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SUMMARY

1.1 PROJECT INFORMATION

A. Project Identification: New Residence Hall.

1. Project Location: Between North 10th and North 11th Streets, Cheney WA.

B. Owner: Eastern Washington University.

1. Owner's Representative: Troy Bester, (509) 359-2204 tbester@ewu.edu.


D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Structural and Civil Consultant: DCI Engineers.
2. Mechanical and Electrical Consultant: MW Engineers.

E. Other Owner Consultants:

F. Contractor: To be determined at bid time.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project: The project is a five story, primarily residential occupancy. The first floor is a Type 1A construction. The upper four floors are wood frame, brick veneer with a sloped asphalt shingle roof. The site is located on the Eastern Washington University’s campus on Cedar Street between North 10th and North 11th Streets.

B. Type of Contract: Single prime contracts.

C. Phased Construction: Single phases.

D. Use of Site: Limited to work in areas indicated.

1. Limits of Site Disturbance: 40 feet (12.2 m) beyond building; 15 feet (4.5 m) beyond roadway and main utility branch trenches.

E. Work Restrictions: Normal noisy activity between the hours of 7:00 a.m. and 5:00 p.m.

END OF SECTION 01 10 00
SECTION 01 22 00

UNIT PRICES

1.1 LIST OF UNIT PRICES

A. Unit Price No. 1 – Imported Fill:
   1. Description: Provide imported fill material to replace unsuitable on-site soil.
   2. Unit of Measurement: Cubic Yard.

B. Unit Price No. 2 – Excavation and Disposal of Unsuitable Soil:
   1. Description: Excavation and Disposal of Unsuitable Soil.
   2. Unit of Measurement: Cubic Yard.

END OF SECTION 01 22 00
SECTION 01 23 00

ALTERNATES

1.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Resident Life Office TI.

B. Alternate No. 2: Provide MC cable in lieu of EMT for branch circuits in all resident rooms.

C. Alternate No. 3: Provide vinyl operable windows in lieu of specified aluminum operable windows.

D. Alternate No. 4: Provide "PEX" piping for all potable domestic water in lieu of specified copper pipe.

E. Alternate No. 5: Provide snow melt system.

F. Alternate No. 6: Add resident floor hallway wainscot.

END OF SECTION 01 23 00
SECTION 01 25 00

SUBSTITUTION PROCEDURES

1.1 ACTION SUBMITTALS

A. Substitution Request Form: CSI Form 13.1A.

B. Documentation:

1. Justification.
2. Coordination information.
3. Detailed comparison.
4. Product Data.
5. Samples.
6. Certificates and qualification data.
7. List of similar installations.
8. Material test reports.
9. Research reports.
10. Detailed comparison of Contractor's construction schedule.
11. Cost information.
12. Contractor's certification.
13. Contractor's waiver of rights to additional payment or time.

C. Architect's Action: If necessary, Architect will request additional information within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection within 15 days of receipt, or seven days of receipt of additional information.

1.2 SUBSTITUTIONS

A. Substitutions for Cause: Not later than 15 days prior to time required for preparation and review of submittals.

B. Substitutions for Convenience: Not allowed unless accompanied with a contract credit proposal.

END OF SECTION 01 25 00
SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

1.1 SUMMARY


B. Owner-Initiated Work Changes Proposal Requests: Issued by Architect.
   1. Respond within 20 days, when not otherwise specified.
   2. Quotation Form: CSI Form 13.6D and Form 13.6C or forms acceptable to Architect/Owner.

C. Contractor-Initiated Work Changes Proposals: Submit to Architect.
   1. Work Changes Proposal Request Form: Form acceptable to Architect/Owner.


END OF SECTION 01 26 00
SECTION 01 29 00
PAYMENT PROCEDURES

1.1 SUMMARY

A. Schedule of Values:

2. Provide multiple line items for principal subcontract amounts in excess of one percent of the Contract Sum.
3. Include separate line items under Contractor and principal subcontracts for LEED documentation and other Project closeout requirements in an amount totaling one percent of the Contract Sum and subcontract amount.

B. Applications for Payment:

1. Payment Application Times: Indicated in the Agreement last day of the month.
3. Waiver of Mechanic's Lien: Submitted from subcontractors, sub-subcontractors, and suppliers for construction period covered by previous application.

END OF SECTION 01 29 00
SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

1.1 COORDINATION DRAWINGS
   A. Prepare coordination drawings where space is limited or if required to integrate products.
   B. Coordination Digital Data Files: Same format as Drawings, Version , operating in Microsoft Windows operating system.

1.2 REQUESTS FOR INFORMATION (RFIs)
   A. RFI Forms: Software-generated form acceptable to Architect.
   B. Architect's Action: Allow fourteen working days for Architect's response for each RFI.
   C. RFI Log: Maintain a tabular log of RFIs. Submit log weekly.

1.3 PROJECT WEB SITE
   A. Use Owner's Provide, administer, and use Project Web site for project communication and documentation.
   B. Provide up to seven Project Web site user licenses for use of Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for Project Web site users.
   C. Provide one of the following Project Web site software packages:
      1. Autodesk, Buzzsaw.
      2. Autodesk, Constructware.

1.4 PROJECT MEETINGS
   A. Schedule and conduct meetings.
   B. Preconstruction conference.
   C. LEED coordination conference.
   D. Preinstallation Conferences: Before each construction activity that requires coordination.
   E. Project Closeout Conference: No later than 60 days prior to the scheduled date of Substantial Completion.
   F. Progress Meetings: At biweekly intervals, coordinated with preparation of payment requests.
G. Coordination Meetings: At biweekly intervals, in addition to specific meetings held for other purposes.

END OF SECTION 01 31 00
SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

1.1 INFORMATIONAL SUBMITTALS
B. Startup construction schedule.
C. Startup network diagram.
D. Contractor's construction schedule.
   1. Submit a working electronic copy of schedule.
E. CPM reports.
F. Daily Construction Reports: Submit at monthly intervals.
G. Material Location Reports: Submit at monthly intervals.
H. Site Condition Reports: Submit at time of discovery of differing conditions.
I. Special Reports: Submit at time of unusual event.

1.2 QUALITY ASSURANCE
A. Scheduling Consultant: Experienced specialist in CPM scheduling and reporting.

1.3 CONTRACTOR'S CONSTRUCTION SCHEDULE
A. Activity Duration: No longer than 20 days.
B. Constraints:
   1. Work by Owner. (Cabling)
   2. Work restrictions.
   3. Work stages.
   4. Construction areas.
C. Milestones: Notice to Proceed, Substantial Completion, and final completion.
D. Software: Microsoft Project Primavera Prolog, for Windows XP operating system.
E. Schedule Type: Cost- and resource-loaded CPM.
F. Updating: At monthly intervals, issued one week before each progress meeting.

