and 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for installation in mounting bracket and of length to suit installation.
H. Mounting Bracket: Flanged fitting for attachment to duct and made to hold thermometer stem.

I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Or equivalent.

B. Case: Dry type, cast aluminum, 6-inch diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.

F. Pointer: Red (or other dark-color) metal.

G. Window: Glass.

H. Ring: Brass.

I. Connector: Adjustable type - 180 degrees in vertical plane and 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
12. Or equivalent.

B. Case: Dry type, cast aluminum, 6-inch diameter with holes for panel mounting.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.

F. Pointer: Red (or other dark-color) metal.

G. Window: Glass.

H. Ring: Brass.

I. Connector: Back union type.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.6 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers:

2. Ernst Gage Co.
3. Eugene Ernst Products Co.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or equivalent.
B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

C. Case: Dry type, stainless steel with 6-inch diameter.

D. Element: Bimetal coil.

E. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.

F. Pointer: Red (or other dark-color) metal.

G. Window: Glass.

H. Ring: Stainless steel.

I. Connector: Adjustable angle, back type.

J. Stem: Metal, for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.7 THERMOWELLS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
3. Ernst Gage Co.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or equivalent.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.
2.8 PRESSURE GAUGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
7. Miljoco Corp.
8. Noshok, Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.
16. Or equivalent.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, cast aluminum, 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, cast aluminum 6-inch diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Brass.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.
D. Pressure-Gage Fittings:
   1. Valves: NPS 1/4 brass or stainless-steel needle type.
   2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
   3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal
disc of material suitable for system fluid and working pressure.

2.9 TEST PLUGS

A. Manufacturers:
   1. Flow Design, Inc.
   2. MG Piping Products Co.
   4. Peterson Equipment Co., Inc.
   5. Sisco Manufacturing Co.
   6. Trerice, H. O. Co.
   8. Or equivalent.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and
   threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.
   1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
   2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

E. Test Kit: Furnish two test kits containing one pressure gauge and adaptor, one thermometer and
carrying case. Pressure gauge, adapter probes, and thermometer sensing elements shall be of
diameter to fit test plugs and of length to project into piping.
   1. Pressure Gauge: Small bourdon-tube insertion type with 2 to 3-inch diameter dial and
      probe. Dial range shall be 0 to 200 psig.
   2. Low-Range Thermometer: Small bimetallic insertion type with 1 to 2-inch diameter dial
      and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
   3. High-Range Thermometer: Small bimetallic insertion type with 1 to 2-inch diameter dial
      and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
   4. Carrying case shall have formed instrument padding.

2.10 PITOT-TUBE FLOWMETERS

A. Manufacturers:
   1. Dieterich Standard Inc.
4. Taco, Inc.
5. Veris Industries.
6. Or equivalent.

B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute (GPM).

C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.

D. Pressure Rating: 150 psig minimum.

E. Temperature Rating: 250 deg F minimum.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

G. Integral Transformer: For low-voltage power connection.

H. Accuracy: Plus or minus 1 percent for liquids and gases.

2.11 FLOW INDICATORS

A. Manufacturers:

2. Dwyer Instruments, Inc.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. McCrometer, Inc.
6. OPW Engineered Systems; Dover Corp.
7. Penberthy, Inc.
8. Or equivalent.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.
PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
   1. Inlet and outlet of each hydronic zone.
   2. Inlet and outlet of each hydronic boiler.
   3. Inlet and outlet of each hydronic coil in air-handling units.
   4. Inlet and outlet of each hydronic heat-recovery unit.
   5. Outside-air, return-air, and mixed-air ducts.

B. Install dry-case-type, vapor-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:
   1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions for system operating temperatures up to 200 deg F and 50 to 400 deg F, with 5-degree scale divisions for system operating temperatures greater than 200 deg F.
   2. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

3.2 GAUGE APPLICATIONS

A. Install dry-case-type pressure gauges for discharge of each pressure-reducing valve.
B. Install dry-case-type pressure gauges at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.
B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
C. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
E. Install direct-mounting pressure gauges in piping tees with pressure gage located on pipe at most readable position.
F. Install remote-mounting pressure gauges on panel.
G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
H. Install needle-valve and syphon fitting in piping for each pressure gage for steam.
I. Install test plugs in tees in piping.
J. Install flow indicators, in accessible positions for easy viewing, in piping systems.
K. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

L. Install flowmeter elements in accessible positions in piping systems.

M. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

N. Install wafer-orifice flowmeter elements between pipe flanges.

O. Install permanent indicators on walls or brackets in accessible and readable positions.

P. Install connection fittings for attachment to portable indicators in accessible locations.

Q. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

R. Assemble components and install thermal-energy meters.

S. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519
SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. 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 general-duty valves:

1. Bronze angle valves.
2. Cast-iron angle valves.
3. Copper-alloy ball valves.
4. Ferrous-alloy ball valves.
5. Ferrous-alloy butterfly valves.
7. Gray-iron swing check valves.
11. Cast-iron gate valves.
13. Cast-iron globe valves.
15. Resilient-seated, cast-iron, eccentric plug valves.

B. Related Sections include the following:

1. Division 23 piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and charts.
3. Division 23 Section "Instrumentation and Control for HVAC" for control valves and actuators.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. PTFE: Polytetrafluoroethylene plastic.
4. SWP: Steam working pressure.
5. **TFE**: Tetrafluoroethylene plastic.

### 1.4 SUBMITTALS

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

### 1.5 QUALITY ASSURANCE

A. **ASME Compliance**: ASME B31.9 for building services piping valves.

B. **ASME Compliance for Ferrous Valves**: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. **NSF Compliance**: NSF 61 for valve materials for potable-water service.

### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

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

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use hand-wheels or stems as lifting or rigging points.

### 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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Handwheel: For valves other than quarter-turn types.
   2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
   3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Extended Valve Stems: On insulated valves.


I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE ANGLE VALVES

A. Manufacturers:
   1. Type 2, Bronze Angle Valves with Nonmetallic Disc:
      a. American Valve, Inc.
      b. Cincinnati Valve Co.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Crane Co.; Crane Valve Group; Jenkins Valves.
      e. Crane Co.; Crane Valve Group; Stockham Div.
f. Grinnell Corporation.

g. Hammond Valve.

h. NIBCO INC.

i. Powell, Wm. Co.

j. Or equivalent.

B. Bronze Angle Valves, General: MSS SP-80, with ferrous-alloy hand-wheel.

C. Type 2, Class 125, Bronze Angle Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

D. Type 2, Class 150, Bronze Angle Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

E. Type 2, Class 200, Bronze Angle Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

2.4 CAST-IRON ANGLE VALVES

A. Manufacturers:

1. Type II, Cast-Iron Angle Valves with Metal Seats:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Crane Co.; Crane Valve Group; Stockham Div.
   d. NIBCO INC.
   e. Or equivalent.

B. Cast-Iron Angle Valves, General: MSS SP-85, Type II.

C. Class 125, Cast-Iron Angle Valves: Bronze mounted with gray-iron body and bronze seats.

D. Class 250, Cast-Iron Angle Valves: Bronze mounted with gray-iron body and bronze seats.

2.5 COPPER-ALLOY BALL VALVES

A. Manufacturers:

1. Three-Piece, Copper-Alloy Ball Valves:

   b. Grinnell Corporation.
   c. Jamesbury, Inc.
   d. NIBCO INC.
   e. Or equivalent.

2. Safety-Exhaust, Copper-Alloy Ball Valves:

b. Grinnell Corporation.
c. Jamesbury, Inc.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Or equivalent.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Three-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

D. Safety-Exhaust, Copper-Alloy Ball Valves: Two-piece bronze body with exhaust vent opening, chrome-plated ball with vent, blowout-proof stem, locking handle, and working pressure rating of 400-psig CWP.

2.6 FERROUS-ALLOY BALL VALVES

A. Manufacturers:
   1. American Valve, Inc.
   3. Crane Co.; Crane Valve Group; Stockham Div.
   5. Jamesbury, Inc.
   7. NIBCO INC.
   8. Or equivalent.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 150, full port.

D. Ferrous-Alloy Ball Valves: Class 300, full port.

2.7 BRONZE CHECK VALVES

A. Manufacturers:
   1. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:
      a. Cincinnati Valve Co.
      b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
      c. Walworth Co.
      d. Or equivalent.
   2. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:
      a. Grinnell Corporation.
      b. Milwaukee Valve Company.
c. Or equivalent.

3. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   c. Grinnell Corporation.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Walworth Co.
   g. Watts Industries, Inc.; Water Products Div.
   h. Or equivalent.

B. Bronze Check Valves, General: MSS SP-80.

C. Type 2, Class 125, 150 and 200, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

D. Type 2, Class 125, 150 and 200, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

E. Type 4, Class 125, 150 and 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.8 GRAY-IRON SWING CHECK VALVES

A. Manufacturers:
   1. Type II, Gray-Iron Swing Check Valves with Composition to Metal Seats:
      a. Crane Co.; Crane Valve Group; Crane Valves or Stockham Div.
      b. Mueller Co.
      d. Or equivalent.
   2. Grooved-End, Ductile-Iron Swing Check Valves:
      a. Grinnell Corporation.
      b. Mueller Co.
      c. Victaulic Co. of America.
      d. Or equivalent.


C. Type II, Class 125 and 250, gray-iron, swing check valves with composition to metal seats.

D. 175-psig and 300-psig CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends.
2.9 FERROUS-ALLOY WAFER CHECK VALVES

A. Manufacturers:

1. Single-Plate, Ferrous-Alloy, Wafer Check Valves:
   a. Mueller Co.
   b. Techno Corp.
   d. Or equivalent.

2. Dual-Plate, Ferrous-Alloy, Wafer Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves or Stockham Div.
   b. Grinnell Corporation.
   c. Mueller Steam Specialty.
   d. NIBCO INC.
   e. Techno Corp.
   g. Or equivalent.

3. Dual-Plate, Ferrous-Alloy, Wafer-Lug Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Or equivalent.

4. Dual-Plate, Ferrous-Alloy, Double-Flanged-Type Check Valves:
   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Techno Corp.
   c. Or equivalent.

B. Ferrous-Alloy Wafer Check Valves, General: API 594, spring loaded.

C. Single-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Wafer Check Valves:
   Flangeless body.

D. Single-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Wafer-Lug Check Valves:
   Single-flange body.

E. Single-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Double-Flanged Check
   Valves: Flanged-end body.

F. Dual-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Wafer Check Valves:
   Flangeless body.

G. Dual-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Wafer-Lug Check Valves:
   Single-flange body.

H. Dual-Plate, Class 125 or 150 and Class 250 or 300, Ferrous-Alloy, Double-Flanged Check
   Valves: Flanged-end body.
2.10 SPRING-LOADED, LIFT-DISC CHECK VALVES

A. Manufacturers:

1. Type I, Wafer Lift-Disc Check Valves:
   a. Mueller Steam Specialty.
   b. Or equivalent.

2. Type II, Compact-Wafer, Lift-Disc Check Valves:
   a. Grinnell Corporation.
   b. Milwaukee Valve Company.
   c. Mueller Steam Specialty.
   d. NIBCO INC.
   e. Or equivalent.

3. Type III, Globe Lift-Disc Check Valves:
   a. Grinnell Corporation.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Or equivalent.

4. Type IV, Threaded Lift-Disc Check Valves:
   a. Grinnell Corporation.
   b. Milwaukee Valve Company.
   c. Mueller Steam Specialty.
   d. NIBCO INC.
   e. Watts Industries, Inc.; Water Products Div.
   f. Or equivalent.

B. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.

C. Type I, Class 125 and Class 250, Wafer Lift-Disc Check Valves: Wafer style with cast-iron shell with diameter matching companion flanges.

D. Type II, Class 125 and Class 250, Compact-Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.

E. Type III, Class 125 and Class 250, Globe Lift-Disc Check Valves: Globe style with cast-iron shell and flanged ends.

F. Type IV, Class 125 and Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.
2.11 BRONZE GATE VALVES

A. Manufacturers:

1. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:
   a. American Valve, Inc.
   b. Cincinnati Valve Co.
   c. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   d. Grinnell Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Or equivalent.

2. Type 3, Bronze, Rising-Stem, Split-Wedge Gate Valves:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. Grinnell Corporation.
   d. NIBCO INC.
   e. Or equivalent.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 2, Class 125, 150 and 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

D. Type 3, Class 125, 150 and 200, Bronze Gate Valves: Bronze body with rising stem and bronze split wedge and union-ring bonnet.

2.12 CAST-IRON GATE VALVES

A. Manufacturers:

1. Type I, Cast-Iron, Nonrising-Stem Gate Valves:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   c. Grinnell Corporation.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   g. Or equivalent.

2. Type I, Cast-Iron, Rising-Stem Gate Valves:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   c. Grinnell Corporation.
   d. Milwaukee Valve Company.
e. NIBCO INC.
g. Or equivalent.

B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, non-rising stem, and solid-wedge disc.

D. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

E. Class 125, NRS, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, non-rising stem, and solid-wedge disc.

F. Class 125, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

G. Class 250, NRS, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, non-rising stem, and solid-wedge disc.

H. Class 250, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: Cast-iron body with bronze trim, rising stem, and solid-wedge disc.

I. Class 250, NRS, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, non-rising stem, and solid-wedge disc.

J. Class 250, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

2.13 BRONZE GLOBE VALVES

A. Manufacturers:

1. Type 2, Bronze Globe Valves with Nonmetallic Disc:

   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   c. Grinnell Corporation.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Or equivalent.

B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy hand-wheel.

C. Type 2, Class 125, 150 and 200, Bronze Globe Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.
2.14 CAST-IRON GLOBE VALVES

A. Manufacturers:

1. Type I, Cast-Iron Globe Valves with Metal Seats:
   a. Cincinnati Valve Co.
   b. Crane Co.; Crane Valve Group; Crane Valves, Jenkins Valves or Stockham Div.
   c. Grinnell Corporation.
   d. Milwaukee Valve Company.
   e. NIBCO INC.
   f. Or equivalent.


C. Type I, Class 125 and Class 250, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

2.15 CAST-IRON PLUG VALVES

A. Manufacturers:

1. Lubricated-Type, Cast-Iron Plug Valves:
   a. Milliken Valve Co., Inc.
   b. Nordstrom Valves, Inc.
   c. Olson Technologies; Homestead Div.
   e. Walworth Co.
   f. Or equivalent.

2. Non-lubricated-Type, Cast-Iron Plug Valves:
   a. Grinnell Corporation.
   d. Wheatley Gaso, Inc.
   e. Or equivalent.

B. Cast-Iron Plug Valves, General: MSS SP-78.

C. Class 125 or 150 and Class 250 or 300, lubricated-type, cast-iron plug valves.

D. Class 125 or 150 and Class 250, non-lubricated-type, cast-iron plug valves.

2.16 RESILIENT-SEATED, CAST-IRON, ECCENTRIC PLUG VALVES

A. Manufacturers:

1. General Signal; DeZurik Unit.
3. Olson Technologies; Homestead Div.
4. Pratt, Henry Company.
6. Or equivalent.

B. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 2-1/2 and Smaller: Design similar to MSS SP-108, and rated for 175-psig minimum CWP.
   1. Resilient Seating Material: Suitable for potable-water service, unless otherwise indicated.

C. Resilient-Seated, Cast-Iron, Eccentric Plug Valves, NPS 3 and Larger: MSS SP-108, and rated for 175-psig minimum CWP.
   1. Resilient Seating Material: Suitable for potable-water service, unless otherwise indicated.

2.17 DIFFERENTIAL PRESSURE CONTROL AND BALANCING VALVE SYSTEMS

A. Manufacturers:
   1. Tour & Andersson.
   2. Or equivalent.

B. Balancing Valves - 1/2 – 2” NPT-STAD.
   1. Provide TA SERIES 787 Balancing Valves with provision for connecting a portable differential (Ft. of Head) pressure meter. Each meter shall have pressure/temperature probes. The balancing valves shall be Y-pattern globe style design and all metal parts of nonferrous, pressure die cast, nonporous metal. Each valve shall provide four (4) functions:
      a) (1) Precise flow measurement;
      b) (2) Precision flow balancing;
      c) (3) Positive shut-off with no drip seat to eliminate need for additional isolation valve;
      d) (4) Drain connection using 3/4” NPT hose end thread.
   2. These valves shall have four (4) 360° adjustment turns of the handwheel for precise setting with hidden memory to provide a tamper-proof balancing setting. Handwheel shall have digital readout and shall be able to be installed in any position without affecting performance.