END OF SECTION 01 32 00
SECTION 01 33 00

SUBMITTAL PROCEDURES

1.1 DEFINITIONS

A. Action Submittals: Information that requires Architect's responsive action.

B. Informational Submittals: Information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.2 PROCEDURES

A. Electronic copies of digital data files of the Contract Drawings will not be provided by Architect for Contractor's use.

B. Processing Time:

1. Initial Review: 15 days.
2. Resubmittal Review: 15 days.
3. Sequential Review: 21 days.
4. Concurrent Consultant Review: 15 days.

C. Transmittal Form: Form acceptable to Owner and Architect.

D. Submittal Procedures:

1. Post as PDF files directly to [Project Web site] [Architect's FTP site].
2. Submit via email as PDF files.
3. Action Submittals: Submit three paper copies.
4. Informational Submittals: Submit two paper copies.
5. Certificates and Certifications Submittals: Includes signature of entity responsible for preparing certification. Provide a digital signature on electronically submitted certificates and certifications where indicated.

E. Delegated-Design Services Certification: In addition to other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional.

F. Contractor's Review:

1. Submittals: Marked with approval stamp before submitting to Architect.

G. Architect's Action:

1. Action Submittals: Stamped with an action stamp and returned.
2. Informational Submittals: Reviewed but not returned, or rejected if they do not comply with requirements.
3. Incomplete submittals will be returned without review.
4. Submittals Not Required: May not be reviewed and may be discarded.
SECTION 01 40 00
QUALITY REQUIREMENTS

1.1 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor's quality control personnel.
   2. Manufacturer.
   3. Fabricator.
   4. Installer.
   5. Professional engineer.
   7. Testing agency.
   8. Manufacturer's technical representative.

B. Preconstruction testing.

C. Mockups: For each form of construction and finish required, using materials indicated for the completed Work.
   1. Demonstrate the proposed range of aesthetic effects and workmanship.
   2. Maintain mockups as a standard for judging the completed Work.
   3. Demolish and remove mockups when directed unless otherwise indicated.

D. Integrated Exterior Mockups: Construct according to approved Shop Drawings.

1.3 QUALITY CONTROL

A. Owner Responsibilities: Where indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility.

C. Manufacturer's field services.
D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Associated Services: Access to the Work, taking and storing samples, and delivery of samples to testing agency.

F. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

G. Special Tests and Inspections: Conducted by a qualified testing agency and special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections.

H. Test and inspection log.

I. Repair and Protection: Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00
SECTION 01 42 00

REFERENCES

1.1 DEFINITIONS

A. Approved.

B. Directed.

C. Indicated.

D. Regulations.

E. Furnish.

F. Install.

G. Provide.

H. Project site.

1.2 INDUSTRY STANDARDS

A. Publication Dates: In effect as of the date of the Contract Documents unless otherwise indicated.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Contractor referred to Thomson Gale's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S."

B. Code Agencies: List included in this Section.

C. Federal Government Agencies: List included in this Section.

D. Standards and Regulations: List included in this Section.

E. State Government Agencies: List included in this Section.

END OF SECTION 01 42 00
SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

1.1 USE CHARGES
A. Sewer Service: Available from existing system without charge.
C. Electric Power Service: Pay charges.

1.2 INFORMATIONAL SUBMITTALS
A. Erosion- and sedimentation-control plan.
B. Moisture-protection plan.
C. Fire-safety program.
D. Dust- and HVAC-control plan.

1.3 MATERIALS
A. Chain-link fencing.
B. Portable chain-link fencing.
C. Wood enclosure fence.

1.4 TEMPORARY FACILITIES
A. Common-Use Field Office: Prefabricated or mobile units, including conference room.
B. Storage and fabrication sheds.

1.5 EQUIPMENT
A. Fire extinguishers.
B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained heaters with individual space thermostatic control.
   1. Permanent HVAC System: If Owner authorizes use of HVAC system, provide filter with MERV of 8 at each return-air grille and clean HVAC system.
C. Air-Filtration Units: HEPA-filter-equipped portable units. Configure to run continuously.
1.6 TEMPORARY UTILITY INSTALLATION
  A. Sewers and drainage.
  B. Water Service: Connect to existing service.
  C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water.
  D. Heating and Cooling: Provide temporary heating and cooling required by construction activities.
  E. Isolation of work areas in occupied facilities.
  F. Ventilation and humidity control.
  G. Electric Power Service: Provide overhead service.
  H. Lighting: Provide temporary lighting.
  I. Telephone Service: Provide temporary telephone service in common-use facilities.
  J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

1.7 SUPPORT FACILITIES INSTALLATION
  A. Temporary Roads and Paved Areas: Locate temporary roads and paved areas within construction limits indicated on Drawings.
  B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas.
  C. Parking: Provide temporary parking areas.
  D. Dewatering Facilities and Drains: Maintain Project site, excavations, and construction free of water.
  E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
  F. Temporary Elevator Use:

1.8 SECURITY AND PROTECTION FACILITIES INSTALLATION
  A. Temporary erosion and sedimentation control.
  B. Stormwater control.
  C. Tree and plant protection.
  D. Covered Walkway: Erect protective, walkway for passage of individuals through or adjacent to Project site.
END OF SECTION 01 50 00
PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall protect from damage all existing vegetation determined by the Owner to remain and on adjacent property. Contractor shall repair any damage, including that to the adjacent property resulting from failure to comply with the requirements of the Contract Documents or failure to exercise reasonable care in performing the Work. If Contractor fails or refuses to repair the damage promptly, Owner may have the necessary work performed and charge the cost to Contractor.

B. The Contractor shall be responsible for providing temporary fencing as required to protect all existing vegetation to remain. The fencing shall be placed outside the drip line of the tree to be protected. The protective fence shall not be disturbed or removed until all exterior construction has been completed.

C. Contractor shall confine all operations, including storage of materials, to prior approved areas.

1.2 DEFINITIONS

A. Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

1.3 SUBMITTALS

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

B. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

C. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

D. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

E. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. All trees, not to be removed, shall be flagged with a distinctive colored ribbon. After flagging and prior to commencement of any work, the Contractor shall notify the Owner's representative who will verify that the correct trees are flagged.
1.4 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA, licensed arborist in jurisdiction where Project is located, current member of ASCA, or registered Consulting Arborist as designated by ASCA.

B. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
7. Disposal of chemicals, petroleum products, or other detrimental substances.
8. Excavation or other digging unless otherwise indicated.
9. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. Restrict vehicular traffic to areas outside the drip line of the tree.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Stockpiled topsoil from location shown on Drawings.

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements.

1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
2. Height of Fencing: 6 feet (1.8 m).
3. Gates: Swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones.
C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. If at any time the Contractor judges that the protection of a tree designated to be saved is incompatible with work required, or if operations necessary threaten the health of a tree, notify immediately the Owner and do no further work affecting the tree until a written agreement is reached concerning acceptable procedures.

B. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

D. Contractor shall construct an earthen berm 8” min. height on the uphill side of the protective fence to divert runoff from the construction site to the protected trees. The berm shall be maintained until protective fence is removed from the project site.

E. Under no circumstances shall the Contractor remove existing trees that are indicated not to be removed.

3.2 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected area except by entrance gates.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer’s written instructions.
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
3.3 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 2 Section, ‘Earthwork’.

B. No rototilling or major soil disturbance shall take place within this zone of protection, before, during, or after the construction, unless designated within construction documents.

C. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

D. Open trenches are not to be routed beneath the over-story of trees that are to be preserved unless impossible to avoid; in which case damage may be reduced by careful placement by hand-digging of trenches to avoid large roots by tunneling under rather than cutting roots greater than 1-1/2" in diameter.

E. Do not cut main lateral roots or tap roots. Roots to be cut shall be pruned cleanly. Protect all exposed roots with moist organic mulch or burlap, backfill as soon as possible.

F. Do not allow exposed roots to dry out before placing permanent backfill.

3.4 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction.
   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   2. Temporarily support and protect roots from damage until they are permanently covered with soil.
   3. Cover exposed roots with burlap and water regularly.
   4. Backfill as soon as possible according to requirements in Section 312000 “Earth Moving.”

B. Root Pruning at Edge of Protection Zone: Prune roots by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.5 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Removal of interfering branches of trees shall not be allowed except as specifically indicated and/or otherwise approved by the Owner’s representative.
   1. Obtain all necessary permits to comply with City of East Wenatchee standards.
2. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.

3. Cut branches with sharp pruning instruments; do not break or chop.

4. Do not apply pruning paint to wounds.

5. Promptly repair trees damaged by construction within 24 hours.


7. All pruning will conform to ANSI A300-Part 1-1995 pruning standards, with the supervision of the Owner’s representative, to remove damaged branches and encourage healthy new growth.

8. Owner will review completed pruning and direct additional work if it is necessary in his opinion.

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

C. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.7 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.8 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.

2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

3. Perform repairs within 24 hours.

4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Any tree that is specifically shown to not be removed and/or which is destroyed or damaged during construction operations to the extent that, in the opinion of the Owner, the continued life of the tree is questionable shall be removed by the Contractor at his/her own expense. Removal shall include the tree and stump to 2 ft. below grade. The stump hole shall be backfilled and compacted to 85% modified proctor.
C. In addition thereto the trees shall be replaced with trees of the same species and equal size. Replaced trees shall be free of disease, injury and insect infestation, and fully foliaged when in leaf. Replacement trees shall be guaranteed for a period of two years (two growing seasons) after final acceptance. Trees that are not established and flourishing at the end of this period shall be replaced at no additional charge.

D. Trees which cannot be replaced due to unavailability of species or size shall be paid for at the rate of $500.00 per square inch of cross sectional area measured three feet above existing grade for trees up to and including six (6) inches caliper, and at the rate of $1,000.00 per square inch of cross sectional area measured three feet above existing grade for trees greater than six (6) inches caliper.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 5639
SECTION 01 60 00
PRODUCT REQUIREMENTS

1.1 ACTION SUBMITTALS

A. Comparable Product Requests: Architect will notify Contractor of approval or rejection within 15 days of receipt of request, or seven days of receipt of additional information.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Use means and methods that will prevent damage, deterioration, and loss, including theft.
B. Store products to allow for inspection and measurement or counting of units.
C. Provide for storage of materials and equipment by Owner.

1.3 PRODUCT WARRANTIES

A. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1.4 PRODUCT SELECTION PROCEDURES

A. Product Selection Procedures:
   1. Product: Product named that complies with requirements.
   2. Manufacturer/Source: Product by manufacturer or from source named that complies with requirements.
   3. Products: One of the products listed that complies with requirements. Comparable products will not be considered unless otherwise indicated.
   4. Manufacturers: Product by one of the manufacturers listed that complies with requirements. Comparable products will not be considered unless otherwise indicated.
   5. Basis-of-Design Product: Either the specified product or a comparable product by one of the other named manufacturers.
   7. Visual Selection Specification: Product (and manufacturer) that complies with other specified requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

1.5 COMPARABLE PRODUCTS

A. Conditions for Consideration:
1. Product does not require revisions to the Contract Documents, is consistent with the Contract Documents and will produce the indicated results, and is compatible with other portions of the Work.
2. Comparison of proposed product with those named in the Specifications.
3. Product provides specified warranty.
4. Similar installations, if requested.
5. Samples, if requested.

END OF SECTION 01 60 00
SECTION 01 73 00
EXECUTION

1.1 INFORMATIONAL SUBMITTALS

A. Qualification data.
B. Certificates: Signed by land surveyor certifying that location and elevation of improvements comply with requirements.
C. Cutting and patching plan.
D. Certified Surveys: Signed by land surveyor.
E. Final property survey.

1.2 EXECUTION

A. Existing Conditions: Existence and location of site improvements, utilities, and other construction affecting the Work must be investigated and verified.
B. Review of the Contract Documents and field conditions.
C. Construction Layout: Engage a land surveyor to lay out the Work using accepted surveying practices.
D. Field Engineering: Owner will identify existing benchmarks, control points, and property corners. Locate existing permanent benchmarks, control points, and similar reference points.
   1. Benchmarks: Establish two permanent benchmarks on Project site.
   2. Certified survey of construction and sitework.
   3. Final property survey.
E. Installation: Comply with manufacturer's written instructions.

1.3 CUTTING AND PATCHING

A. Provide temporary support.
B. Protect in-place construction.
C. Protect adjacent occupied areas.
D. Existing Utility Services and Mechanical/Electrical Systems: Prevent interruption to occupied areas.
E. Cutting: In general, use hand or small power tools. Cut holes and slots neatly to minimum size required. Temporarily cover openings when not in use.
F. Patching: Patch with durable seams that are as invisible as practicable. Restore exposed finishes.

1.4 OWNER-INSTALLED PRODUCTS

A. Provide access to Project site for Owner's personnel.

B. Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable.

C. Include Owner's personnel at preinstallation conferences.

1.5 PROGRESS CLEANING

A. Clean Project site and work areas daily. Dispose of materials lawfully.

   1. City streets shall be kept clean and free of construction debris and dust.

B. Keep installed work clean.

C. Remove debris from concealed spaces.

1.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation.

B. Adjust equipment for proper operation.

1.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure Work is without damage.

1.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces if not repaired without visible evidence of repair.

END OF SECTION 01 73 00
SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

1.1 SUMMARY
A. Salvaging nonhazardous demolition and construction waste.
B. Recycling nonhazardous demolition and construction waste.
C. Disposing of nonhazardous demolition and construction waste.

1.2 PERFORMANCE REQUIREMENTS
A. End-of-Project Rates for Salvage/Recycling: 75 percent.

1.3 WASTE MANAGEMENT PLAN
A. Types and quantities of demolition and construction waste.
B. Type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.
C. Net additional cost or net savings resulting from waste management plan.

1.4 PLAN IMPLEMENTATION
A. Engage a waste management coordinator.
B. Train workers, subcontractors, and suppliers on proper waste management procedures.
C. Recycling Incentives: Revenues and other incentives for recycling will accrue to Contractor.

END OF SECTION 01 74 19
SECTION 01 77 00
CLOSEOUT PROCEDURES

1.1 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection, complete the following.

1. Contractor’s list of incomplete items (punch list) prepared on CSI Form 14.1A.
   b. Submit PDF electronic file.
   c. Submit paper copies.

2. Owner advised of pending insurance changeover.
3. Warranties, maintenance service agreements, and similar documents submitted.
4. Releases, occupancy permits, and operating certificates submitted.
5. Project Record Documents submitted.
6. Tools, spare parts, and extra materials delivered.
7. Final changeover of locks performed.
8. Startup testing completed.
10. Temporary facilities removed.
11. Owner advised of heat and utility changeover.
13. Owner’s personnel instructed in operation, adjustment, and maintenance of equipment and systems, including demonstration and training videotapes submitted.
14. Final cleaning performed.
15. Touchup performed.

1.2 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection, complete the following:

1. Final Application for Payment submitted.
2. List of incomplete items (punch list) endorsed by Architect as completed or otherwise resolved for acceptance.
3. Evidence of continuing insurance coverage submitted.

1.3 SUBMITTAL OF PROJECT WARRANTIES

A. Partial Occupancy: Submit warranties within 15 days of completion of designated portions of the Work that are occupied or used by Owner.


C. Scan warranties and bonds into a single indexed electronic PDF file.
1.4 FINAL CLEANING

A. Cleaning Agents: Comply with Green Seal's GS-37 and California Code of Regulations maximum allowable VOC levels.

B. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.

C. Replace disposable air filters and clean permanent air filters.

D. Clean ducts, blowers, and coils if units were operated without filters during construction.


1.5 REPAIR OF THE WORK

A. Repair or remove and replace defective construction. Where damaged or worn items cannot be repaired or restored, provide replacements. Restore damaged construction and permanent facilities used during construction to specified condition.

END OF SECTION 01 77 00
SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

1.1 SUMMARY

A. Operation and maintenance manuals.

1.2 PRODUCTS

A. Format:

1. PDF electronic files with composite electronic index on digital media acceptable to Architect. Include a complete electronically linked operation and maintenance directory.
2. Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, three set(s) of copies.

B. Emergency Manuals: Types of emergencies, emergency instructions, and emergency procedures.

C. Operation Manuals: System, subsystem, and equipment descriptions, operating procedures, wiring diagrams, control diagrams and sequence of operation, and piped system diagrams.

D. Product Maintenance Manuals: Source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds.

E. Systems and Equipment Maintenance Manuals: Source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds.

END OF SECTION 01 78 23
SECTION 01 78 39

PROJECT RECORD DOCUMENTS

1.1 PRODUCTS

A. Record Drawings:
   1. One set(s) of marked-up record prints.
      a. Initial Submittal:
         1) One paper-copy set(s) of marked-up record prints.
         2) PDF electronic files of scanned record prints and one set(s) of file prints.
         3) Record digital data files and one set(s) of plots.
      b. Final Submittal:
         1) Three paper-copy set(s) of marked-up record prints.
         2) PDF electronic files of scanned record prints and three set(s) of prints.
      c. Final Submittal:
         1) One paper-copy set(s) of marked-up record prints.
         2) Record digital data files and three set(s) of record digital data file plots.

B. Record Specifications: One paper copy Annotated PDF electronic files.

C. Record Product Data: One paper copy Annotated PDF electronic files and directories.

D. Miscellaneous Record Submittals: One paper copy Annotated PDF electronic files and directories.

1.2 PRODUCTS

A. Record Prints: One set of paper copies of Contract Documents and Shop Drawings, marked to show actual installation.

B. Record Digital Data Files: Corrected digital data files of the Contract Drawings, as follows:
   1. Format: Same as the original Contract Drawings.
   2. Format: [DWG] [DXF] [DGN], Version <Insert designation>, [Microsoft Windows] [Apple Macintosh] operating system.
   3. Format: Annotated PDF electronic file[ with comment function enabled].

END OF SECTION 01 78 39
SECTION 01 79 00

DEMONSTRATION AND TRAINING

1.1 INSTRUCTION PROGRAM

A. Program Structure: Training modules for each system and for equipment not part of a system, including the following:

1. Basis of system design, operational requirements, and criteria.
2. Documentation.
3. Emergencies.
5. Adjustments.
6. Troubleshooting.
7. Maintenance.
8. Repairs.

B. Facilitator to prepare instruction program and training modules and to coordinate instructors.

C. Evaluation: Written and Demonstration performance-based test.

1.2 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Commercial videographer to record demonstration and training video recordings.

B. Narration: Describe scenes on video recording and provide a transcript of the narration.

C. Provide video recordings used as a component of training modules.

END OF SECTION 01 79 00
1.1 SUMMARY
   A. LEED Silver certification based on LEED-NC.

1.2 ACTION SUBMITTALS
   A. LEED Documentation Submittals: Product data, receipts, certification letters, chain-of-custody certificates, and other documentation needed to show compliance with requirements.