C. Balancing Valves - 2 1/2 – 16” FLANGED-STAF and grooved-stag with digital handwheel.
   1. Provide TA Series 788/789 Balancing valves with provision for connecting a portable differential (Ft. of Head) pressure meter. Each meter connection shall have pressure/temperature probes. The balancing valves shall be Y-pattern globe style design with ductile iron body all other wetted parts of nonferrous, pressure die cast metal. Each valve shall provide three (3) functions:
      a) (1) Precise flow measurement;
b) (2) Precision flow balancing;
c) (3) Shut-off feature, eliminating the need of an additional isolation valve.

2. These valves shall have eight (8), twelve (12), sixteen (16), twenty (20) or twenty-two (22) 360° adjustment turns of the handwheel for precise setting with hidden memory feature to program the valve with precision tamper-proof balancing setting. Handwheel shall have digital readout and shall be able to be installed in any position without affecting performance.

D. Balancing Valves - 1/2 – 2" NPT - 300 psi:

1. Provide TA Series 786-STAS or 787-STAD Balancing Valves, Y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter.

E. Balancing Valves - 2 1/2 – 16" FLANGED-STAF - 300 psi:

1. Provide TA Series 788-STAF or 789-STAG Balancing Valves, Y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other metal parts of metal brass copper alloy, EPDM O-ring seals. 8, 12, 16, 20 or 22 turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter.

F. Insulation.

1. Provide preformed rigid polyurethane insulation on the valves to prevent heat loss or condensation.

G. Balancing Meters.

1. Provide one balancing meter from the same provider as the balancing valves, Victaulic TA Series 734 TA-Scope, or TA Series 73M CMI Pressure Differential Meter as manufactured by Tour and Andersson and provided by Victaulic. Needle gauge type meters will not be allowed.

H. Differential Pressure Control Valves 1/2 through 2 inches:

1. Maximum differential pressure shall not be less than 51 psi and the maximum temperature shall not be less than 225°F for use in heating and cooling systems. NPT threaded valve body and bonnet shall be manufactured of metal copper alloy, O-rings, seat seal, and membrane manufactured of HBNR. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, polymide handle, and drain.

2. Shall be capable of stabilizing ΔpV ranges of 1.5- 8.7 psi in sizes 3/4-1 inch or 2.9- 11.6 psi in sizes 1-1/4 – 2 inches. TA Series 786- STAD, TA Series 787-STAS, TA Series 788-STAG, TA Series 789-STAF dependent on system size and connection requirements.

3. Provide capillary tube, hose kit, and all connection fittings manufactured by Tour and Andersson to ensure proper operation of installed STAP valves. Mechanical contractor
and balancing contractor shall be trained on installation, connection, and balancing procedures by certified Victaulic/TA representative.

I. Differential Pressure Control Valves 2-1/2 through 4 inches:

1. Maximum differential pressure shall not be less than 51 psi and the maximum temperature shall not be less than 175°F for use in heating and cooling systems. ANSI Class 150 flange body to be cast of ductile iron and bonnet shall be manufactured of metal copper alloy, O-rings, seat seal, and membrane manufactured of EPDM. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, polymide handle, and drain.

2. Shall be capable of stabilizing ΔpV ranges of 2.9-11.6 psi for spring option 1 and 5.8-23.3 psi for spring option 2. TA Series 786- STAD, TA Series 787-STAS, TA Series 788-STAG, TA Series 789-STAF dependant on system size and connection requirements.

3. Provide capillary tube, hose kit, and all connection fittings manufactured by Tour and Andersson to ensure proper operation of installed STAP valves. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified Victaulic/TA representative.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

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

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.
3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, gate, or plug valves.
2. Throttling Service: Angle, ball, or globe valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled Water and Heating Hot Water Piping: Use the following types of valves:

1. Angle Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 250, cast iron.
4. Ball Valves, NPS 2-1/2 and Larger: Class 300, ferrous alloy.
5. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 250-psig CWP rating, ferrous alloy, with EPDM liner.
8. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 200, horizontal or vertical, bronze.
9. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 200, bronze.
10. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 250, gray iron.
12. Wafer Check Valves, NPS 2-1/2 and Larger: Dual-plate, wafer-lug, double-flanged, Class 250 or 300, ferrous alloy.
14. Swing-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 250, cast iron.
15. Gate Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
16. Gate Valves, NPS 2-1/2 & Larger: Type I, Class 250, OS&Y, bronze-mounted cast iron.
17. Globe Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
18. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 250, bronze-mounted cast iron.
19. Plug Valves, NPS 2 and Larger: Class 250 or 300, non-lubricated type, cast iron.
21. T&A Differential Control and Balancing Valves System at the main branch takeoffs from the risers on each floor and/or in the branch takeoffs to each air handling unit.

D. Air Conditioning Condensate Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Three-piece, 400-psig CWP rating, copper alloy.
2. Lift Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal, bronze.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
E. Low-Pressure Steam Piping: Use the following types of valves:

1. Angle Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 125, cast iron.
4. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
5. High-Pressure Butterfly Valves, NPS 3 and Larger: Single-flange, Class 150.
6. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 150, bronze.
7. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
8. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
9. Gate Valves, NPS 2-1/2 & Larger: Type I, Class 125, OS&Y, bronze-mounted cast iron.
10. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
11. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

F. High-Pressure Steam Piping: Use the following types of valves:

1. Angle Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
2. Angle Valves, NPS 2-1/2 and Larger: Type II, Class 250, cast iron.
4. Ball Valves, NPS 2-1/2 and Larger: Class 300, ferrous alloy.
6. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 200, bronze.
7. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 250, gray iron.
8. Gate Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
9. Gate Valves, NPS 2-1/2 & Larger: Type I, Class 250, OS&Y, bronze-mounted cast iron.
10. Globe Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.

G. Steam Condensate Piping: Use the following types of valves:

1. Ball Valves, NPS 2 and Smaller: Three-piece, 400-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 300, ferrous alloy.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 200, bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 250, gray iron.
7. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 250, cast iron.
8. Gate Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
9. Gate Valves, NPS 2-1/2 & Larger: Type I, Class 250, OS&Y, bronze-mounted cast iron.
10. Globe Valves, NPS 2 and Smaller: Type 2, Class 200, bronze.
11. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 250, bronze-mounted cast iron.
12. Plug Valves, NPS 2 and Larger: Class 250 or 300, non-lubricated type, cast iron.

H. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for air conditioning condensate.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
5. For Grooved-End, Steel Piping: Valve ends may be grooved. Do not use for steam or steam condensate piping.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

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

END OF SECTION 230523
SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following hangers and supports for HVAC system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Thermal-hanger shield inserts.
6. Fastener systems.
7. Pipe stands.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
4. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
5. Division 23 Section(s) "Metal Ducts and Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."
1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Fiberglass pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Powder-actuated fastener systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Fiberglass strut systems. Include Product Data for components.
   4. Pipe stands. Include Product Data for components.
   5. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

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

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified - equivalent products by equivalent manufacturers will be considered based on providing proof that they are equal in both quality of construction and all capacity capabilities.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Or equivalent.

C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.
8. Or equivalent.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.
7. Or equivalent.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.
f. Or equivalent.

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

1. Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.
   g. Or equivalent.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Manufacturers:
   a. ERICO/Michigan Hanger Co.
   b. MIRO Industries.
   c. Or equivalent.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Manufacturers:
   a. MIRO Industries.
   b. Or equivalent.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
   a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.
d. Or equivalent.

3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturers:
   a. Portable Pipe Hangers.
   b. Or equivalent.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

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

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
   4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
   5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
   6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
   7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
   8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
      a. Horizontal (MSS Type 54): Mounted horizontally.
      b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Painting Sections – “High-Performance Coatings.”

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529
SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Freestanding and restrained air-mounting system.
12. Restrained vibration isolation roof-curb rails.
13. Restraining braces and cables.
14. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS


C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 90 MPH
2. Building Classification Category: III
3. Importance Factor: 1.15
4. Exposure Category: B
5. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

A. Product Data: For the following:

B. The manufacturer of vibration isolation shall provide submittals for products as follows:

1. Descriptive Data:

   1) Schedules of flexibly mounted equipment, referencing drawings by number.

   b. Catalog cuts or data sheets on vibration isolators.

2. Drawings:

   a. Submit details of equipment bases including dimensions, structural member sizes and support point locations.

   b. Submit details of isolation hangers for ceiling hung equipment, piping and ductwork.

   c. Submit details of mountings for floor supported equipment, piping and ductwork.

   d. All hanger, mounting or pad drawings shall indicate deflections and model numbers as well as any other requirements in the specifications.

   e. Spring diameters, rated loads and deflections, heights at rated load and closed height shall be provided for all springs shown in the submittals in tabular form.

   f. Complete flexible connector details.

C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.
1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified - equivalent products by equivalent manufacturers will be considered based on providing proof that they are equal in both quality of construction and all capacity capabilities:

   a. Amber/Booth Company, Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control.
   e. Mason Industries.
   f. Vibration Eliminator Co., Inc.
   g. Vibration Isolation.
   h. Vibration Mountings & Controls, Inc.
   i. Or equivalent.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

   1. Resilient Material: Oil- and water-resistant neoprene or rubber.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
D. Restrained Mounts: All-directional mountings with seismic restraint.
   1. Materials: Cast-ductile-iron or welded steel housing containing two separate and
      opposing, oil-resistant rubber or neoprene elements that prevent central threaded element
      and attachment hardware from contacting the housing during normal operation.
   2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-
      bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the
      spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without
      deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber
      isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw
      to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop
   restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to
      weight being removed; factory-drilled baseplate bonded to 1/4-inch thick, neoprene or
      rubber isolator pad attached to baseplate underside; and adjustable equipment mounting
      and leveling bolt that acts as blocking during installation.
   2. Restraint: Seismic or limit stop as required for equipment and authorities having
      jurisdiction.
   3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the
      spring at rated load.
   4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without
      deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral snubbers.
   1. Housing: Ductile-iron or steel housing to provide all-directional restraint.
   2. Base: Factory drilled for bolting to structure.
   3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down
      before contacting a resilient collar.

H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant
   elastomeric isolator elements bonded to steel housings with threaded connections for hanger
   rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert
   in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

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

   1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
5. Mason Industries.
6. Thybar Corporation.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
10. Or equivalent.

B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.

C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
   a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
   b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
   a. Resilient Material: Oil- and water-resistant standard neoprene or natural rubber.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
2.3 VIBRATION ISOLATION EQUIPMENT BASES

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

1. Amber/Booth Company, Inc.
2. Isolation Technology, Inc.
5. Vibration Mountings & Controls, Inc.
6. Or equivalent.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.


1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic and wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and wind control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.
E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer’s recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.


4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.


7. Measure isolator deflection.

8. Test and adjust air-mounting system controls and safeties.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548
SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.
   5. Stencils.
   6. Valve tags.
   7. Warning tags.

1.3 SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
B. Letter Color: Black.
C. Background Color: Red.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
G. Fasteners: Stainless-steel rivets or self-tapping screws.
H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS
A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS
A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
B. Letter Color: Black.
C. Background Color: White.
D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.
2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 20 feet in areas of congested piping and equipment.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping:
   b. Letter Color: Blue.

2. Condenser-Water Piping:
   a. Background Color: Yellow.
   b. Letter Color: Blue.

3. Air Conditioning Condensate Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black.

4. Heating Water Piping:
   b. Letter Color: Red.

5. Low-Pressure Steam Piping:
   a. Background Color: Red.
   b. Letter Color: Black.

6. High-Pressure Steam Piping:
   a. Background Color: Red.
   b. Letter Color: Black.

7. Steam Condensate Piping:
   a. Background Color: Yellow.
   b. Letter Color: Red.

8. Refrigerant Piping:
   b. Letter Color: Black.
3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 2 inches round

2. Valve-Tag Color:
   a. Chilled Water: Green.
   b. Condenser Water: Green.
   c. Refrigerant: Green.
   d. Hot Water: Red.
   e. Gas: Yellow.
   f. Low-Pressure Steam: Yellow.
   g. High-Pressure Steam: Red.
   h. Steam Condensate: Red.

3. Letter Color:
   e. Gas: Black.
   f. Low-Pressure Steam: Black.
g. High-Pressure Steam: White.
h. Steam Condensate: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553
SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   2. Hydronic Piping Systems: Constant-flow and Variable-flow systems
   3. HVAC equipment quantitative-performance settings.
   4. Space pressurization testing and adjusting.
   5. Vibration measuring.
   7. Indoor-air quality measuring.
   8. Verifying that automatic control devices are functioning properly.
   9. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service
representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, " Section II, " Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

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

A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and
fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

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

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

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

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

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.
3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

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

1. Measure fan static pressures to determine actual static pressure as follows:
   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
   a. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance systems similar to constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.

7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
   a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

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

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, RPM, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.
3.10 PROCEDURES FOR STEAM SYSTEMS

A. Measure and record upstream and downstream pressure of each piece of equipment.
B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
C. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record the final setting.
D. Check the settings and operation of each safety valve. Record settings.
E. Verify the operation of each steam trap.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.
C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.
3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
   1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
   2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
   3. Test room pressurization first, then zones, and finish with building pressurization.
D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
   1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
   2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test over pressurization and under pressurization, and observe and report on the system's ability to revert to the set point.
   3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.
3.16 PROCEDURES FOR VIBRATION MEASUREMENTS

A. Use a vibration meter meeting the following criteria:
   1. Solid-state circuitry with a piezoelectric accelerometer.
   2. Velocity range of 0.1 to 10 inches per second.
   3. Displacement range of 1 to 100 mils.
   4. Frequency range of at least 0 to 1000 Hz.
   5. Capable of filtering unwanted frequencies.

B. Calibrate the vibration meter before each day of testing.
   1. Use a calibrator provided with the vibration meter.
   2. Follow vibration meter and calibrator manufacturer's calibration procedures.

C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
   1. Turn off equipment in the building that might interfere with testing.
   2. Clear the space of people.

D. Perform vibration measurements after air and water balancing and equipment testing is complete.

E. Clean equipment surfaces in contact with the vibration transducer.

F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.

G. Measure and record vibration on rotating equipment over 3 hp.

H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.
   1. Fans and HVAC Equipment with Fans:
      a. Fan Bearing: Drive end and opposite end.
      b. Motor Bearing: Drive end and opposite end.
      c. Equipment Casing: Top and side.
      d. Equipment Base: Top and side.
      e. Building: Floor.
      f. Ductwork: To and from equipment after flexible connections.
      g. Piping: To and from equipment after flexible connections.

I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.

J. Inspect, measure, and record vibration isolation.
   1. Verify that vibration isolation is installed in the required locations.
   2. Verify that installation is level and plumb.
   3. Verify that isolators are properly anchored.
   4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.
5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

3.17 PROCEDURES FOR SOUND-LEVEL MEASUREMENTS

A. Perform sound-pressure-level measurements with an octave-band analyzer complying with ANSI S1.4 for Type 1 sound-level meters and ANSI S1.11 for octave-band filters. Comply with requirements in ANSI S1.13, unless otherwise indicated.

B. Calibrate sound meters before each day of testing. Use a calibrator provided with the sound meter complying with ANSI S1.40 and that has NIST certification.

C. Use a microphone that is suitable for the type of sound levels measured. For areas where air velocities exceed 100 fpm, use a windscreen on the microphone.

D. Perform sound-level testing after air and water balancing and equipment testing are complete.

E. Close windows and doors to the space.

F. Perform measurements when the space is not occupied and when the occupant noise level from other spaces in the building and outside are at a minimum.

G. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.

H. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, and other large surface capable of altering the measurements.

I. Take sound measurements in dBA and in each of the 8 un-weighted octave bands in the frequency range of 63 to 8000 Hz.

J. Take sound measurements with the HVAC systems off to establish the background sound levels and take sound measurements with the HVAC systems operating.
   1. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.

K. Perform sound testing in at least two locations in the Project for each of the following space types. For each space type tested, select a measurement location that has the greatest sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.
   1. Private office.
   2. Open office area.
   3. Conference room.
   4. Auditorium/large meeting room/lecture hall.
   5. Classroom/training room.
   6. Patient room/exam room.
   7. Each space with a noise criterion of RC or NC 25 or lower.
   8. Each space with an indicated noise criterion of RC or NC 35 and lower that is adjacent to a mechanical equipment room or roof mounted equipment.
   9. Inside each mechanical equipment room.
3.18 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.

B. Observe and record the following conditions for each HVAC system:
   1. The distance between the outside-air intake and the closest exhaust fan discharge, cooling tower, flue termination, or vent termination.
   2. Specified filters are installed. Check for leakage around filters.
   3. Cooling coil drain pans have a positive slope to drain.
   4. Cooling coil condensate drain trap maintains an air seal.
   5. Evidence of water damage.
   6. Insulation in contact with the supply, return, and outside air is dry and clean.

C. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
   1. Most remote area.
   2. One location per floor.
   3. One location for every 5000 sq. ft.

D. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113:
   1. Temperature.
   2. Relative humidity.
   3. Air velocity.
   4. Concentration of carbon dioxide (PPM).
   5. Concentration of carbon monoxide (PPM).
   7. Formaldehyde (PPM).

3.19 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.
J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.20 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
   2. Air Outlets and Inlets: 0 to minus 10 percent.
   3. Heating-Water Flow Rate: 0 to minus 10 percent.
   4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.21 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.22 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Pump curves and Fan curves.
   2. Manufacturers’ test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name and location.
   4. Architect's and Engineer's name and address.
5. Contractor's name and address.
7. Signature of TAB firm who certifies the report.
8. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
9. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
10. Nomenclature sheets for each item of equipment.
11. Data for terminal units, including manufacturer, type size, and fittings.
12. Notes to explain why certain final data in the body of reports varies from indicated values.
13. Test conditions for fans and pump performance forms including the following:
   a. Settings for outside-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data: Include the following:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
      j. Number of belts, make, and size.
      k. Number of filters, type, and size.
2. Motor Data:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in CFM.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat coil static-pressure differential in inches wg.
   g. Cooling coil static-pressure differential in inches wg.
   h. Heating coil static-pressure differential in inches wg.
   i. Outside airflow in CFM.
   j. Return airflow in CFM.
   k. Outside-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
   f. Make and model number.
   g. Face area in sq. ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in CFM.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outside-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in GPM.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.

n. Refrigerant suction temperature in deg F.

o. Inlet steam pressure in psig.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in CFM.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
   a. System and air-handling unit number.
   b. Location and zone.
   c. Traverse air temperature in deg F.
   d. Duct static pressure in inches wg.
   e. Duct size in inches.
   f. Duct area in sq. ft.
   g. Indicated airflow rate in CFM.
   h. Indicated velocity in fpm.
   i. Actual airflow rate in CFM.
   j. Actual average velocity in fpm.
   k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:
1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Test apparatus used.
   d. Area served.
   e. Air-terminal-device make.
   f. Air-terminal-device number from system diagram.
   g. Air-terminal-device type and model number.
   h. Air-terminal-device size.
   i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in CFM.
   b. Air velocity in fpm (m/s).
   c. Preliminary airflow rate as needed in CFM.
   d. Preliminary velocity as needed in fpm.
   e. Final airflow rate in CFM.
   f. Final velocity in fpm.
   g. Space temperature in deg F.

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

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

   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in CFM.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

L. Vibration Measurement Reports:

   1. Date and time of test.
   2. Vibration meter manufacturer, model number, and serial number.
   3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
   4. Diagram of equipment showing the vibration measurement locations.
   5. Measurement readings for each measurement location.
   7. Description of predominant vibration source.

M. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both
"background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:

1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number.
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.

N. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

O. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.23 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure water flow of at least 5 percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Measure sound levels at two locations.
   e. Measure space pressure of at least 10 percent of locations.
   f. Verify that balancing devices are marked with final balance position.
   g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Engineer and Owner’s Representatives.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of the Engineer and Owner’s Representatives.

3. The Engineer and Owner’s Representatives shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.

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

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

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.24 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593
SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Calcium silicate.
   b. Cellular glass.
   c. Flexible elastomeric.
   d. Mineral fiber.
   e. Phenolic.
   f. Polyisocyanurate.
   g. Polyolefin.
   h. Polystyrene.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
7. Sealants.
8. Factory-applied jackets.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Metal Ducts" for duct liners.
4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.
1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
   1. Sample Sizes:
      b. Sheet Form Insulation Materials: 12 inches square.
      d. Sheet Jacket Materials: 12 inches square.
      e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label
insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Industrial Insulation Group (The); Thermo-12 Gold.
   b. Or equivalent.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cell-U-Foam Corporation; Ultra-CUF.
   b. Pittsburgh Corning Corporation; Foamglas Super K.
   c. Or equivalent.

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Prefomed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.


7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
d. Or equivalent.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Knauf Insulation; Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap.
   e. Owens Corning; All-Service Duct Wrap.
   f. Or equivalent.

J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

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

   b. Owens Corning; High Temperature Flexible Batt Insulations.
   c. Or equivalent.

K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ or FSK jacket. For equipment applications, provide insulation with factory-applied ASJ or FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.
   g. Or equivalent.

L. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

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

   a. Fibrex Insulations Inc.; FBX.
   b. Johns Manville; 1000 Series Spin-Glas.
c. Owens Corning; High Temperature Industrial Board Insulations.
d. Rock Wool Manufacturing Company; Delta Board.
e. Roxul Inc.; Roxul RW.
f. Thermafiber; Thermafiber Industrial Felt.
g. Or equivalent.

M. Mineral-Fiber, Preformed Pipe Insulation:

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

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000 Pipe Insulation.
   d. Manson Insulation Inc.; Alley-K.
   e. Owens Corning; Fiberglas Pipe Insulation.
   f. Or equivalent.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory applied jacket requirements are specified in "Factory-Applied Jackets" Article.

3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory applied jacket requirements are specified in "Factory-Applied Jackets" Article.

N. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

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

   a. Knauf Insulation; Permawick Pipe Insulation.
   b. Owens Corning; VaporWick Pipe Insulation.
   c. Or equivalent.

O. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100-deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.
f. Or equivalent.

P. Phenolic:

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

   a. Kingspan Corp.; Koolphen K.
   b. Or equivalent.

2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

   a. Preformed Pipe Insulation: ASJ.
   b. Board for Duct and Plenum Applications: ASJ.
   c. Board for Equipment Applications: ASJ.
   d. Or equivalent.

Q. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.

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

   b. Dow Chemical Company (The); Trymer.
   c. Duna USA Inc.; Corafoam.
   d. Elliott Company; Elfoam.
   e. Or equivalent.

2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.

   a. Pipe Applications: ASJ-SSL.
   b. Equipment Applications: ASJ-SSL.
   c. Or equivalent.

R. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Armacell LLC; Tubolit.
   b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
   c. RBX Corporation; Therma-cell.
   d. Or equivalent.

S. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Styrofoam.
   b. Knauf Insulation; Knauf Polystyrene.
   c. Or equivalent.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; Super Firetemp M.
   b. Or equivalent.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corp.; FlameChek.
   b. Johns Manville; Firetemp Wrap.
   d. Thermal Ceramics; FireMaster Duct Wrap.
   e. 3M; Fire Barrier Wrap Products.
   f. Unifrax Corporation; FyreWrap.
   g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.
   h. Or equivalent.
2.3 INSULATING CEMENTS


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

   a. Insulco, Division of MFS, Inc.; Triple I.
   c. Or equivalent.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

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

   b. Or equivalent.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

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

   a. Insulco, Division of MFS, Inc.; SmoothKote.
   c. Rock Wool Manufacturing Company; Delta One Shot.
   d. Or equivalent.

2.4 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

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

   a. Childers Products, Division of ITW; CP-97.
   c. Marathon Industries, Inc.; 290.
   d. Mon-Eco Industries, Inc.; 22-30.
   e. Vimasco Corporation; 760.
   f. Or equivalent.

C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-96.
   c. Or equivalent.

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

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

   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.
   e. Or equivalent.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

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

   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.
   f. Or equivalent.

F. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

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

   a. Childers Products, Division of ITW; CP-96.
   c. Or equivalent.


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

   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.
f. Or equivalent.

H. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   
a. Dow Chemical Company (The); 739, Dow Silicone.
e. Speedline Corporation; Speedline Vinyl Adhesive.
f. Or equivalent.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.
g. Or equivalent.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.


C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   
a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
e. Mon-Eco Industries, Inc.; 55-10.
f. Or equivalent.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; Encacel.
      b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
      c. Marathon Industries, Inc.; 570.
      d. Mon-Eco Industries, Inc.; 55-70.
      e. Or equivalent.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-10.
      b. Foster Products Corporation, H. B. Fuller Company; 35-00.
      c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
      e. Mon-Eco Industries, Inc.; 55-50.
      f. Vimasco Corporation; WC-1/WC-5.
      g. Or equivalent.
   2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 200 deg F.
   4. Solids Content: 63 percent by volume and 73 percent by weight.

2.6 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-52.
      b. Foster Products Corporation, H. B. Fuller Company; 81-42.
      c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
f. Or equivalent.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.

3. Service Temperature Range: Minus 50 to plus 180 deg F.


2.7 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 30-45.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Pittsburgh Corning Corporation; Pittseal 444.
   f. Vimasco Corporation; 750.
   g. Or equivalent.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-70.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
   f. Or equivalent.

3. Materials shall be compatible with insulation materials, jackets, and substrates.

4. Permanently flexible, elastomeric sealant.

5. Service Temperature Range: Minus 100 to plus 300 deg F.

6. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

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

   a. Childers Products, Division of ITW; CP-76-8.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.
   f. Or equivalent.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-76.
   b. Or equivalent.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
      2) Or equivalent.
6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
2) Or equivalent.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
      2) Or equivalent.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Vimasco Corporation; Elastafab 894.
      b. Or equivalent.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; Chil-Glas No. 5.
      b. Or equivalent.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      b. Vimasco Corporation; Elastafab 894.
      c. Or equivalent.
2.10 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Or equivalent.

2.11 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.
   e. Or equivalent.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: Color as selected by the Owner’s Representative and the Architect.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.
   d. Or equivalent.
   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 2.5-mil-thick Polysurlyn.
   e. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
   a. Sheet and roll stock ready for shop or field sizing.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: 2.5-mil-thick Polysurlyn.
   e. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stuccoembossed aluminum-foil facing.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Polyguard; Alumaguard 60.
   b. Or equivalent.
F. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.
   b. Or equivalent.

G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flamespread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.
   b. Or equivalent.


1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
   b. Or equivalent.

2.12 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   e. Or equivalent.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Bilrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
   e. Or equivalent.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Bilrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
   e. Or equivalent.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Bilrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.
   e. Or equivalent.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
   b. Or equivalent.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
   b. Or equivalent.

2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.
   d. Or equivalent.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 316; 0.015 inch thick, 3/4-inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size shall be as determined by manufacturer for application.
B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
   
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) 4) Nelson Stud Welding; TPA, TPC, and TPS.
      5) Or equivalent.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
      5) Or equivalent.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
      4) Or equivalent.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely
in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1) GEMCO; Nylon Hangers.
   2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   3) Or equivalent.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
   2) GEMCO; Press and Peel.
   3) Midwest Fasteners, Inc.; Self Stick.
   4) Or equivalent.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1) AGM Industries, Inc.; RC-150.
   2) GEMCO; R-150.
   3) Midwest Fasteners, Inc.; WA-150.
   4) Nelson Stud Welding; Speed Clips.
   5) Or equivalent.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inches thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      
      1) GEMCO.
      2) Midwest Fasteners, Inc.
      3) Or equivalent.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

1. Manufacturer’s and Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   b. Childers Products.
   c. PABCO Metals Corporation.
   d. RPR Products, Inc.
   e. Or equivalent.

2.14 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

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

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.
J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.
3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
   2. Pipe: Install insulation continuously through floor penetrations.
   3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."
3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gauges, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Boiler Breechings and Ducts:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

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

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100% (percent) coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor discharge weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100% (percent) coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor barrier seal.

   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.10 PHENOLIC INSULATION INSTALLATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.11 POLYISOCYANURATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of polyisocyanurate insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.12 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of polyolefin pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.13 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed section of polystyrene insulation to valve body.
   2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.

3.14 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-pre-sized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install pre-sized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish-mouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.15 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.16 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.


B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

   1. Inspect ductwork, randomly selected by the Engineer and/or Owner’s Representative, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to 2 location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

   2. Inspect field-insulated equipment, randomly selected by Architect, by removing field applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to 2 location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

   3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to 3 locations of straight pipe, 3 locations of threaded fittings, 3 locations of welded fittings, 2 locations of threaded strainers, 2 locations of welded strainers, 3 locations of threaded valves, and 3 locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.18 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in nonconditioned space.
   4. Indoor, exposed return located in nonconditioned space.
   5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
5. Flexible connectors.
7. Factory-insulated access panels and doors.

3.19 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air, return air, outdoor air and exhaust air duct insulation shall be:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, rectangular, supply-air, return-air and outdoor-air duct insulation shall be:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density with the exception of located within mechanical rooms.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density for ductwork located within mechanical rooms.

C. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density with the exception of located within mechanical rooms.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density for ductwork located within mechanical rooms.

D. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated board; thickness as required to achieve 2-hour fire rating.

E. Concealed, supply-air, return-air, outdoor-air and exhaust-air plenum insulation shall be:

1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density with the exception of located within mechanical rooms.
2. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density for ductwork located within mechanical rooms.
F. Exposed, round and flat-oval, supply-air, return air, outside air and exhaust air duct insulation shall be:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

G. Exposed, rectangular, supply-air, return-air and outdoor-air duct insulation shall be:
   1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

H. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated board; thickness as required to achieve 2-hour fire rating.

I. Exposed, supply-air, return-air, outside-air and exhaust-air plenum insulation shall be:
   1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

3.20 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Concealed, round and flat-oval, supply-air, return-air, outside-air and exhaust-air duct insulation shall be:
   1. Phenolic: 2 inches thick with specified field applied jacket coating.

C. Concealed, rectangular, supply-air, return-air, outside-air and exhaust-air duct and plenum insulation shall be:
   1. Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density with specified field applied jacket coating.

D. Exposed, round and flat-oval, supply-air, return-air, outside-air and exhaust-air duct insulation shall be:
   1. Phenolic: 2 inches thick with specified field applied jacket coating.

E. Exposed, rectangular, supply-air, return-air, outside-air and exhaust-air duct and plenum insulation shall be:
   1. Mineral-Fiber Board: 3 inches thick and 6-lb/cu. ft. nominal density with specified field applied jacket coating.

3.21 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
C. Chilled-water, Condenser-water, Dual-service heating and cooling, Heating-hot-water and Heat recovery pumps insulation shall be one of the following:

1. Cellular Glass: 3 inches thick.

D. Chilled-water and Condenser-water; Dual-service heating and cooling; Heating-hot-water; and Heat-recovery expansion/compression tank and air-separator insulation shall be one of the following:

1. Calcium Silicate: 2 inches thick.
3. Phenolic: 1 inch thick.
4. Polyisocyanurate: 1 inch thick.
5. Polyolefin: 1 inch thick.

E. Piping system filter-housing insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 6-lb/cu. ft. nominal density.

3.22 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.23 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Chilled Water, above 40 Deg F:

1. NPS 2 and Smaller: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 2 inches thick.
2. NPS 2-1/2 and Larger: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I or Pipe Insulation Wicking System: 3 inches thick.
C. Condenser-Water Supply and Return:
   1. NPS 4 and Smaller: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
   2. NPS 5 and Larger: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

D. Heating-Hot-Water Supply and Return, 200 Deg F and below:
   1. NPS 4 and Smaller: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
   2. NPS 5 and Larger: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 3 inches thick.

E. Steam and Steam Condensate, 350 Deg F and below:
   1. NPS 3/4 and Smaller: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
   2. NPS 1 and Larger: Insulation shall be: Mineral-Fiber, Preformed Pipe, Type I: 3 inches thick.

F. Refrigerant Suction and Hot-Gas Piping:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

G. Refrigerant Suction and Hot-Gas Flexible Tubing:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Flexible Elastomeric: 1 inch thick.
      b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

H. Hot Service Drains:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Calcium Silicate: 1-1/2 inches thick.
      b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

I. Hot Service Vents:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Calcium Silicate: 1-1/2 inches thick.
      b. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
3.24 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
   1. None.

D. Ducts and Plenums, Exposed:
   1. Aluminum, Smooth 0.024 inch thick.

E. Equipment, Concealed:
   1. None.

F. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. Aluminum, Smooth 0.020 inch thick.

G. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Aluminum, Smooth with 4-by-1-Inch Box Ribs: 0.040 inch thick.

H. Piping, Concealed:
   1. None.

I. Piping, Exposed:
   1. Aluminum, Smooth 0.020 inch thick.

END OF SECTION 230700
SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. OPR, BoD, and BoD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY
A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."
B. Related Sections include the following:
   1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

1.3 DEFINITIONS
A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
B. BoD: Basis of Design.
C. BoD-HVAC: HVAC systems basis of design.
D. CxA: Commissioning Authority.
E. OPR: Owner's Project Requirements.
F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
G. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES
A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."
B. Each Contractor:
   1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.