1.3 INFORMATIONAL SUBMITTALS
   A. Project Materials Cost Data: For building materials used for Project, excluding mechanical, electrical, and plumbing components, and specialty items such as elevators and equipment.
      1. For wood-based materials used for Project.
   B. LEED Action Plans: Submit within 20 days of date established for commencement of the Work the Notice of Award.
      2. Credit MR 3: Salvaged and refurbished materials.
      4. Credit MR 5: Regional materials.
      5. Credit MR 7: Certified wood products.
   C. LEED Progress Reports: With each Application for Payment, comparing construction and purchasing with LEED action plans.

1.4 QUALITY ASSURANCE
   A. LEED Coordinator: Engage an experienced LEED-Accredited Professional.

1.5 PRODUCTS
   A. Contractor selects materials to comply with the following:
      1. Credit MR 4: Post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials.
      2. Credit MR 5: 20 percent regional materials.
1.6 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit IEQ 3.1: SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."

B. Credit IEQ 3.2: Indoor air flush-out or air-quality testing.

1.7 LEED CHECKLIST

END OF SECTION 01 81 13.13
SECTION 03 30 00
CAST-IN-PLACE CONCRETE

1.1 QUALITY ASSURANCE
A. Quality Standard: ACI 301.

1.2 PRODUCTS
A. Form facing materials.
B. Steel Reinforcement:
   1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] [60] <Insert number> percent.
   2. Reinforcing Bars: Deformed.
C. Concrete Materials:
   1. Portland Cement: ASTM C 150, Type I/II, supplement with fly ash or ground granulated blast-furnace slag.
   2. Silica fume.
   3. Aggregate: Normal weight.
D. Mixing: Ready mixed.

1.3 CONCRETE MIXTURES
A. Portland Cement Replacement: Use fly ash, ground granulated blast-furnace slag, and silica fume to reduce portland cement by 20 percent.
B. Compressive Strength (28 Days): As indicated on drawings.

1.4 INSTALLATION
A. Formed Finishes: [Rough] [Smooth] [Rubbed].
B. Floor and Slab Finishes:
   1. Scratch: Surfaces to receive [concrete floor toppings] [mortar setting beds for bonded cementitious floor finishes].
   2. Float: Surfaces to receive trowel finish and surfaces to be covered with [fluid-applied or sheet waterproofing] [built-up or membrane roofing] [sand-bed terrazzo].
   3. Trowel: Surfaces exposed to view or to be covered with [resilient flooring] [carpet] [ceramic or quarry tile set over a cleavage membrane] [paint] [thin-film-finish coating system].
4. Trowel and Fine-Broom: Surfaces to be covered with ceramic or quarry tile to be installed by either thickset or thin-set method.
5. Broom: Exterior concrete [platforms] [steps] [ramps].
6. Slip-Resistive Finish: Concrete [stair treads] [platforms] [ramps].
7. Dry-Shake Floor Hardener: <Insert locations>.
8. Polished Concrete: <Insert locations>.

1.5 FIELD QUALITY CONTROL

A. Testing: By Owner-engaged agency.

B. Special Inspections: By Owner-engaged special inspector.

END OF SECTION 03 30 00
SECTION 03 35 36
POLISHED CONCRETE FLOOR FINISH

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of polished concrete floor system for new interior concrete floors by dry grinding, application of concrete densifier, and polishing with various size grit metal-bonded and resin-bonded diamonds to the scheduled specified minimum local and overall gloss values.

B. Application of chemical dye and complementary edge band treatment.

1.2 SUBMITTALS

A. Installer’s Certification:

1. Provide list of 5 projects performed with last three years of similar type, size and complexity. Submit project names, addresses, contacts and phone numbers for each project.


1.3 MOCK-UP

A. Provide polished concrete floor finish mock-up, a minimum of 250 square feet, illustrating completed finish including dye, all specified liquid surface treatments and specified gloss levels.

1.4 PRE-CERTIFIED INSTALLERS

A. All bidding contractors must have completed certification for this project.

1.5 EQUIPMENT TO BE USED FOR INSTALLATION

A. Floor Grinder:

B. Dust Extraction System and pre-separator for grinding/polishing:

C. Diamond Tooling for Coating Removal, Initial Grinding, and Preparing Floor for Polishing:

D. Diamond Tooling for Polishing Concrete:

E. Grinding / Polishing Pads for Edges

F. Hand Grinder with dust extraction attachment and pads.

G. Joint cutting saw with dust extraction attachment

H. Self-propelled shaver/leveler for slab surface demolition and leveling.

I. High speed propane burnisher

J. Diamond Impregnated Burnisher Pads

K. Applicator Pads and Equipment
1.5 MATERIALS
A. Penetrating Hardener/Densifier: Clear liquid reactive lithium-silicate based.
B. Protective Surface Treatment (Stain Guard):
C. Solvent-base dye color:
D. Joint Filler
E. Crack and Spall Repair
F. Wide Area Surface Repairs
G. Grout Coat

1.6 EXAMINATION
A. Examine floor to receive polished concrete floor system.
B. Do not begin surface preparation or installation until conditions are corrected and approved.

1.7 SURFACE PREPARATION
A. Protection: Protect surrounding areas and adjacent surfaces.
B. Clean Surfaces: Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, and other surface contaminants which could adversely affect installation of polished concrete floor system.

1.8 INSTALLATION
A. Install polished concrete floor system in accordance with manufacturer’s instructions at locations indicated on the Drawings.
B. Aggregate Exposure:
C. Polished Concrete Floor System
   1. Open Slab Surface:
      2. Remove metal-bonded diamond scratches by grinding with progressively finer metal-bonded diamonds, up to metal bond 150-grit.
      3. Apply densifier
      4. Floor Polishing:
         5. Apply stain guard
         6. High speed burnish:
D. Penetrating Dye

1.9 FIELD QUALITY CONTROL
A. Inspect completed polished concrete floor system.
B. Specular Gloss/Reflectance, ASTM D 523:

1.10 PROTECTION

A. Protect completed polished concrete floor system from damage until Substantial Completion.

B. Immediately remove mortar splatter, spilled liquids, oil, grease, paint, coatings, and other surface contaminants which could adversely affect completed polished concrete floor system.

C. Repair damaged areas of completed polished concrete floor system to satisfaction of Contracting Officer.

END OF SECTION
SECTION 03 54 13

GYPSUM CEMENT UNDERLAYMENT

1.1 QUALITY ASSURANCE

A. Fire-Resistance Rating: UL listed.

B. Sound Transmission Characteristics: STC and IIC rated assemblies.

1.2 MATERIALS

A. Gypsum-cement-based, self-leveling underlayment.

END OF SECTION 03 54 13
SECTION 04 21 13

BRICK MASONRY

1.1 QUALITY ASSURANCE

A. Mockups of typical wall areas.

1.2 MATERIALS

A. Brick: Face brick.

B. Ties and Anchors: Galvanized steel.
   1. Corrugated metal ties.
   2. Adjustable anchors for connecting to structural steel framing.
   3. Adjustable anchors for connecting to concrete.