C. Mechanical Contractor:
   1. Attend TAB verification testing.
   2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Contractor:
      a. Verify the following:
         1) Accessibility of equipment and components required for TAB Work.
         2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
         3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
         4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
         5) Air and water flow rates have been specified and compared to central equipment output capacities.
      b. Identify discontinuities and omissions in the Contract Documents.
      c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

   2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" and

F. Electrical Contractor:
   1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
   2. Attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."
B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.
2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
3. Control sequences for HVAC systems.
4. Strength of control signal for each set point at specified conditions.
5. Responses to control signals at specified conditions.
6. Sequence of response(s) to control signals at specified conditions.
7. Electrical demand or power input at specified conditions.
9. Expected performance of systems, subsystems, and equipment at each step of test.
10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
11. Interaction of auxiliary equipment.
12. Issues log.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from each Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

E. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.

G. Corrective Action Documents: CxA shall submit corrective action documents.

H. Certified TAB Reports: CxA shall submit verified, certified TAB reports.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

    a. Supply and return flow rates for VAV and constant volume systems in each operational mode.
    b. Operation of terminal units in both heating and cooling cycles.
    c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflow rates.
    d. Building pressurization.
    e. Total exhaust airflow and total outdoor-air intake.
    f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.
12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

1. Occupied and unoccupied.
2. Warm up and cool down.
3. Economizer cycle.
4. Emergency power supply.
5. Life-safety and safety systems.
6. Smoke control.
7. Fire safety.
8. Stair pressurization system.
9. Temporary upset of system operation.
10. Partial occupancy conditions.
11. Special cycles.

3.2 TAB VERIFICATION

A. TAB Contractor shall coordinate with CxA for work required in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" TAB Contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Each Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

   1. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

      a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork Air Leakage Testing:

   1. Architect will identify, for HVAC Contractor and CxA, portions of duct systems to have ductwork air leakage testing. Ductwork air leakage testing shall be performed according to Division 23 Section "Metal Ducts," and shall be witnessed by the CxA.

   2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.
E. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Contractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:
   a. For all readings other than sound, a deviation of more than 10 percent.
      1) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)
4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

F. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

G. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from the new central rooftop air handling unit through the new distribution systems including the new VAV boxes and terminal heating coils to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
D. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Contractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation for HVAC Controls" The CxA, HVAC Contractor, and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.
2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

F. Pipe cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC Contractor shall prepare pipe system cleaning, flushing, and hydrostatic testing. CxA shall review and comment on plan and final reports. CxA shall certify that pipe cleaning, flushing, hydrostatic tests, and chemical treatment have been completed. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

G. Rooftop Unit Testing: HVAC Contractor shall prepare a testing plan to verify performance of the new rooftop air handling unit including the chilled water cooling coil; hot water heating coil; steam humidifier; UVC lights; filter differential pressure monitors; supply and return fans and static pressure controllers; smoke detection and dampers; all control points including all safety and alarm points including freeze protection. Plan shall include the following:

1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

H. VAV boxes and Terminal Heating Coils Testing: HVAC Contractor shall prepare a testing plan to verify performance of all of the new VAV boxes and terminal heating coils as well as of all of the new temperature and humidity sensors. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each item of equipment and pipe test
section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

I. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air and hydronic distribution systems and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

J. Vibration and Sound Tests: HVAC Contractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.

K. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

L. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

END OF SECTION 230800
SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1   RELATED DOCUMENTS

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

1.2   SUMMARY

   A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

   B. Provide an extension of the existing TCNJ building management and control system that is completely compatible with the existing systems. Provide any and all additional equipment, control panels and modules, hardware and software, power and all wiring and programming as required for a complete and functioning system and to accomplish the sequences of operation.

   C. Related Sections include the following:

   1. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.
   2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.
   3. Division 23 Section “Air Duct Accessories” for requirements that relate to this Section.

1.3   DEFINITIONS

   A. DDC: Direct digital control.

   B. I/O: Input/output.

   C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

   D. MS/TP: Master slave/token passing.

   E. PC: Personal computer.

   F. PID: Proportional plus integral plus derivative.

   G. RTD: Resistance temperature detector.

1.4   SYSTEM PERFORMANCE

   A. Comply with the following performance requirements:
1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
   a. Water Temperature: Plus or minus 1 deg F.
   b. Water Flow: Plus or minus 5 percent of full scale.
   c. Water Pressure: Plus or minus 2 percent of full scale.
   d. Space Temperature: Plus or minus 1 deg F.
   e. Ducted Air Temperature: Plus or minus 1 deg F.
   f. Outside Air Temperature: Plus or minus 2 deg F.
   g. Dew Point Temperature: Plus or minus 3 deg F.
   h. Temperature Differential: Plus or minus 0.25 deg F.
   i. Relative Humidity: Plus or minus 5 percent.
   j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
   k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
   l. Airflow (Terminal): Plus or minus 10 percent of full scale.
   m. Air Pressure (Space): Plus or minus 0.01-inch wg.
   n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
   o. Carbon Monoxide: Plus or minus 5 percent of reading.
   p. Carbon Dioxide: Plus or minus 50 ppm.
   q. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION
A. Refer to Specification Division 23 Section 230993 for the Sequence of Operation.

1.6 SUBMITTALS
A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relaysswitches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
   2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   4. Details of control panel faces, including controls, instruments, and labeling.
   5. Written description of sequence of operation.
   6. Schedule of dampers including size, leakage, and flow characteristics.
   7. Schedule of valves including flow characteristics.
   8. DDC System Hardware:
      a. Wiring diagrams for control units with termination numbers.
      b. Schematic diagrams and floor plans for field sensors and control hardware.
      c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
   9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:
      a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
      b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
      c. Written description of sequence of operation including schematic diagram.
      d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135 and LonWorks.

D. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

E. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

F. Software and Firmware Operational Documentation: Include the following:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
   3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

H. Qualification Data: For installer and manufacturer.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with the following Sections in Division 26:
1. Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
2. Section “Electrical Wiring” to coordinate supply of conditioned electrical branch circuits for control units and operator workstations.
3. Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
4. Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
5. Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices

C. Coordinate equipment with the following Sections in Division 27:
1. Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with the following Sections in Division 28:
1. Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with the building master clock.
2. Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
3. Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
4. Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique damper motor, valve motor, controller, thermostat and positioning relay.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2.2 CONTROL SYSTEM

A. Manufacturers: Honeywell.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

C. Control system shall include the following:

1. Building lighting control system specified in Division 26 Section "Network Lighting Controls."
2. Fire alarm system specified in Division 28 Section "Fire Detection and Alarm."

2.3 DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
   a. Global communications.
   b. Discrete/digital, analog, and pulse I/O.
   c. Monitoring, controlling, or addressing data points.
   d. Software applications, scheduling, and alarm processing.
   e. Testing and developing control algorithms without disrupting field hardware and controlled environment.
3. Standard Application Programs:
   a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
   b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
   c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
   d. Remote communications.
   e. Maintenance management.
   f. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
6. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
   1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
      a. Global communications.
      b. Discrete/digital, analog, and pulse I/O.
      c. Monitoring, controlling, or addressing data points.
   3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
   4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
   5. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
   1. Binary Inputs: Allow monitoring of on-off signals without external power.
   2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
   3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
   4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
   5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
   7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
   1. Output ripple of 5.0 mV maximum peak to peak.
   2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. LonWorks Compliance: Communicate using EIA/CEA 709.1 datalink/physical layer protocol using LonTalk protocol.
5. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
6. Enclosure: Waterproof rated for operation at 40 to 150 deg F.

2.5 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
2. Proportional band shall extend from 2 to 20 percent for 5 psig.
3. Authority shall be 20 to 200 percent.
4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
5. Gages: 2-1/2 inches in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.6 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. Ebtron, Inc.
   c. Heat-Timer Corporation.
   d. I.T.M. Instruments Inc.
   e. MAMAC Systems, Inc.
   f. RDF Corporation.
   g. Or equivalent.

2. Accuracy: Plus or minus 0.5 deg F at calibration point.
4. Insertion Elements in Ducts: Single point, 18 inches long (if ductwork is 18-inches or wider otherwise utilize an 8-inch element); use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: 36-inches long, flexible or 18-inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

   a. Set-Point Adjustment: Exposed Concealed;
   b. Set-Point Indication: Exposed;
   c. Thermometer: Exposed, Red-reading glass;
   d. Color: TBD by Architect;
e. Orientation: Horizontal.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

C. RTDs and Transmitters:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. MAMAC Systems, Inc.
   c. RDF Corporation.
   d. Or equivalent.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
4. Insertion Elements in Ducts: Single point, 18 inches long (if ductwork is 18-inches or wider otherwise utilize an 8-inch element); use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: 36-inches long, flexible or 18-inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

   a. Set-Point Adjustment: Exposed Concealed;
   b. Set-Point Indication: Exposed;
   c. Thermometer: Exposed, Red-reading glass;
   d. Color: TBD by Architect;
   e. Orientation: Horizontal.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.
   g. Or equivalent.

2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
a. Set-Point Adjustment: Concealed;  
b. Set-Point Indication: Concealed;  
c. Color: TBD by Architect;  
d. Orientation: Horizontal.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.
   g. Or equivalent.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Exposed.
4. Color: To be selected by the Architect.
5. Orientation: Horizontal.

G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
3. Adjusting Key: As required for calibration and cover screws.

2.7 THERMOSTATS

A. Manufacturers:

1. Erie Controls.
4. tekmar Control Systems, Inc.
5. Theben AG - Lumilite Control Technology, Inc.
6. Or equivalent.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF".
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on weekday, Saturday, and Sunday.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
   1. Bulbs in water lines with separate wells of same material as bulb.
   2. Bulbs in air ducts with flanges and shields.
   3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
   4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
   5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
   6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
   2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point

I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

K. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

L. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
   2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
2.8 HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.
3. Or equivalent.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.9 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:
   a. Belimo Aircontrols (USA), Inc.
   b. Or equivalent.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.

3. Dampers: Size for running torque calculated as follows:

   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
   e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
7. Power Requirements (Two-Position Spring Return): 24 or 120-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 30 seconds.

C. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required and start-point adjustment and positioning relay. Operator shall maintain full shutoff at maximum pump differential pressure.

D. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Where actuators operate in sequence, provide pilot positioners.

1. Pilot Positioners: With the following characteristics:
   a. Start Point: Adjustable from 2 to 12 psig.
   b. Operating Span: Adjustable from 5 to 13 psig.
   c. Linearity: Plus or minus 10 percent of output signal span.
   d. Hysteresis: 3 percent of span.
   e. Response: 0.25-psig input change.
   g. Maximum Control Air-Supply Pressure: 60 psig.

2. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 deg F unless located in return-air plenums.

2.10 CONTROL VALVES

A. Manufacturers:

2. Erie Controls.
3. Hayward Industrial Products, Inc.
5. Neles-Jamesbury.
6. Parker Hannifin Corporation; Skinner Valve Division.
7. Pneuline Controls.
8. Sauter Controls Corporation.
9. Or equivalent.
B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
   2. Disc Type: Elastomer-coated ductile iron.
   3. Sizing: 1-psig maximum pressure drop at design flow rate.

E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
   1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
   3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Thermostatic Operator: Liquid-filled integral sensor with integral adjustable dial.

2.11 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. Don Park Inc.; Autodamp Div.
3. TAMCO (T. A. Morrison & Co. Inc.).
4. United Enertech Corp.
5. Vent Products Company, Inc.
6. Or equivalent.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatabl e blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 CFM per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.12 CONTROL DEVICES:

A. Pressure Transmitters/Transducers:

1. Manufacturers:
   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.
   f. Vaisala.
   g. Or equivalent.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg.

d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.

4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.

5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

B. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.

2. Set-Point Indication: Exposed.


4. Color: Custom Color as selected by the Architect.

5. Orientation: Horizontal.

C. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.

2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.

3. Adjusting Key: As required for calibration and cover screws.

2.13 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available and provide all wiring and conduits as required to provide conditioned power to control units and operator workstation.

B. Verify that all duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor to comply with ADA. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:
   1. Entrances.
   2. Public areas.
   3. Where indicated.

E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

I. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."

J. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

K. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

L. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

M. Provide emergency power as required for all control panels and associated devices. Provide low voltage wiring to power all control devices as required including automatic dampers; smoke and combination fire/smoke dampers; automatic valves; VAV Boxes; etc. Install all wiring in accordance with Division 26.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
5. Test each point through its full operating range to verify that safety and operating control set points are as required.
6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
7. Test each system for compliance with sequence of operation.
8. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.

7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.

8. Check temperature instruments and material and length of sensing elements.

9. Check control valves. Verify that they are in correct direction.

10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.

11. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.
   d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:

   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:
a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three additional site visits during other than normal occupancy hours for this purpose.

3.6 GRAPHIC DISPLAYS

A. Update the graphic displays on the new Operators Interface Station to incorporate all of the new control systems, zones and devices and setpoints and alarms that are provided as part of this project. Demonstrate that all of the new controls have been properly “mapped” and represented on the existing graphic display system to the Owner and Engineer.

3.7 COMMISSIONING

A. Engage a factory-authorized service representative to assist the Engineer with commissioning the new control systems as specified in Section 230800 “Commissioning of HVAC Systems”

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900
SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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 control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

   1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. VAV: Variable air volume.

1.4 CONTROL SEQUENCE UPDATES

A. Demolition:

   1. The scope of the project will include updating the existing Building Management System as needed to reflect the demolition of existing systems. This shall include but not be limited to the demolition of the following systems and associated controls and control sequences:

      a. Existing heating and ventilating unit, HV-2,
      b. Existing supply air fans, SF-5 and SF-6,
      c. Existing exhaust air fans, EF-4 and EF-5.

   2. Remove all associated control sequences of operation and associated system monitoring and/or display and associated graphics from the system.

1.5 EXISTING AIR-CONDITIONING-UNIT, AC-1 AND REMOTE CONDENSING UNIT CONTROL SEQUENCES

A. Operation:

   1. Existing Air Conditioning Unit, AC-1 and associated remote condensing unit shall continue to run as previously controlled via the existing Building Management System and shall be continued
to be controlled to maintain space temperature per the existing sequence of operation – which was in place prior to this project.

2. Existing Air Conditioning Unit, AC-1 and associated remote condensing unit shall be shut down upon receiving a signal from the existing fire alarm system identifying that there has been an event in one of the new kitchen hoods installed in the renovated Servery space which triggered an alarm. *Coordinate work with the kitchen hood supplier and the fire alarm system provider as needed.*

1.6 NEW EXHAUST FANS, EF-1, EF-2 AND EF-4 CONTROL SEQUENCES

A. Operation:

1. Action: Exhaust air fans, EF-1, EF-2 and EF-4 shall be energized to run 24 hours per day, 7 days per week through the existing Building Management System.
   a. Exhaust air Fans, EF-1 and EF-2 shall run even in the event of an alarm condition as sensed by the new kitchen hood alarm system and associated control panel.

2. Display:
   a. Status of each exhaust air fan at the existing main Building Management System work station.

1.7 EXISTING HEATING AND VENTILATING UNIT, HV-1 AND ASSOCIATED EXISTING EXHAUST AIR FAN, EF-3

A. Operation:

1. Action:
   a. Existing Heating and Ventilating Unit, HV-1 and associated existing exhaust air fan, EF-3 shall continue to run only when controlled to do so via the existing controller which is part of the existing kitchen hood control system.
   b. Existing Heating and Ventilating Unit, HV-1 and associated existing exhaust air fan, EF-3 shall continue to run only when controlled to do so via the existing controller which is part of the existing kitchen hood control system.
   c. Existing Heating and Ventilating Unit, HV-1 shall be de-energized when controlled to do so via the existing controller which is part of the existing kitchen hood control system.
   d. Existing exhaust air fan, EF-3 shall continue to run when there is an event in the existing kitchen hood as sensed by the existing kitchen hood control system.

2. Display:
a. Status of the heating and ventilation unit, HV-1 and associated existing exhaust air fan, EF-3 shall be continued to be monitored at the existing main Building Management System work station.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION (Not Applicable)

END OF SECTION 230993
SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Chilled water piping
   2. Hot-water heating and reheat piping.
   3. AC condensate piping
   5. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:
   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Chilled and Hot Water Heating and Reheat Piping: 200 psig at 200 deg F.
   2. Makeup-Water Piping: 80 psig at 150 deg F.
   3. Condensate-Drain Piping: 150 deg F.
   4. Blowdown-Drain Piping: 200 deg F.
   5. Air-Vent Piping: 200 deg F.
   6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.
1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Plastic pipe and fittings with solvent cement.
   2. RTRP and RTRF with adhesive.
   3. Pressure-seal fittings.
   4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   5. Air control devices.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
   2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

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

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

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

   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic Company of America.
   d. Or equivalent.

2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.

3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Copper or Bronze Pressure-Seal Fittings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Stadler-Viega.
   b. Or equivalent.

2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

F. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. T-DRILL Industries Inc.
   b. Or equivalent.

G. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.


E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.
H. Grooved Mechanical-Joint Fittings and Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Central Sprinkler Company; a division of Tyco Fire & Building Products.
   c. National Fittings, Inc.
   d. S. P. Fittings; a division of Star Pipe Products.
   e. Victaulic Company of America.
   f. Or equivalent.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pressure-Seal Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Victaulic Company of America.
   b. Or equivalent.

2. Housing: Steel.
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 300-psig working-pressure rating at 230 deg F.

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.


C. CPVC Solvent Cement: ASTM F 493.
D. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.


F. PVC Solvent Cement: ASTM D 2564.

2.4 FIBERGLASS PIPE AND FITTINGS

A. RTRP: ASTM D 2996, filament-wound pipe with tapered bell and spigot ends for adhesive joints.

B. RTRF: Compression or spray-up/contact molded of same material, pressure class, and joining method as pipe.

C. Flanges: ASTM D 4024. Full-face gaskets suitable for the service, minimum 1/8-inch thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.

D. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.5 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

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

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.


G. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. IPEX Inc.
   c. KBi.
   d. Or equivalent.

2. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.
   e. Or equivalent.

2. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.7 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Central Plastics Company.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
   f. Or equivalent.

2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Central Plastics Company.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   d. Or equivalent.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.
   e. Or equivalent.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Calpico, Inc.
   b. Lochinvar Corporation.
   c. Or equivalent.

2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Victaulic Company of America.
   e. Or equivalent.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.8 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Plastic Ball Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Valve, Inc.
   b. Asahi/America.
   c. Charlotte Pipe and Foundry Company.
   d. Colonial Engineering.
   e. George Fischer Inc.
   f. Hayward Industrial Products, Inc.
   g. IPEX Inc.
   h. Jomar International Ltd.
   i. KBi.
j. Legend Valve.  
k. NIBCO INC.  
l. Plast-O-Matic Valves, Inc.  
m. SMC The Specialty Mfg. Co.  
n. Thermoplastic Valves Inc.  
o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.  
p. Or equivalent.

2. Body: Three-piece CPVC or PVC to match piping.  
3. Ball: Full-port CPVC or PVC to match piping.  
4. Seats: PTFE.  
5. Seals: EPDM.  
6. End Connections: Socket, union, or flanged.  
7. Handle Style: Tee shape.  
8. CWP Rating: Equal to piping service.  
10. Comply with MSS SP-122.

D. Plastic Butterfly Valves:

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

   a. American Valve, Inc.  
   b. Asahi/America.  
   c. Colonial Engineering.  
   d. George Fischer Inc.  
   e. Hayward Industrial Products, Inc.  
   f. IPEX Inc.  
   g. Legend Valve.  
   h. NIBCO INC.  
   i. Plast-O-Matic Valves, Inc.  
   j. SMC The Specialty Mfg. Co.  
   k. Thermoplastic Valves Inc.  
   l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.  
   m. Or equivalent.

2. Body: PVC or CPVC to match piping wafer type for installation between flanges.  
4. Seats: PTFE.  
5. Handle Style: Locking lever.  
6. CWP Rating: Equal to piping service.  
7. Maximum Operating Temperature: Equal to piping service.

E. Plastic Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
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a. American Valve, Inc.
b. Asahi/America.
c. Colonial Engineering.
d. George Fischer Inc.
e. Hayward Industrial Products, Inc.
f. IPEX Inc.
g. KBi.
h. Legend Valve.
i. NIBCO INC.
j. Plast-O-Matic Valves, Inc.
k. SMC The Specialty Mfg. Co.
l. Thermoplastic Valves Inc.
m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
n. Or equivalent.

2. Body: Three-piece PVC or CPVC to match piping.
3. Ends: Socket or flanged.
4. Seats: PTFE.
5. Check Style: Swing or ball type.
6. CWP Rating: Equal to piping service.
7. Maximum Operating Temperature: Equal to piping service.

F. Bronze, Calibrated-Orifice, Balancing Valves:

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

a. Armstrong Pumps, Inc.
b. Bell & Gossett Domestic Pump; a division of ITT Industries.
c. Flow Design Inc.
d. Gerand Engineering Co.
e. Griswold Controls.
f. Taco.
g. Or equivalent.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
8. Handle Style: Lever, with memory stop to retain set position.
10. Maximum Operating Temperature: 250 deg F.

G. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.
   g. Tour & Andersson; available through Victaulic Company of America.
   h. Or equivalent.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
9. Handle Style: Lever, with memory stop to retain set position.
11. Maximum Operating Temperature: 250 deg F.

H. Diaphragm-Operated, Pressure-Reducing Valves:

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

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   g. Or equivalent.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
I. Diaphragm-Operated Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   g. Or equivalent.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
8. Inlet Strainer: removable without system shutdown.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

J. Automatic Flow-Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Flow Design Inc.
   b. Griswold Controls.
   c. Or equivalent.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Corrosion resistant, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
9. Maximum Operating Temperature: 250 deg F.
2.9 AIR CONTROL DEVICES

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

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Or equivalent.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
4. Inlet Connection: NPS 1/2.
7. Maximum Operating Temperature: 240 deg F.

D. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

E. Diaphragm-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

F. Tangential-Type Air Separators:
   1. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature.
   2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
   3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
   5. Size: Match system flow capacity.

G. In-Line Air Separators:
   1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
   3. Maximum Operating Temperature: Up to 300 deg F.

H. Air Purgers:
   1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
   3. Maximum Operating Temperature: 250 deg F.

2.10 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
   1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.11 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

C. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

D. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

E. Spherical, Rubber, Flexible Connectors:
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Chilled and Hot water heating and reheat piping, aboveground, NPS 2 and smaller, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Chilled and Hot-water heating and reheat piping, aboveground, NPS 2-1/2 and larger shall be:
   1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints

C. Chilled and Hot-water heating piping installed below ground and/or within slabs shall be:
   1. RTRP and RTRF with adhesive or flanged joints.

D. Makeup-water piping installed aboveground shall be:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

E. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

F. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

G. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

H. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

I. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
B. Install calibrated-orifice, balancing valves at each branch connection to return main.
C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.
F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS
A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

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

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


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

I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
   1. Install tank fittings that are shipped loose.
   2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics:
   1. pH: 9.0 to 10.5 pH.
   2. "P" Alkalinity: 100 to 500 ppm.
   3. Boron: 100 to 200 ppm.
   4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
   5. Corrosion Inhibitor:
      a. Sodium Nitrate: 1000 to 1500 ppm.
      b. Molybdate: 200 to 300 ppm.
      c. Chromate: 200 to 300 ppm.
      d. Sodium Nitrate Plus Molybdate: 100 to 200 ppm each.
      e. Chromate Plus Molybdate: 50 to 100 ppm each.
6. Soluble Copper: Maximum 0.20 ppm.
7. Tolytriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
8. Total Suspended Solids: Maximum 10 ppm.
10. Free Caustic Alkalinity: Maximum 20 ppm.
11. Microbiological Limits:
   a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
   b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
   c. Nitrate Reducers: 100 organisms/ml.
   d. Sulfate Reducers: Maximum 0 organisms/ml.
   e. Iron Bacteria: Maximum 0 organisms/ml.

B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113
SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following for low and high pressure (LP and HP) steam and condensate piping:

1. Pipe and fittings.
2. Strainers.
3. Flash tanks.
4. Safety valves.
5. Pressure-reducing valves.
6. Steam traps.
7. Thermostatic air vents and vacuum breakers.
8. Steam and condensate meters.

1.3 DEFINITIONS

A. HP Systems: High-pressure piping operating at more than 15 psig as required by ASME B31.1.

B. LP Systems: Low-pressure piping operating at 15 psig or less as required by ASME B31.9.

C. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

D. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1. HP Steam Piping: 250 PSIG
2. LP Steam Piping: 200 PSIG
3. Condensate Piping: 200 PSIG at 250 deg F.
4. Makeup-Water Piping: 80 PSIG at 150 deg F.
5. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
6. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
7. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. RTRP and RTRF with adhesive.
   2. Pressure-reducing and safety valve.
   3. Steam trap.
   4. Air vent and vacuum breaker.
   5. Flash tank.
   6. Meter.

B. Shop Drawings: Detail, 1/4 inch equals 1 foot scale, flash tank assemblies and fabrication of pipe anchors, hangers, pipe, multiple pipes, alignment guides, and expansion joints and loops and their attachment to the building structure. Detail locations of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

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

C. Pipe Welding: Qualify processes and operators according to the following:
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels...
shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L or ASTM B 88, Type M to match the facility’s existing standard.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. Wrought-Copper Fittings and Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, plain ends, Type, Grade, and Schedule as indicated in Part 3 piping applications articles.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in Part 3 piping applications articles.

C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in Part 3 piping applications articles.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 piping applications articles.

E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in Part 3 piping applications articles; raised ground face, and bolt holes spot faced.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

I. Stainless-Steel Bellows, Flexible Connectors:

2. End Connections: Threaded or flanged to match equipment connected.
5. Maximum Operating Temperature: 250 deg F.

2.3 FIBERGLASS PIPE AND FITTINGS

A. RTRP: ASTM D 2996 filament-wound pipe with tapered bell and spigot ends for adhesive joints.

B. RTRF: Compression or spray-up/contact molded fittings of same material, pressure class, and joining method as pipe.

C. Flanges: ASTM D 4024 full-face gaskets suitable for the service, minimum 1/8 inch thick, 60-70 durometer. ASTM A 307, Grade B, hex head bolts with washers.

D. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

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

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      d. Watts Water Technologies, Inc.
      e. Zurn Plumbing Products Group.
      f. Or equivalent.

   2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      c. Watts Water Technologies, Inc.
      d. Or equivalent.

   2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
      e. Or equivalent.

   2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

   3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure as required to suit system pressures.
2.6 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Stop-Check Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crane Co.
   b. Jenkins Valves; a Crane Company.
   c. Lunkenheimer Valves.
   d. A.Y. McDonald Mfg. Co.
   e. Or equivalent.

2. Body and Bonnet: Malleable iron.
4. Disc: Cylindrical with removable liner and machined seat.
5. Stem: Brass alloy.
6. Operator: Outside screw and yoke with cast-iron handwheel.
8. Pressure Class: 250.

2.7 STRAINERS

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. CWP Rating: 250-psig working steam pressure.

B. Basket Strainers:

1. Body: ASTM A 126, Class B cast iron, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 250-psig working steam pressure.
2.8 FLASH TANKS

A. Shop or factory fabricated of welded steel according to ASME Boiler and Pressure Vessel Code, for 150-psig rating; and bearing ASME label. Fabricate with tappings for low-pressure steam and condensate outlets, high-pressure condensate inlet, air vent, safety valve, and legs.

2.9 SAFETY VALVES

A. Bronze Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Kunkle Valve; a Tyco International Ltd. Company.
   c. Spirax Sarco, Inc.
   d. Watts Water Technologies, Inc.
   e. Or equivalent.

2. Disc Material: Forged copper alloy.
3. End Connections: Threaded inlet and outlet.
4. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.
7. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Safety Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Kunkle Valve; a Tyco International Ltd. Company.
   c. Spirax Sarco, Inc.
   d. Watts Water Technologies, Inc.
   e. Or equivalent.

2. Disc Material: Forged copper alloy with bronze nozzle.
3. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
4. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
5. Pressure Class: 250.
6. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
7. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.

2.10 PRESSURE-REDUCING VALVES

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

2. Hoffman Specialty; Division of ITT Industries.
3. Leslie Controls, Inc.
5. Spirax Sarco, Inc.
6. Or equivalent.

B. Size, Capacity, and Pressure Rating: Factory set for inlet and outlet pressures indicated.

C. Description: Pilot-actuated, diaphragm type, with adjustable pressure range and positive shutoff.

D. Body: Cast iron.

E. End Connections: Threaded connections for valves NPS 2 and smaller and flanged connections for valves NPS 2-1/2 and larger.

F. Trim: Hardened stainless steel.

G. Head and Seat: Replaceable, main head stem guide fitted with flushing and pressure-arresting device cover over pilot diaphragm.

H. Gaskets: Non-asbestos materials.

I. Capacities and Characteristics – Refer to Drawings

2.11 STEAM TRAPS

A. Thermostatic Traps:

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

   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
d. Hoffman Specialty; Division of ITT Industries.
e. Spirax Sarco, Inc.
f. Sterling.
g. Or equivalent.

2. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
3. Trap Type: Balanced-pressure.
4. Bellows: Stainless steel or monel.
5. Head and Seat: Replaceable, hardened stainless steel.
6. Pressure Class: 125.

B. Thermodynamic Traps:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty; Division of ITT Industries.
   e. Spirax Sarco, Inc.
   f. Or equivalent.

4. Disc and Seat: Stainless steel.
5. Maximum Operating Pressure: 600 psig.

C. Float and Thermostatic Traps:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty; Division of ITT Industries.
   e. Spirax Sarco, Inc.
   f. Sterling.
   g. Or equivalent.

2. Body and Bolted Cap: ASTM A 126, cast iron.
6. Trap Type: Balanced pressure.
7. Thermostatic Bellows: Stainless steel or monel.
8. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.

D. Inverted Bucket Traps:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty; Division of ITT Industries.
   e. Spirax Sarco, Inc.
   f. Sterling.
   g. Or equivalent.
2. Body and Cap: Cast iron.
7. Strainer: Integral stainless-steel inlet strainer within the trap body.

2.12 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Barnes & Jones, Inc.
   c. Dunham-Bush, Inc.
   d. Hoffman Specialty; Division of ITT Industries.
   e. Spirax Sarco, Inc.
   f. Sterling.
   g. Or equivalent.
2. Body: Cast iron, bronze or stainless steel.
5. Thermostatic Element: Phosphor bronze bellows in a stainless-steel cage.
7. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
b. Dunham-Bush, Inc.
c. Hoffman Specialty; Division of ITT Industries.
d. Johnson Corporation (The).
e. Spirax Sarco, Inc.
f. Or equivalent.

2. Body: Cast iron, bronze, or stainless steel.
5. O-ring Seal: EPR.
7. Maximum Temperature Rating: 350 deg F.

2.13 STEAM METERS

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

1. EMCO Flow Systems; Division of Advanced Energy Company.
2. ISTEC Corp.
3. Preso Meters; a division of Racine Federated Inc.
4. Spirax Sarco, Inc.
5. Or equivalent.

B. Meters shall have a microprocessor to display totalizer flow, flow rate, temperature, pressure, time, and date; alarms for high and low flow rate and temperature.

1. Computer shall have 4 to 20-mA or 2 to 10 volt output for temperature, pressure, and contact closure for flow increments.
2. Independent timers to store four peak flow rates and total flow.
3. Interface compatible with central workstation described in Division 23 Section "Instrumentation and Control for HVAC."

C. Sensor: Venturi, of stainless-steel construction, for insertion in pipeline between flanges. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

D. Sensor: Vortex type with stainless-steel wetted parts and flange connections; and with a piezoelectric sensor removable and serviceable without shutting down the process. At least 10:1 turndown with plus or minus 1 percent accuracy over full-flow range.

E. Sensor: Spring-loaded, variable-area flowmeter type; density compensated with stainless-steel wetted parts and flange connections. At least 10:1 turndown with plus or minus 2 percent accuracy over full-flow range.
2.14 CONDENSATE METERS

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

   1. Central Station Steam Co.
   2. Lincoln Meter Company.
   3. Or equivalent.

B. Body: Cast iron, bronze, or brass.

C. Turbine: Copper, brass, or stainless steel.

D. Connections: Threaded for NPS 2 and smaller and flanged for NPS 2-1/2.

E. Totalizer: Meters shall have a microprocessor to display flow, flow rate, time, and date; alarms for high and low flow rate, pressure, and temperature.