C. Embedded Flashing:
   1. Partially Exposed Flashing: Copper.
   2. Concealed (Flexible) Flashing: Copper laminated.
      a. Used with copper drip edge.

D. Weep/Vent Holes: round plastic tubing.

E. Cavity drainage material.

F. Mortar:
   1. Portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.

1.3 INSTALLATION

A. Bond Pattern: As indicated.

B. Clean masonry waste recycled as fill material.

1.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner engaged.

B. Inspections: Level 1 special inspections according to the "International Building Code."
SECTION 04 72 00
CAST STONE MASONRY

1.1 SUMMARY

A. Section Includes:
   1. Cast stone trim.
      a. Window sills.
      b. Lintels.
      c. Coping.
      d. Wall caps.
      e. Belt courses.

1.2 QUALITY ASSURANCE

A. Manufacturer Qualifications: A plant certified by the Architectural Precast Association or the Precast/Prestressed Concrete Institute for Group A, Category AT.

B. Full-size Samples.

C. Mockups.

1.3 MATERIALS

A. Cast Stone Units: ASTM C 1364 and resistant to freezing and thawing.

B. Embedded Anchors: Stainless steel.

C. Mortar: Masonry cement or mortar cement.
   1. Coloring: Plain mortar, no coloring.

1.4 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor engaged.

1.5 INSTALLATION

A. Cast stone set in mortar.

B. Mechanically anchored cast stone with sealant-filled joints.

END OF SECTION 04 72 00
SECTION 05 12 00

STRUCTURAL STEEL FRAMING

1.1 SUMMARY
A. Structural steel as classified by AISC 303.
B. Prefabricated building columns.
C. Grout.

1.2 PERFORMANCE REQUIREMENTS
A. Fabricator to select or complete [simple shear] connections, including engineering analysis by a qualified professional engineer, to withstand design loads.

1.3 QUALITY ASSURANCE
A. Fabricator Qualifications: AISC-Certified Plant, Category STD.
B. Installer Qualifications: AISC-Certified Erector, Category [ACSE] [CSE].
C. Shop-Painting Applicator Qualifications: AISC's Sophisticated Paint Endorsement [P1] [P2] [P3] or SSPC-QP 3.
D. Quality Standards: AISC 303, AISC 341, AISC 341s1, and AISC 360.

1.4 MATERIALS
A. Recycled Content of Steel: Postconsumer plus one-half of preconsumer recycled content not less than [25 percent.] [50 percent.] [<Insert number> percent.] [the following:]
   1. W-Shapes: [60] <Insert number> percent.
   2. Channels, Angles, [M], [S]-Shapes: [60] <Insert number> percent.
   3. Plate and Bar: [25] <Insert number> percent.
   4. Cold-Formed Hollow Structural Sections: [25] <Insert number> percent.
   5. Steel Pipe: [25] <Insert number> percent.
   6. <Insert Category Name>: <Insert number> percent.
   7. All Other Steel Materials: [25] <Insert number> percent.
B. Structural-Steel Shapes: [W-shapes] [channels] [angles] [M-shapes] [S-shapes] [plate and bar] [cold-formed hollow structural sections] [and] [steel pipe].
C. Steel castings.
D. Steel forgings.
E. Bolts, Nuts, and Washers: [High strength] [Tension control, high strength].
F. Anchor Rods: [Unheaded] [Headed] rods, nuts, plate washers, and washers.

G. Connectors: [Shear connectors] [threaded rods] [clevises] [turnbuckles] [eye bolts and nuts] [and] [sleeve nuts].

H. Structural slide bearings.

I. Primer: [Zinc oxide, oil] [Latex] [Fabricator's standard, nonasphaltic].
   1. Primers comply with LEED for Schools Credit IEQ 4.

J. Grout: [Metallic, shrinkage resistant] [Nonmetallic, shrinkage resistant].

K. Prefabricated Building Columns:
   1. Fire-Resistance Rating: [4 hours] [3 hours] [2 hours] [As indicated].

1.5 FABRICATION

A. Shop Connections:
   1. High-Strength Bolts: [Snug tightened] [Pretensioned] [Slip critical].
   2. Welded connections.

B. Surface Preparation: [SSPC-SP 2] [SSPC-SP 3] [SSPC-SP 7/NACE No. 4] [SSPC-SP 11] [SSPC-SP 14/NACE No. 8] [SSPC-SP 6/NACE No. 3] [SSPC-SP 10/NACE No. 2] [SSPC-SP 5/NACE No. 1] [SSPC-SP 8].

C. Galvanizing: Hot dip.

1.6 SOURCE QUALITY CONTROL

A. Testing Agency: Owner engaged.

1.7 INSTALLATION

A. Field Connections:
   1. High-Strength Bolts: [Snug tightened] [Pretensioned] [Slip critical].
   2. Welded connections.

1.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner engaged.

END OF SECTION 05 12 00
SECTION 05 31 00
STEEL DECKING

1.1 QUALITY ASSURANCE
A. FM Global Listing: Steel roof deck.

1.2 PERFORMANCE REQUIREMENTS
A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

1.3 MATERIALS
A. Roof Deck: Galvanized-steel sheet.
   1. Profile Depth: As indicated on drawings.
B. Composite Floor Deck: Galvanized-steel sheet.
   1. Profile Depth: 1-1/2 inches (38 mm) or as indicated on drawings.
C. Accessories: Flexible closure strips, pour stops, girder fillers, column closures, end closures, Z-closures, and cover plates recessed sump pans and flat sump plates.

1.4 INSTALLATION
A. Roof Deck: Welded.
B. Floor Deck: Welded.

1.5 FIELD QUALITY CONTROL
A. Testing Agency: Owner engaged.

END OF SECTION 05 31 00
SECTION 05 40 00
COLD-FORMED METAL FRAMING

1.1 MATERIALS
A. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, metallic coated.
   1. Minimum Steel Thickness: As noted on drawings.
   2. [Single deflection track] [Double deflection track].
D. Framing Accessories: Supplementary framing bracing, bridging, and solid blocking, web stiffeners, anchor clips, end clips, foundation clips, gusset plates, stud kickers and knee braces, hole reinforcing plates and backer plates.

1.2 INSTALLATION
A. Fasten framing by welding or screw fastening.

END OF SECTION 05 40 00
SECTION 05 50 00

METAL FABRICATIONS

1.1 PRODUCTS

A. Materials: Steel plates, shapes, and bars Steel tubing, Steel pipe, Slotted channel framing.
   1. Low-Emitting Primer.