   1. Computer shall have 4- to 20-mA or 2- to 10-volt output for temperature, pressure, and contact closure for flow increments.
   2. Independent timers to store four peak flow rates and total flow.
   3. Interface compatible with central workstation specified in Division 23 Section "Instrumentation and Control for HVAC."

F. Pressure Rating: Atmospheric.

G. Maximum Temperature Rating: 250 deg F.

PART 3 - EXECUTION

3.1 LP STEAM PIPING APPLICATIONS

A. LP Steam Piping, NPS 2 and Smaller: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. LP Steam Piping, NPS 2-1/2 and larger: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above grade, NPS 2 and smaller, shall be:

   1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

D. Condensate piping above grade, NPS 2-1/2 and larger, shall be:

   1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
E. Condensate piping below grade, NPS 2 and smaller and smaller, shall be:
   1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

F. Condensate piping below grade, NPS 2-1/2 and larger, shall be:
   1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.2 HP STEAM PIPING APPLICATIONS

A. HP Steam Piping, NPS 2 and smaller and smaller shall be: Schedule 40, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

B. HP Steam Piping, NPS 2-1/2 and larger shall be: Schedule 40, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

C. Condensate piping above grade, NPS 2 and smaller and smaller shall be:
   1. Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

D. Condensate piping above grade, NPS 2-1/2 and larger shall be:
   1. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.3 ANCILLARY PIPING APPLICATIONS

A. Makeup-water piping installed above grade shall be either:
   1. Drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   2. Schedule 80 CPVC plastic pipe and fittings, and solvent welded joints.

B. Makeup-Water Piping Installed below Grade and within Slabs: Annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
C. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

D. Air-Vent Piping:

1. Inlet: Same as service where installed.
2. Outlet: Type K annealed-temper copper tubing with soldered or flared joints.

E. Vacuum-Breaker Piping: Outlet, same as service where installed.

F. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.4 VALVE APPLICATIONS

A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.

B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.5 PIPING INSTALLATION

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

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

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

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

E. Install piping to permit valve servicing.

F. Install piping free of sags and bends.

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

H. Install piping to allow application of insulation.

I. Select system components with pressure rating equal to or greater than system operating pressure.
J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

K. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

L. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.

M. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side down.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

V. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
   1. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 300 feet.
   2. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.

W. Flash Tank:
   1. Pitch condensate piping down toward flash tank.
   2. If more than one condensate pipe discharges into flash tank, install a check valve in each line.
   3. Install thermostatic air vent at tank top.
   4. Install safety valve at tank top.
5. Install full-port ball valve, and swing check valve on condensate outlet.
6. Install inverted bucket or float and thermostatic trap at low-pressure condensate outlet, sized for three times the calculated heat load.
7. Install pressure gage on low-pressure steam outlet according to Division 23 Section "Meters and Gages for HVAC Piping."

3.6 STEAM-TRAP INSTALLATION

A. Install steam traps in accessible locations as close as possible to connected equipment.
B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.7 PRESSURE-REDUCING VALVE INSTALLATION

A. Install pressure-reducing valves in accessible location for maintenance and inspection.
B. Install bypass piping around pressure-reducing valves, with globe valve equal in size to area of pressure-reducing valve seat ring, unless otherwise indicated.
C. Install gate valves on both sides of pressure-reducing valves.
D. Install unions or flanges on both sides of pressure-reducing valves having threaded- or flanged-end connections respectively.
E. Install pressure gages on low-pressure side of pressure-reducing valves after the bypass connection according to Division 23 Section "Meters and Gages for HVAC Piping."
F. Install strainers upstream for pressure-reducing valve.
G. Install safety valve downstream from pressure-reducing valve station.

3.8 STEAM OR CONDENSATE METER INSTALLATION

A. Install meters with lengths of straight pipe upstream and downstream according to steam meter manufacturer's instructions.
B. Provide data acquisition wiring. Refer to Division 23 Section "Instrumentation and Control for HVAC."

3.9 SAFETY VALVE INSTALLATION

A. Install safety valves according to ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping."
B. Pipe safety-valve discharge without valves to atmosphere outside the building.
C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.

D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

3.10 HANGERS AND SUPPORTS

A. Install hangers and supports according to Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with requirements below for maximum spacing.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.

D. Install hangers with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 9 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 9 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 12 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 13 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 14 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 15 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 17 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 21 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 24 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 26 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 30 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 32 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 35 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 37 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 39 feet; minimum rod size, 1-1/4 inches.

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 4 feet; minimum rod size, 1/4 inch.
2. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

G. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

3.11 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

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

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

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube ends. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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

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

I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.12 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install traps and control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install vacuum breakers downstream from control valve, close to coil inlet connection.

E. Install a drip leg at coil outlet.

3.13 FIELD QUALITY CONTROL

A. Prepare steam and condensate piping according to ASME B31.1, "Power Piping" and ASME B31.9, "Building Services Piping," and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

B. Perform the following tests on steam and condensate piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength.
3. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

C. Prepare written report of testing.

END OF SECTION 23 2213
SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2 to plus 10-inch wg. Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
3. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
4. Duct liner.

B. Related Sections include the following:

1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.


1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect and/or Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 SUBMITTALS

A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts.
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevations of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.

D. Field quality-control test reports.

1.6 QUALITY ASSURANCE


B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.


D. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.

E. Stainless Steel: ASTM A 480/A 480M, Type 316.

F. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.

   1. Available Manufacturers:
2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
   a. Thickness: 1 inch.
   b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
   c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      1) Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
      2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
      3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
   1. Available Manufacturers:
      a. Armstrong World Industries, Inc.
      b. Or equivalent.
      a. Thickness: 1 inch.
      b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
      c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
      d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

2.4 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and
complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Available Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.
   d. Or equivalent.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Available Manufacturers:
   a. Ductmate Industries, Inc.
   b. Lockformer.
   c. Or equivalent.

2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal and Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval, Longitudinal and Spiral Lock Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.

1. Available Manufacturers:
D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

   a. Available Manufacturers:
      1) Ductmate Industries, Inc.
      2) Lindab Inc.
      3) Or equivalent.

5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

   a. Available Manufacturers:
      1) Ductmate Industries, Inc.
      3) SEMCO Incorporated.
      4) Or equivalent.

E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:

   a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

   a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
   b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
   c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
   d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

H. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

   1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
   2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
   3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
   4. Other Fittings: Riveted and bonded joints.
   5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.
PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts (before Air Terminal Units): 3-inch wg.
2. Supply Ducts (after Air Terminal Units): 1-inch wg.

B. All ducts shall be galvanized steel except as follows:

1. Range Hood Exhaust Ducts: Comply with NFPA 96.
   b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
   c. Weld and flange seams and joints.
2. Dishwasher Hood Exhaust Ducts:
   a. Type 304, stainless steel with finish to match kitchen equipment and range hood.
   b. Aluminum, with seams and laps arranged on top of duct.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

O. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Refer to SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

Q. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.3 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS

A. Repair damage to PVC coating with manufacturer's recommended materials.

3.4 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

A. Install ducts to allow for thermal expansion through 2000 deg F (1110 deg C) temperature range.

B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.
C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.

3.5 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.6 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.9 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.

E. Mechanical Cleaning Methodology:
   1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
   2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

3.0 CLEANING EXISTING SYSTEMS

A. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Use existing service openings where possible.
   2. Create other openings to comply with duct standards.
   3. Disconnect flexible ducts as needed for cleaning and inspection.
   4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
   5. Remove and reinstall ceiling sections to gain access during the cleaning process.

B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

C. Particulate Collection and Odor Control:
   1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
   2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:
   1. Air outlets and inlets (registers, grilles, and diffusers).
   2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
   3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
   5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
   7. Dedicated exhaust and ventilation components and makeup air systems.
E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

G. Gravimetric Analysis: At discretion and expense of Owner, sections of metal duct system, chosen randomly by Owner, may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.

END OF SECTION 233113
SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   A. Backdraft dampers.
   B. Volume dampers.
   C. Motorized control dampers.
   D. Fire dampers.
   E. Ceiling fire dampers.
   F. Smoke dampers.
   G. Combination fire and smoke dampers.
   H. Duct silencers.
   I. Turning vanes.
   J. Duct-mounting access doors.
   K. Flexible connectors.
   L. Flexible ducts.
   M. Duct accessory hardware.

B. Related Sections include the following:
   A. Division 23 Section "Instrumentation and Control for HVAC" for electric and pneumatic damper actuators.
   B. Division 28 Section "Fire Detection and Alarm" for duct-mounting fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For the following:
   A. Backdraft dampers.
   B. Volume dampers.
   C. Motorized control dampers.
   D. Fire dampers.
   E. Ceiling fire dampers.
   F. Smoke dampers.
   G. Combination fire and smoke dampers.
   H. Duct silencers.
I. Turning vanes.
J. Duct-mounting access doors.
K. Flexible connectors.
L. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   A. Special fittings.
   B. Manual-volume damper installations.
   C. Motorized-control damper installations.
   D. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
   E. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE


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.
   A. Fusible Links: Furnish quantity equal to 10-percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified:
      A. Air Balance, Inc.
      B. CESCO Products.
C. Duro Dyne Corp.
D. Greenheck.
E. Penn Ventilation Company, Inc.
F. Prefco Products, Inc.
G. Ruskin Company.
H. Vent Products Company, Inc.
I. Ward Industries, Inc.
J. Or equivalent.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
C. Stainless Steel: ASTM A 480/A 480M.
D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

A. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
B. Frame: 0.052-inch-thick, galvanized sheet steel with welded corners and mounting flange.
C. Blades: 0.050-inch-thick aluminum sheet.
D. Blade Seals: Vinyl.
E. Blade Axles: Nonferrous.
F. Tie Bars and Brackets: Aluminum.
G. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

A. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream and suitable for horizontal or vertical applications.

A. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
B. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
C. Aluminum Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
D. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
E. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
F. Blade Axles: Nonferrous.
G. Bearings: Molded synthetic.
H. Tie Bars and Brackets: Aluminum.
I. Tie Bars and Brackets: Galvanized steel.

C. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream and suitable for horizontal or vertical applications.

A. Steel Frames: Angle-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
B. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
C. Aluminum Frames: Angle-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
D. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
E. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
F. Blade Axles: Nonferrous.
G. Bearings: Molded synthetic thrust or ball.
H. Blade Seals: Vinyl.
I. Jamb Seals: Cambered aluminum.
J. Tie Bars and Brackets: Aluminum.

D. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

A. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
2.5 MOTORIZED CONTROL DAMPERS

A. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch- thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch- thick, galvanized-steel damper blades with maximum blade width of 8 inches.

   A. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
   B. Operating Temperature Range: From minus 40 to plus 200 deg F.
   C. Provide opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 CFM per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.6 FIRE DAMPERS

A. Fire dampers shall be labeled according to UL 555.

B. Fire Rating: 1-1/2 or 3 hours as required for the rated construction.

C. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

   A. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
   B. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

H. Fusible Links: Replaceable, 165 deg F or 212 deg F rated as required for application.

2.7 CEILING FIRE DAMPERS

A. General Description: Labeled according to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

B. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

C. Blades: Galvanized sheet steel with refractory insulation.

D. Fusible Links: Replaceable, 165 deg F or 212 deg F rated as required for application.
2.8 COMBINATION FIRE/ SMOKE DAMPERS AND SMOKE DAMPERS

A. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

B. Fusible Links: Replaceable, 165 deg F or 212 deg F rated as required for application.

C. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

D. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.

E. Damper Motors: Modulating and two-position action.
   A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   B. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   C. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
   D. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
   E. Non-spring Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
   F. Electrical Connection by Mechanical/ATC Contractor: 24-Volt.
   G. Provide an approved duct mounted Smoke Detector for each smoke damper and combination fire/smoke damper that must be located in the ductwork within 5-feet of the associated damper. Each smoke detector must include a relay for interconnection to the building fire alarm system.

2.9 DUCT SILENCERS

A. Available Manufacturers:
   A. Industrial Noise Control, Inc.
   B. McGill AirFlow Corporation.
   C. Ruskin Company.
   D. Vibro-Acoustics.
   E. Or equivalent.

B. General Description: Factory-fabricated and -tested, round or rectangular silencers with performance characteristics and physical requirements as indicated.

C. Fire Performance: Adhesives, sealants, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.
D. Rectangular Units: Fabricate casings with a minimum of 0.034-inch thick, solid galvanized sheet metal for outer casing and 0.022-inch thick, ASTM A 653/A 653M, [G90] [G60], perforated galvanized sheet metal for inner casing.

E. Round Units:

A. Outer Casings:
   b. Up to 24 Inches in Diameter: 0.034 inch thick.
   c. 26 through 40 Inches in Diameter: 0.040 inch thick.
   d. 42 through 52 Inches in Diameter: 0.052 inch thick.
   e. 54 through 60 Inches in Diameter: 0.064 inch thick.
   f. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.

B. Interior Casing, Partitions, and Baffles:
   b. At least 0.034 inch thick and designed for minimum aerodynamic losses.

F. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

G. Fill Material: Moisture-proof nonfibrous material.

A. Erosion Barrier: Polymer bag enclosing fill and heat-sealed before assembly.

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

A. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
B. Lock form and seal or continuously weld joints.
C. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
D. Reinforcement: Cross or trapeze angles for rigid suspension.

I. Source Quality Control:

A. Acoustic Performance: Test according to ASTM E 477.
B. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
C. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.10 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
B. Manufactured Turning Vanes: Fabricate 1-1/2-inch wide, double vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

A. Available Manufacturers:
   
a. Ductmate Industries, Inc.
b. Duro Dyne Corp.
c. METALAIRE, Inc.
d. Ward Industries, Inc.
e. Or equivalent.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.11 DUCT-MOUNTING ACCESS DOORS

A. Available Manufacturers:
   
a. CESCO Products.
b. Ductmate Industries, Inc.
c. Flexmaster U.S.A., Inc.
d. Greenheck.
f. Ventfabrics, Inc.
g. Ward Industries, Inc.
h. Or equivalent.

B. General Description: Fabricate doors airtight and suitable for duct pressure class.

C. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

A. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
B. Provide number of hinges and locks as follows:
   
a. Less Than 12 Inches Square: Secure with two sash locks.
b. Up to 18 Inches Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Sizes 24 by 48 Inches and Larger: One additional hinge.

D. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

A. Frame: Galvanized sheet steel, with spin-in notched frame.
E. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.

   A. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

F. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

G. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.12 FLEXIBLE CONNECTORS

A. Available Manufacturers:

   A. Ductmate Industries, Inc.
   B. Duro Dyne Corp.
   C. Ventfabrics, Inc.
   D. Ward Industries, Inc.
   E. Or equivalent.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.


   A. Minimum Weight: 26 oz./sq. yd.
   B. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   C. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

   A. Minimum Weight: 24 oz./sq. yd.
   B. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   C. Service Temperature: Minus 50 to plus 250 deg F.


   A. Minimum Weight: 16 oz./sq. yd.
   B. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
   C. Service Temperature: Minus 67 to plus 500 deg F.


   A. Minimum Weight: 14 oz./sq. yd.
B. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
C. Service Temperature: Minus 67 to plus 500 deg F.

2.13 FLEXIBLE DUCTS

A. Available Manufacturers:
   A. Flexmaster U.S.A., Inc.
   B. Hart & Cooley, Inc.
   C. McGill AirFlow Corporation.
   D. Or equivalent.

B. Noninsulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
   A. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   B. Maximum Air Velocity: 4000 fpm.
   C. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.
   A. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
   B. Maximum Air Velocity: 4000 fpm.
   C. Temperature Range: Minus 10 to plus 160 deg F.

D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches to suit duct size.

2.14 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.

H. Install duct silencers independent of ducts with flexible duct connectors, lagged with loaded vinyl sheet on inlets and outlets.

I. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
   
   A. On both sides of duct coils.
   B. Downstream from volume dampers, turning vanes and equipment.
   C. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
   D. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
   E. On sides of ducts where adequate clearance is available.

J. Install the following sizes for duct-mounting, rectangular access doors:
   
   A. One-Hand or Inspection Access: 8 by 5 inches.
   B. Two-Hand Access: 12 by 6 inches.
   C. Head and Hand Access: 18 by 10 inches.
   D. Head and Shoulders Access: 21 by 14 inches.

K. Install the following sizes for duct-mounting, round access doors:
   
   A. One-Hand or Inspection Access: 8 inches in diameter.
   B. Two-Hand Access: 10 inches in diameter.
   C. Head and Hand Access: 12 inches in diameter.
   D. Head and Shoulders Access: 18 inches in diameter.
   E. Body Access: 24 inches in diameter.