B. Miscellaneous Framing and Supports: Galvanized where indicated.
   1. Steel framing and supports for operable partitions, overhead doors, countertops, mechanical and electrical equipment, applications where framing and supports are not specified in other Sections.
   2. Steel beams and pipe columns for supporting wood frame construction.

C. Shelf angles, galvanized at exterior walls.

D. Metal Ladders: Steel.

E. Elevator Machine Beams.

F. Miscellaneous Steel Trim: Steel angle corner guards.

G. Metal Bollards: Schedule 40 steel pipe.
   1. Primed with zinc-rich primer.

H. Loose bearing and leveling plates, galvanized.

I. Loose steel lintels, galvanized at exterior walls.

J. Steel weld plates and angles not specified in other Sections, for casting into concrete.

END OF SECTION 05 50 00
SECTION 05 51 00
METAL STAIRS

1.1 SUMMARY
A. Preassembled steel stairs with concrete-filled and precast concrete treads.
B. Steel tube railings attached to metal stairs.
C. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 PERFORMANCE REQUIREMENTS
A. Engineering design of steel stairs and railings by Contractor.

1.3 QUALITY ASSURANCE
A. Stair Standard: NAAMM AMP 510, "Metal Stairs Manual."
   1. Preassembled Stairs: Commercial class.

1.4 MATERIALS
A. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Stringers: Steel channels.
C. Metal-Pan Stairs: Uncoated cold-rolled or Uncoated hot-rolled steel sheet.
D. Steel Tube Railings:
   1. Rails and Posts: [1-5/8-inch- (41-mm-) diameter] [1-1/2-inch- (38-mm-) square] top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
   2. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
   5. Mesh Infill: Woven wire mesh crimped into steel channel frames.
   6. Intermediate Rails Infill: [1-5/8-inch- (41-mm-) diameter] [1-1/2-inch- (38-mm-) square] intermediate rails spaced less than [12 inches (305 mm)] [21 inches (533 mm)] clear.

END OF SECTION 05 51 00
SECTION 05 52 13

PIPE AND TUBE RAILINGS

1.1 SUMMARY
A. Stainless-steel pipe and tube railings, Type 304.

1.2 PERFORMANCE REQUIREMENTS
A. Engineering design of railings by Contractor.

1.3 FABRICATION
A. Changes in Direction of Members: by inserting prefabricated fittings.
B. Connections: Welded.

1.4 FINISHES
A. Stainless Steel: Dull satin, No. 6.

END OF SECTION 05 52 13
SECTION 051200 - STRUCTURAL STEEL FRAMING

1.1 SUMMARY

A. Structural steel as classified by AISC 303.
B. Prefabricated building columns.
C. Grout.

1.2 PERFORMANCE REQUIREMENTS

A. Fabricator to select or complete [simple shear] connections, including engineering analysis by a qualified professional engineer, to withstand design loads.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: AISC-Certified Plant, Category STD.
B. Installer Qualifications: AISC-Certified Erector, Category [ACSE] [CSE].
C. Shop-Painting Applicator Qualifications: AISC’s Sophisticated Paint Endorsement [P1] [P2] [P3] or SSPC-QP 3.
D. Quality Standards: AISC 303, AISC 341, AISC 341s1, and AISC 360.

1.4 MATERIALS

A. Recycled Content of Steel: Postconsumer plus one-half of preconsumer recycled content not less than [25 percent.] [50 percent.] [<Insert number> percent.] [the following:]
   1. W-Shapes: [60] <Insert number> percent.
   2. Channels, Angles, M, S-Shapes: [60] <Insert number> percent.
   3. Plate and Bar: [25] <Insert number> percent.
   4. Cold-Formed Hollow Structural Sections: [25] <Insert number> percent.
   5. Steel Pipe: [25] <Insert number> percent.
   6. <Insert Category Name>: <Insert number> percent.
   7. All Other Steel Materials: [25] <Insert number> percent.
B. Structural-Steel Shapes: [W-shapes] [channels] [angles] [M-shapes] [S-shapes] [plate and bar] [cold-formed hollow structural sections] [and] [steel pipe].
C. Steel castings.
D. Steel forgings.
E. Bolts, Nuts, and Washers: [High strength] [Tension control, high strength].
F. Anchor Rods: [Unheaded] [Headed] rods, nuts, plate washers, and washers.

G. Connectors: [Shear connectors] [threaded rods] [clevises] [turnbuckles] [eye bolts and nuts] [and] [sleeve nuts].

H. Structural slide bearings.

I. Primer: [Zinc oxide, oil] [Latex] [Fabricator's standard, nonasphaltic].
   1. Primers comply with LEED for Schools Credit IEQ 4.

J. Grout: [Metallic, shrinkage resistant] [Nonmetallic, shrinkage resistant].

K. Prefabricated Building Columns:
   1. Fire-Resistance Rating: [4 hours] [3 hours] [2 hours] [As indicated].

1.5 FABRICATION

A. Shop Connections:
   1. High-Strength Bolts: [Snug tightened] [Pretensioned] [Slip critical].
   2. Welded connections.

B. Surface Preparation: [SSPC-SP 2] [SSPC-SP 3] [SSPC-SP 7/NACE No. 4] [SSPC-SP 11]
   [SSPC-SP 14/NACE No. 8] [SSPC-SP 6/NACE No. 3] [SSPC-SP 10/NACE No. 2] [SSPC-
   SP 5/NACE No. 1] [SSPC-SP 8].

C. Galvanizing: Hot dip.

1.6 SOURCE QUALITY CONTROL

A. Testing Agency: Owner engaged.

1.7 INSTALLATION

A. Field Connections:
   1. High-Strength Bolts: [Snug tightened] [Pretensioned] [Slip critical].
   2. Welded connections.

1.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner engaged.

END OF SECTION 051200
SECTION 06 10 00
ROUGH CARPENTRY

1.1 MATERIALS

A. Wood Products, General:
   1. Rough carpentry materials.
      a. Dimension lumber framing.
      b. Laminated veneer lumber.
      c. Parallel strand lumber.
      d. Prefabricated wood I-joists.
      e. Rim boards
      f. Miscellaneous lumber.

   2. Maximum Moisture Content of Lumber: 19 percent.

B. Wood-Preservative-Treated Lumber:
   1. Preservative Treatment: AWPA U1; Use Category UC2.
      a. Preservative Chemicals: Containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
   2. Application: Items indicated and as follows:
      a. Items in contact with roofing or waterproofing.
      b. Items in contact with concrete or masonry.
      c. Framing less than 18 inches (460 mm) above ground in crawlspaces.
      d. Floor plates installed over concrete slabs-on-grade.