L. Install the following sizes for duct-mounting, pressure relief access doors:
   
   A. One-Hand or Inspection Access: 7 inches in diameter.
B. Two-Hand Access: 10 inches in diameter.
C. Head and Hand Access: 13 inches in diameter.
D. Head and Shoulders Access: 19 inches in diameter.

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."

N. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

O. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with draw bands.

S. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233300
SECTION 233423 – EXHAUST FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Centrifugal roof ventilators;
   2. Centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.
   6. Roof curbs.
   7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following or an approved equal:

1. Greenheck.
2. Loren Cook Company.
3. Penn Ventilation.
4. Or equivalent.

B. Description: Direct or belt-driven centrifugal fans as scheduled on the drawings consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.

   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 18 inches.
   5. Metal Liner: Galvanized steel.
   6. Burglar Bars: 1/2-inch thick steel bars welded in place to form 6-inch squares.
   7. Mounting Pedestal: Galvanized steel with removable access panel.
   8. Vented Curb: Unlined with louvered vents in vertical sides.

H. Capacities and Characteristics:

   1. Airflow, External Static Pressure, Brake Horsepower, Fan Rpm, Tip Speed and Fan Diameter; Motor Size and RPM and Electrical Characteristics shall be as scheduled on the drawings;
   2. Hood Material: Galvanized Steel;
   3. Drive Arrangement: Direct;
   4. Sound: Shall not exceed specified and/or scheduled limits;
   5. Curb Size: as required by scheduled fan;
   6. Curb Height: Minimum 18 inches;
   7. Damper: Yes.

2.2 AIRFOIL CENTRIFUGAL EXHAUST FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following or an approved equal:

   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Ventilation.
   4. Or equivalent.

B. Description: Factory-fabricated, assembled, tested, and finished, belt or direct driven (as scheduled on the drawings) centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

C. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.

   1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   2. Horizontally split, bolted-flange housing.
   3. Spun inlet cone with flange.
   4. Outlet flange.
D. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws; and special coating.

E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
   1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
   2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

   1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
   2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.

G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.5.
   2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5-hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

H. Accessories:
   1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
   2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
   3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
   4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
   6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
   7. Inlet Screens: Grid screen of same material as housing.
   8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

I. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Enclosure Type: Totally enclosed, fan cooled.

J. Capacities and Characteristics: Refer to the specific performance, motor and electrical data as scheduled on the drawings:
   2. Special Housing Coating: Synthetic resin.
   4. Special Wheel Coating: Synthetic resin.
   5. Class: II.
   6. Drive Type: Belt or Direct as scheduled on the drawings.
   7. Vibration Isolators: Restrained spring isolators having a static deflection of 1 inch.

2.3 MOTORS
   A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   B. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL
   A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
   B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Install exhaust fans level and plumb.
   B. Support units using restrained elastomeric mounts having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance.

E. Install centrifugal fans level and plumb.

F. Support floor-mounting units using restrained spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

G. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that all connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423
SECTION 233713 – GRILLES, REGISTERS AND DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

C. Samples for Initial Selection and for Verification: For diffusers, registers, and grilles with factory-applied color finishes in manufacturer's standard sizes to verify color selected.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified herein:
   a. Krueger.
   b. Price Industries.
   c. Titus.
   d. Tuttle & Bailey.
   e. Or equivalent.

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

2.2 GRILLES AND REGISTERS

A. Adjustable Bar Grilles and Registers:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
3. Face Blade Arrangement: Adjustable horizontal spaced 1-1/2 inches apart.
4. Rear Blade Arrangement: Adjustable vertical spaced 1/2 inch apart.
5. Frame: 1 inch wide.
7. Mounting: Concealed and Lay in depending on actual ceiling construction.
8. Damper Type: Adjustable opposed-blade assembly.

B. Fixed Face Grilles and Registers:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
4. Rear Blade Arrangement: Adjustable vertical spaced 1/2 inch apart.
5. Frame: 1 inch wide.
7. Mounting: Concealed and Lay in depending on actual ceiling construction.
8. Damper Type: Adjustable opposed-blade assembly.

2.3 LINEAR SLOT OUTLETS

A. Linear Bar Grilles or Diffusers:
1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
3. Pencil-Proof Core Spacing Arrangement: 3/16-inch thick blades spaced 7/16 inch apart, 15-degree deflection.
5. Frame: 1 inch wide.
7. Mounting: Concealed Spring clip.
8. Damper Type: Adjustable opposed-blade assembly.
9. Accessories: Directional vanes, Alignment pins, Core clips and Blank-off strips.

B. Linear Slot Diffuser:

1. Material - Shell: Steel, insulated.
3. Finish - Face and Shell: Baked enamel, black.
4. Finish - Pattern Controller: Baked enamel, black.
5. Finish - Tees: Baked enamel in custom color selected by Architect.
7. Number of Slots and Length: (Refer to Schedule on Drawing).
8. Accessories: T-bar clips on both sides.

2.4 CEILING DIFFUSER OUTLETS

A. Round Ceiling Diffuser:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
3. Face Style: Four cone.
5. Dampers: Radial opposed blade.
6. Accessories:
   a. Equaling grid.
   b. Plaster ring.
   c. Safety chain.
   d. Wire guard.
   e. Sectorizing baffles.
   f. Operating rod extension.

B. Rectangular and Square Ceiling Diffusers:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
3. Face Size: 24 by 24 inches Insert size.
4. Face Style: Four cone.
7. Accessories:
a. Equaling grid.
b. Plaster ring.
c. Safety chain.
d. Wire guard.
e. Sectorizing baffles.
f. Operating rod extension.

C. Louver Face Diffuser:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
3. Face Size: 24 by 24 inches Insert size.
4. Mounting: Surface with beveled frame, T-bar or Mounting panel as required to accommodate the actual ceiling construction.
5. Pattern: Four-way core style.
7. Accessories:
   a. Square to round neck adaptor.
   b. Adjustable pattern vanes.
   c. Throw reducing vanes.
   d. Equaling grid.
   e. Plaster ring.
   f. Safety chain.
   g. Wire guard.
   h. Sectorizing baffles.
   i. Operating rod extension.

2.5 SECURITY GRILLES AND REGISTERS:

1. Material: Steel.
2. Finish: Baked enamel with a custom color selected by Architect.
1. Face Arrangement: 3/16-inch-thick perforated faceplate with 5/16-inch-diameter holes spaced 7/16 inch o.c., staggered at 60 degrees.
2. Wall Sleeve: 1/8 inch welded to face.
4. Damper Type: Adjustable opposed-blade assembly.

2.6 SOURCE QUALITY CONTROL

D. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Install Security Type Registers and Grilles in all areas as noted on the drawings.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713
DIVISION 260000 - ELECTRICAL SPECIFICATIONS

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END OF SECTION
SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

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

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

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
   e. Or Equivalent.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Stainless steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables or wireways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Space sleeves in concrete at least 4 inches apart.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level. Extend sleeves 8 inches above roof deck.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
I. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve or as required for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500
SECTION 260503 – ELECTRICAL RESTORATION AND RETROFIT

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Removal and/or relocation of existing electrical work.
   2. Alterations to existing wiring, conduits and terminations; panelboards; ceilings; lighting fixtures; and other systems.

1.3 EXISTING PROJECT CONDITIONS
A. Drawings do not identify all possible interferences which may be encountered. However, drawings show reasonable representations of actual conditions and in general, only new work required.
B. Verify locations, sizes and capacities of existing electrical systems. Make modifications as required to accommodate new work. Notify the owner if actual locations prevent new work.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS
A. Use products specified in applicable Sections of Divisions 26, 27 and 28.
B. If products are required, but not specified, use products that are compatible with existing materials. Wherever possible, use products of the same manufacturer as existing materials.

PART 3 - EXECUTION

3.1 GENERAL
A. All of the work will be performed in existing facilities.
B. Remove and/or relocate existing equipment as required by renovations. Reconnect disturbed facilities and place in operating condition.
C. Coordinate with the Owner for reinstallation or disposition of existing equipment.

D. Drawings show only major items to be removed or relocated. In addition to items shown, remove associated conduit, wiring, fastenings and supports.

E. Disconnect electrically operated equipment to be removed or relocated and blank off wiring. Disconnect and reconnect electrically operated equipment which is to be reworked.

F. Where removal and/or relocation affects electrical services to devices, fixtures, or equipment outside contract area, reroute services to affected equipment so as to enable its continued normal functioning. Such rerouting shall leave the service or circuit in a permanently connected condition.

G. Record modifications on Project Record Documents.

3.2 ALTERATIONS TO EXISTING WIRING AND CONDUIT

A. Where new construction interferes with existing outlets, remove outlets and replace with new. Extend existing wiring as required.

B. Where new interior building surfaces are installed, extend existing outlet boxes out to new surface with appropriate extension rings.

C. Where ceiling heights are lowered and interfere will wall mounted equipment such as clocks, loudspeakers, bells and fire alarm devices, relocate equipment and associated outlets to clear new ceiling height.

D. Where parts of existing wiring system are disrupted, rework wiring as required to re-energize loads to remain in operation. Remove existing conduit and wiring, provide new conduit and wiring between remaining outlets, and make final connections.

E. Where outlets are cut off from existing feed, re-feed them from another direction if possible. Provide new conduit and wire if necessary.

F. Abandon existing lines where no longer required. Remove them where they interfere with new construction. Remove wire from abandoned conduit. Cut conduit flush with finished floor.

G. Remove wiring devices shown. Abandon boxes if they are in existing walls to remain. Provide blank cover plates for abandoned boxes, using cast corrosion resistant covers with gaskets for outdoor use.

H. Conceal conduit in finished areas where possible. Fish flexible conduit and cable wiring above suspended ceilings and existing walls where possible. Where new ceilings are shown or where walls will be refinished, cut existing ceilings, structural members, and walls as required to conceal wiring. Where existing ceilings or walls are to remain intact, provide surface metal raceway unless otherwise noted.

I. Existing conduit may be reused if in good condition and in compliance with the NEC.
J. Where new wire will be installed in existing conduit, disconnect and remove existing wire. Replace existing wire with new, of same general characteristics and appropriate insulation. Reconnect existing wire and check entire system, placing it in approved operating condition.

3.3 ALTERATIONS TO EXISTING PANELBOARDS

A. Install new circuit breakers in panelboards where required. New circuit breakers shall be of the same manufacturer as the existing panelboard and have short circuit ratings equal to or greater than the short circuit rating of the existing panelboard.

B. Provide updated typewritten panel directory to show the latest revisions.

C. Where panelboards will be replaced, replace existing cabinets unless otherwise noted. Rework existing wiring as required to fit the new panelboard, and replace wire damaged in the process.

3.4 ALTERATIONS TO EXISTING CEILINGS

A. Remove existing ceiling materials where required for installation of electrical work and store. Replace upon completion. Replace existing material damaged as a result of alterations, using matching material.

B. In general, existing lay-in ceiling panels and supporting framework will remain in place during construction. Remove materials where necessary for execution of work, and reinstall upon completion. Replace materials damaged in process.

3.5 ALTERATIONS TO EXISTING LIGHTING FIXTURES

A. Repair existing lighting fixtures shown to remain. Clean both inside and outside of fixtures and lens. Replace broken and inoperative parts. Rewire equipment if necessary. Replace all lamps with new.

3.6 CUTTING AND PATCHING

A. Reroute electrical work to avoid cutting of structural members whenever possible.

B. Saw cut and core drill existing concrete and paving. Cut reinforcing steel to provide a stub for connecting new reinforcing steel.

END OF SECTION 260503
SECTION 260505 – WIRING EQUIPMENT FURNISHED BY OTHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes electrical connections to equipment furnished under other Specification Sections, existing equipment being relocated and furnished by owner.

1.3 COORDINATION

A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size and type of electrical connections.

B. Provide all conduit, wiring, outlet boxes, etc. to make final connections to equipment and associated control devices such as, but not limited to, limit switches, push button stations, etc.

C. Coordinate all requirements with equipment supplier and installing contractor.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Straight-Blade Plug: NEMA WD 1.

B. Locking-Blade Plug: NEMA WD 5.

C. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.2 WIRING

A. Conduit: As specified in Section 26 05 33.

B. Conductors, Cables and Cords: As specified in Section 26 05 19.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power wiring to disconnect switches and/or starters and power wiring from these devices to equipment.

B. Install disconnect switches, control panels, starters, control equipment, etc. furnished with equipment.

C. Provide control wiring as indicated by equipment supplier.

D. In heat producing equipment, use wire and cable with insulation suitable for the temperatures encountered.

E. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit in damp or wet locations.

F. Install cord with attachment plug where indicated or specified.

G. Provide suitable strain-relief clamps for cord connections to outlet boxes and connections to equipment.

H. Make wiring connections in control panel or in wiring compartment of pre-wired equipment. Provide interconnecting wiring where indicated.

I. Install disconnect switches, controllers, control stations and control devices such as limit switches and temperature switches. Connect with conduit and wiring as required by equipment supplier.

J. Coolers and Freezers: Cut and seal conduit openings in enclosure walls, floor and ceiling.

K. Provide interlocking and control wiring between fire suppression system and fire alarm system, and power shut-down system.

END OF SECTION 260500
SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Building wires and cables rated 600 V and less.
      2. Connectors, splices, and terminations rated 600 V and less.
      3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS
   A. EPDM: Ethylene-propylene-diene terpolymer rubber.
   B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Qualification Data: For testing agency.
   C. Field quality-control test reports.
   D. Informational Submittals:
      1. Certifications: Certify that field tests have been performed and that work meets or exceeds specified requirements.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with NFPA 70.
1.6  COORDINATION

A.  Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1  CONDUCTORS

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

1.  Cerro Wire, L.L.C.
2.  General Cable Corporation.
4.  Or equivalent.

B.  Description: Copper conductors, 600V insulation, Comply with NEMA WC 70.

2.2  CONNECTORS AND SPLICES

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

1.  AFC Cable Systems, Inc.
2.  Burndy.
3.  Ideal Industries, Inc.
5.  O-Z/Gedney; EGS Electrical Group LLC.
6.  3M; Electrical Products Division.
7.  T&B.
8.  Tyco Electronics Corp.
9.  Or equivalent.

B.  Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1  CONDUCTOR MATERIAL APPLICATIONS

A.  Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B.  Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Type THHN/THWN, single conductors in raceway: Use for all feeders and branch circuits in interior dry locations, unless indicated otherwise.

B. Type THWN or XHHW, single conductors in raceway: Use for feeders and branch circuits in exterior, underground, and interior damp or wet locations.

C. High Temperature Areas: Wire installed in areas and locations subject to temperature unsafe for the thermoplastic insulation shall be heat resistant and be type V, FEP, TFE, SA OR Z as required.

D. Type THHN or TFFN: Use for lighting fixture wiring.

E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable, concealed in building finishes, UL listed sand labeled for plenum use, unless indicated otherwise in other specification sections.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Use wire no smaller than No. 12 AWG for power and lighting circuits. Use no smaller than No. 14 AWG for control wiring unless specified otherwise in other sections.

B. Use minimum No. 10 AWG conductor for 120 Volt, 20A circuits over 75 feet in length. Use minimum No. 10 AWG conductor for 277V, 20 Amp circuits over 150 feet in length.

C. Place an equal number of conductors for each phase of a circuit in the same raceway or cable.

D. Neatly train and lace wiring inside boxes, panelboards and equipment.

E. Make connections in panelboard such that loads are balanced within 10 percent across all phases.

F. Provide separate neutral conductors for each branch circuit. Do not share neutrals.

G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

H. Install no more than three phase conductors in one conduit or cable unless shown otherwise.

I. 208/120 Volt and 480/277 Volt circuits shall be installed in separate raceways or cables.

J. Do not install conductors or cables for emergency circuits in the same raceway or enclosure.
K. Where oversized wiring is indicated and does not fit into equipment, provide a suitable junction box adjacent to equipment for change in conductor size. Keep conductor size as large as possible but not less than the ampacity required by the equipment.

3.4 INSTALLATION OF CONDUCTORS IN RACEWAY

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

C. Provide vertical cable supports in vertical raceways. Install supports in bottom of panelboards or in separate pull boxes as required.

D. Swab raceway before installing conductors.

3.5 CONNECTIONS AND SPLICES

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack. Connect each wiring device with a short jumper so that removal of device will not interrupt continuity of neutral conductor.

D. Splice only in junction, outlet or pull boxes.

E. Provide waterproof encapsulated splice kits for splices in wet or damp locations.

F. Use insulated twist-on pressure connectors for wires 10 AWG and smaller.

G. Use compression connectors for copper conductors 8 AWG and larger unless indicated otherwise.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."
3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
   a. Insulation Resistance: Test each feeder cable with feed end of cable connected to open feeder disconnect device and load end disconnected from load.


3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
   B. Field quality-control test reports.

1.4 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
   B. Bare Copper Conductors:
2.2 CONNECTORS
A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

2.3 CONDUIT GROUND BUSHINGS
A. Galvanized malleable iron with screw pressure connector; insulated throat where required.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING
A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.2 INSTALLATION
A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

C. Ground frames of motors. Conduit system is approved if connection box is bolted to motor frame. In other instances, provide grounding bushing on conduit, and extend grounding conductor to a bolt on frame of motor. Where motor is part of apparatus, such as an air handling unit, ground enclosure using connector furnished by manufacturer. Provide connector if none is furnished.

D. Make all metallic raceway fittings and grounding clamps tight to insure that equipment grounding system will operate continuously at ground potential to provide low impedance current path to insure proper operation of overcurrent devices during possible ground fault currents.

3.3 FIELD QUALITY CONTROL
A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526
SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. This Section includes the following:
      1. Hangers and supports for electrical equipment and systems.
   B. Related Sections include the following:
      1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS
   A. EMT: Electrical metallic tubing.
   B. IMC: Intermediate metal conduit.
   C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS
   A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS
   A. Product Data: For the following:
1. Steel slotted support systems.

1.6 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with NFPA 70.

1.7 COORDINATION
A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.
   h. Or equivalent.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or
cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; MasterSet Fastening Systems Unit.
      5) Or equivalent.

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

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

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
      6) Or equivalent.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or...
greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. FMC: Flexible metal conduit.
C. IMC: Intermediate metal conduit.
D. LFMC: Liquidtight flexible metal conduit.
E. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members in the paths of conduit groups with common supports.
   2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand
seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
7. Maverick Tube Corporation.
10. Or equivalent.


C. IMC: ANSI C80.6. Hot dipped galvanized steel, threaded.

D. EMT: ANSI C80.3. Galvanized thin wall steel.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.
G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Compression fittings for 2-1/2 inch and below, Set-screw or compression fittings for conduits 3 inches and above.
2. Corrosion resistant finish.
3. Insulated conduit throat where required.
4. Not approved: Tamp-on types; zinc alloy and similar die cast soft metal pressure castings.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plasstics Group.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.
13. Or equivalent.

B. RNC: Heavy wall plastic non-metallic conduit. NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings RNC: NEMA TC 3; match to conduit type and material.

2.3 METAL WIREWAYS

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

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. Or equivalent.
B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12 or 3R, as required. Other types as indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type or flanged-and-gasketed type as required.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Thomas & Betts Corporation.
   c. The Wiremold Company.
   d. Or equivalent.

2.5 BOXES, ENCLOSURES, AND CABINETS

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
10. Spring City Electrical Manufacturing Company.
14. Or equivalent.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum or galvanized, cast iron with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, 3R or 4X as required, with continuous-hinge cover with flush latch, unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:
   1. NEMA 250, Type 1, 3R or 4X as required, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

2.6 SLEEVES FOR RACEWAYS

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

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

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.7 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.
   5. Or equivalent.
B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Carbon steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 EXPANSION FITTINGS

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

1. Appleton.
2. Crouse Hinds
3. O.Z./Gedney.
4. Or equivalent.

B. Material and finish: Same as rigid metal conduit.

C. Description: Cast slip joint fitting for conduit, with flexible bonding conductor for continuity of ground through metallic conduit.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit or IMC.
2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, unless otherwise indicated.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC.
3. Use RNC inside building only for separate ground wires.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations and in kitchen tables or millwork.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Embedded in slabs: Rigid steel conduit.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
9. At kitchen and cafeteria equipment with, or within 4 feet of, steam connections use ferrous alloy type boxes with external threaded hubs and with gasketed weatherproof covers.

C. Minimum Raceway Size: 3/4-inch trade size, unless indicated otherwise.

D. RNC Minimum size: 1 inch for underground installations and 3/4 inch inside building.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

O. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.
2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Extend sleeves installed in floors 2 inches above finished floor level.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.7 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Warning labels and signs.
4. Equipment identification labels.
5. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

B. Comply with NFPA 70.

1.5 COORDINATION


B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:
   1. Arc Flash Hazard Warning: Similar to "DANGER – ARC FLASH AND SHOCK HAZARD."
   2. Workspace Clearance Warning: Similar to "WARNING - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
2.4 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 1/2" for large equipment, 1/4" for small equipment.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

1. Interior Ferrous Metal:
   a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior ferrous-metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.

2. Interior Zinc-Coated Metal (except Raceways):
   a. Semigloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
      1) Primer: Interior zinc-coated metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
5. Mechanical and Electrical Supervisory System: Green and blue.
7. Control Wiring: Green and red.
C. Power-Circuit Conductor Identification: For secondary conductors No. 1/0 AWG and larger in pull and junction boxes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, write-on tags. Identify each ungrounded conductor according to source and circuit number.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Engraved, laminated acrylic or melamine label. Indicate equipment identification, load served, source, voltage, or other information as applicable. For example, under the equipment name in smaller letters, the words “FED FROM” followed by the source panel or riser name shall be included.
   2. Equipment to Be Labeled:
      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Electrical switchgear and switchboards.
      d. Emergency system boxes and enclosures.
      e. Disconnect switches.
3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   e. Ground: Green

3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.
   d. Neutral: Gray
e. Ground Green

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 260553
SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following lighting control devices:
   1. Time switches.
   2. Indoor occupancy sensors.
   3. Contactors.
B. Related Sections include the following:
   1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS
A. PIR: Passive infrared.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

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

1. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).
9. Or equivalent.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 500 sq. ft. when mounted on a 96-inch high ceiling.

2.2 CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   4. GE Industrial Systems; Total Lighting Control.
   5. Square D; Schneider Electric.
   6. Or equivalent.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served,
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as required, matching the NEMA type specified for the enclosure.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in contactors.
2. Identify circuits or luminaries controlled by occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923
SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Lighting and appliance branch-circuit panelboards.
   2. Load centers.
   3. Transient voltage suppression panelboards.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

   2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports including the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Eaton Corporation; Cutler-Hammer Products.
   c. Siemens Energy & Automation, Inc.
   d. Square D.
   e. Or equivalent.

2.2 MANUFACTURED UNITS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: NEMA PB 1, Type 1 unless noted otherwise.

1. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
4. Stainless steel flush cover for panelboards located in kitchen areas.

C. Phase and Ground Buses:

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
D. Conductor Connectors: Suitable for use with conductor material.
   1. Main and Neutral Lugs: Mechanical type.
   2. Ground Lugs and Bus Configured Terminators: Compression type.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
   3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and \( I^2t \) response.

   4. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as indicated.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
2.6 ACCESSORY COMPONENTS AND FEATURES

A. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.
B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
D. Install overcurrent protective devices and controllers.
   1. Set field-adjustable switches and circuit-breaker trip ranges.
E. Install filler plates in unused spaces.
F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
C. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic nameplate mounted with stainless steel screws.
3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416
SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Twist-locking receptacles.
   3. Wall-box motion sensors.
   4. Snap switches and wall-box dimmers.
   5. Communications outlets.
   6. Pendant cord-connector devices.
   7. Cord and plug sets.
   8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1.3 DEFINITIONS
A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
D. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control test reports.
C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
5. Philips Lighting Controls (Lightolier)
6. Or equivalent.


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

   a. Cooper; 5351B (single), AH5362B (duplex).
   b. Hubbell; HBL5361 (single), HBL5362 (duplex).
   c. Leviton; 5361 (single), 5362 (duplex).
   d. Pass & Seymour; 5361 (single), PS5362 (duplex).
   e. Or equivalent.

2. Other Types: As shown or required to match plugs for equipment furnished by Owner or other trades. Weather resistant, listed and visibly indicated as such, where required.
2.2 GFCI RECEPTACLES

A. General Description: Straight blade. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; TRVGF20.
   c. Pass & Seymour; 2095TRWR.
   d. Or equivalent.

2.3 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.
   e. Or equivalent.

2. Other Types: As shown or required to match plugs for equipment furnished by Owner or other trades. Weather resistant, listed and visibly indicated as such, where required.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SO; with green-insulated grounding conductor and equipment-rating ampacity and upstream overcurrent protective device.


2.5 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; AH2221B (single pole), AH2222B (two pole), AH2223 (three way), AH2224 (four way).
   b. Hubbell; HBL1221 (single pole), HBL1222 (two pole), HBL1223 (three way), HBL1224 (four way).
   c. Leviton: 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour; PS20AC1 (single pole), PS20AC2 (two pole), PS20AC3 (three way), PS20AC4 (four way).
   e. Or equivalent.

2.6 WALL-BOX DIMMERS

   A. Basis-of-Design Product: Subject to compliance with requirements, provide Lightolier ‘Sunrise Preset Electronic Dimmable Fluorescent’ model #ZP600FAM120 for use with Advance Mark 7 dimmable Electronic Ballast or a comparable product by one of the following:

      1. Leviton.
      2. Lutron.
      3. Wattstopper.
      4. Or equivalent.

   B. Description: Streamlined operation with push button on-off switch, and a red LED light to locate the push button when the unit is turned off. The unit has toroidal filters used to suppress EMI and RFI.

   C. Control: Integral Slide knob for full-range dimming control. Soft Start to preserve lamp life. with single-pole or three-way switching. UL listed to U.S. and Canadian Safety standards.

   D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.7 WALL PLATES

   A. Single and combination types to match corresponding wiring devices.

      1. Plate-Securing Screws: Metal with head color to match plate finish.
      2. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel.
      4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

   B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.
2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
   1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing Conductors:
      a. Cut back and pigtail, or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtailed that are not less than 6 inches in length.
5. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
6. When conductors larger than No. 10 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailed for device connections.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.


I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Ground Impedance: Values of up to 2 ohms are acceptable.
3. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
4. Using the test plug, verify that the device and its outlet box are securely mounted.
5. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726
SECTION 262813 - FUSES

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. Cartridge fuses rated 600 V and less for use in switches and controllers.

1.3 SUBMITTALS
   A. Product Data: Include the following for each fuse type indicated:
      1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE
   A. Source Limitations: Obtain fuses from a single manufacturer.
   B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   C. Comply with NEMA FU 1.
   D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS
   A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.
1.6  COORDINATION
   A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

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. Fuses: Quantity equal to three of each type and size.

PART 2 - PRODUCTS

2.1  MANUFACTURERS
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1. Cooper Bussman, Inc.
      3. Ferraz Shawmut, Inc.
      5. Or equivalent.

2.2  CARTRIDGE FUSES
   A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1  EXAMINATION
   A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
   
   B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
   
   C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2  FUSE APPLICATIONS
   A. Motor Branch Circuits: Class RK1 or RK5, time delay.
B. Other Branch Circuits: Class RK1 or RK5. Class J when equipment cannot accommodate Class RK1 or RK5 fuses.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 262813
SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1  RELATED DOCUMENTS

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

1.2  SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Enclosures.

1.3  DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.
B. HD: Heavy duty.
C. RMS: Root mean square.
D. SPDT: Single pole, double throw.

1.4  SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details.
2. Current and voltage ratings.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Qualification Data: For testing agency.
D. Operation and Maintenance Data: For enclosed switches to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NONFUSIBLE SWITCHES

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

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
4. Square D/Group Schneider.
5. Or equivalent.

B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate Class RK1 or RK5 fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit (when required): Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper neutral conductors, where required.
3. Auxiliary Contact Kit (when required): Auxiliary set of contacts arranged to open before switch blades open.

2.2 ENCLOSURES

   A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

      1. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION

   A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches.

   B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated.

3.3 IDENTIFICATION

   A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

   B. Enclosure Nameplates: Label each enclosure with engraved laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

3.4 CLEANING

   A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

   B. Inspect exposed surfaces and repair damaged finishes.
END OF SECTION 262816
SECTION 262913 - ENCLOSED CONTROLLERS

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 ac, enclosed controllers rated 600 V and less, of the following types:
   1. Across-the-line, manual and magnetic controllers.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current rating of integrated unit.
      d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
      e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

   2. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for enclosed controllers and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
E. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2. Danfoss Inc.; Danfoss Electronic Drives Div.
5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
6. Siemens/Furnas Controls.
7. Square D.
8. Or equivalent.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.

2.3 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.4 ACCESSORIES
   A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
   C. Control Relays: Auxiliary and adjustable time-delay relays.

2.5 FACTORY FINISHES
   A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances and other conditions affecting performance.
      1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS
   A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
   B. Select horsepower rating of controllers to suit motor controlled. Minimum starter shall be Size 1.

3.3 INSTALLATION
   A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
   B. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."
3.4 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
   2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 262913
SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Exit signs.
   3. Lighting fixture supports.

B. Related Sections include the following:
   1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

C. BF: Ballast factor.

D. CRI: Color-rendering index.

E. CU: Coefficient of utilization.

F. HID: High-intensity discharge.

G. LER: Luminaire efficacy rating.

H. Luminaire: Complete lighting fixture, including ballast housing if provided.

I. RCR: Room cavity ratio.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Ballast.
4. Life, output, and energy-efficiency data for lamps.
5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, Outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. Other items in finished ceiling including the following:
   a. Air outlets and inlets.
   b. Speakers.
   c. Sprinklers.
   d. Smoke and fire detectors.
   e. Occupancy sensors.
   f. Access panels.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.
1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer’s standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Ballasts: Manufacturer’s standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.

C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer’s standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

G. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

H. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

I. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; instant start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
2. Total Harmonic Distortion Rating: Less than 10 percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: 42 kHz or higher.
5. Lamp Current Crest Factor: 1.7 or less.
6. BF: 0.85 or higher.
7. Power Factor: 0.95 or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.


D. Ballasts for Low-Temperature Environments:

1. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

E. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate 2 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.6 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and flashing red LED.

2.7 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.

C. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

E. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

F. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.8 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100
DIVISION 280000 – SAFETY AND SECURITY SPECIFICATIONS

TABLE OF CONTENTS

SECTION 283100 FIRE DETECTION AND ALARM

END OF SECTION
SECTION 283100 - FIRE DETECTION AND ALARM

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 alarm systems.

1.3 DEFINITIONS

A. FACP: Fire alarm control panel.
B. LED: Light-emitting diode.
C. NICET: National Institute for Certification in Engineering Technologies.
D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

A. Existing System: Simplex 4120, 4 Node System network addressable.
   1. New devices shall be compatible with and interface with existing fire alarm system.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.
B. Performance of system shall match existing system and only modified to incorporate new or relocated devices, unless noted otherwise.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings:
   1. Shop Drawings shall be prepared by persons with the following qualifications:
a. Trained and certified by manufacturer in fire alarm system design.
b. Fire alarm certified by NICET, minimum Level III.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

3. Device Address List: Coordinate with final system programming.

4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes for work as part of this project.

5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.

6. Batteries: Size calculations, when new devices are added to an existing battery supply.

7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

8. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual.

F. Submittals to Authorities Having Jurisdiction (if required): In addition to distribution requirements for submittals specified in Division 01 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner. Format of the written sequence of operation shall be the optional input/output matrix.
   a. Hard copies on paper to Owner.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level III.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of fire alarm service.
2. Do not proceed with interruption of fire alarm service without Owner's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Maintain fully operational until new and/or relocated equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

1.10 EXTRA MATERIALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: SimplexGrinnell LP; a Tyco International Company or other device compatible with existing fire alarm system.

1. Wire and Cable: All wiring class and styles shall match existing and be in accordance with manufacturer’s requirements.

2.2 EXISTING FIRE ALARM SYSTEM

A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.
2.3 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
   a. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
   a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where indicated.

2.5 HEAT DETECTORS

A. General: UL 521 listed.
B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.


B. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.

C. Voice/Tone Speakers:

1. UL 1480 listed.
2. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

2.7 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to a circuit-breaker shunt trip for power shutdown.

2.8 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.


1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Connect new monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.
4. Provide additional amplifiers, batteries, power supplies, or other equipment as required to integrate the existing and new devices into the existing fire alarm system.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.

D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method: Plenum rated cable or Type MC Fire Alarm Cable is acceptable where run concealed in wall or above ceiling. Where run exposed wiring shall be in dedicated conduit.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess.
Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

3.3 IDENTIFICATION
A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL
A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
   a. Include the existing system in tests and inspections.
3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.5 ADJUSTING
A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

END OF SECTION 283100