C. Dimension Lumber Framing:
   1. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
      a. Application: Interior partitions not indicated as load-bearing.
      b. Species: Douglas Fir-Larch.

   2. Load-Bearing Partitions: No. 2 grade.
      b. Species: Douglas fir-larch.

   3. Load-Bearing Partitions: Machine stress-rated lumber, 2600-1.9E.
      a. Application: Exterior walls and where noted on drawings.

   4. Joists, Rafters, and Other Framing: No. 2 grade.


1. Contain no urea formaldehyde.

E. Miscellaneous Lumber:

1. Dimension Lumber: Construction or No. 2 grade Douglas Fir Larch.
2. Concealed Boards: 19 percent maximum moisture content.

F. Plywood Backing Panels: Fire-retardant treated.

G. Fasteners: Hot-dip galvanized steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.

H. Metal Framing Anchors:

1. Hot-dip galvanized steel for interior locations.
2. Hot-dip, heavy-galvanized steel for treated lumber and where indicated.
3. Types: Joist hangers, I-joist hangers, top flange hangers, bridging, post bases, joist ties, rafter tie-downs, rafter tie-downs (hurricane or seismic ties), floor-to-floor ties, hold-downs and wall bracing.

I. Miscellaneous Materials:


1.2 INSTALLATION

A. Furring to Receive Plywood or Hardboard Paneling: 1-by-3-inch nominal-size (19-by-63-mm actual-size) furring at 16 inches (406 mm) o.c.


C. Exterior Wall Framing: As noted on drawings.

D. Interior Partitions Framing: As noted on drawings.

END OF SECTION 06 10 00
SECTION 06 16 00

SHEATHING

1.1 QUALITY ASSURANCE

A. Forest certification by a Forest Stewardship Council-accredited certification body for the following:

1. Plywood.
2. Oriented strand board.

1.2 MATERIALS

A. Wood Products, General:

1. The following products FSC-certified:
   a. Plywood.
   b. Oriented strand board.

2. Wood panel products comply with low-emitting materials requirements of LEED for Schools.

B. Wall Sheathing:

1. Plywood: Exterior Exposure 1, 1/2 inch (13 mm) thick.
2. Oriented Strand Board: Exposure 1, 1/2 inch (13 mm) thick.

C. Roof Sheathing:

1. Plywood: Exterior Exposure 1, 15/32 inch (11.9 mm) thick.
2. Oriented Strand Board: Exposure 1, 15/32 inch (11.9 mm) thick.

D. Composite Nail Base Insulated Roof Sheathing:

1. Type: Vented.
2. Polysisocyanurate Foam: [1 inch (25 mm)] [1-1/2 inches (38 mm)] [2 inches (50 mm)]
   [2-1/2 inches (64 mm)] [3 inches (76 mm)] [3-1/2 inches (89 mm)] [4 inches (102 mm)]
   thick.
3. Oriented Strand Board: [7/16 inch (11.1 mm)] [5/8 inch (15.9 mm)] thick.

E. Subflooring and Underlayment:

1. Plywood Combination Subfloor-Underlayment: [Exterior, Structural I, C-C Plugged]
   [Exterior, C-C Plugged] [Exposure 1, Structural I, Underlayment] [Exposure 1, Underlayment],
   [23/32 inch (18.3 mm)] [7/8 inch (22.2 mm)] [1 inch (25 mm)] thick.
2. Oriented-Strand-Board Combination Subfloor-Underlayment: Exposure 1, [23/32 inch
   (18.3 mm)] [7/8 inch (22.2 mm)] [1 inch (25 mm)] thick.
3. Plywood Subflooring: [Exterior, Structural I] [Exterior] [Exposure 1, Structural I]
   [Exposure 1], [23/32 inch (18.3 mm)] [7/8 inch (22.2 mm)] [1 inch (25 mm)] thick.
4. Oriented-Strand-Board Subflooring: [Exposure 1, Structural I] [Exposure 1], [23/32 inch (18.3 mm)] [7/8 inch (22.2 mm)] [1 inch (25 mm)] thick.

5. Plywood Underlayment for Resilient Flooring: [Exterior A-C] [Exterior B-C] [Exterior, C-C Plugged] [Exposure 1 Underlayment] thick.

6. Plywood Underlayment for Ceramic Tile: Exterior, C-C Plugged, 5/8 inch (15.9 mm) thick.

7. Plywood Underlayment for Carpet: [Exterior, C-C Plugged] [Exposure 1, Underlayment] [Interior, Underlayment].

8. Particleboard Underlayment: Grade [PBU] [M-2, urea-formaldehyde free].


F. Fasteners: Hot-dip galvanized steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.

G. Miscellaneous Materials:

1. Sealant for gypsum sheathing.
2. Sheathing tape.
3. Adhesives: Low VOC..

1.3 INSTALLATION

A. Wood Structural Panel:

1. Combination Subfloor-Underlayment:
   a. Glue and nail to wood framing.

2. Subflooring:
   a. Glue and nail to wood framing.

3. Sheathing:
   a. Nail to wood framing.

4. Underlayment:
   a. Nail to subflooring.

B. Gypsum Sheathing:

1. [Nail] [or] [screw] to wood framing.
2. Screw to cold-formed metal framing.

C. Fiberboard Sheathing:

1. [Nail] [Nail or staple] to wood framing.

D. Particleboard Underlayment:

1. [Glue and nail] [Nail] [Nail or staple] to subflooring.

E. Hardboard Underlayment:
1. [Nail] [Nail or staple] to subflooring.

END OF SECTION 06 16 00
SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

1.1 SUMMARY

A. Wood roof and girder trusses.
B. Wood truss bracing.
C. Metal truss accessories.

1.2 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that participates in a quality-assurance program that complies with TPI 1 with third-party inspection acceptable to Architect and authorities having jurisdiction.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Fabricator to design metal-plate-connected wood trusses.
   1. Design Loads: As indicated.

1.4 MATERIALS

A. Permanent Bracing: Comply with [Section 061000 "Rough Carpentry"] [Section 061053 "Miscellaneous Rough Carpentry."]

B. Metal Connector Plates:
   1. Hot-dip galvanized steel.

C. Metal Truss Accessories:
   1. Hot-dip galvanized steel.
   2. Types: [Truss tie-downs] [Truss tie-downs (hurricane or seismic ties)] [Roof truss clips] [Floor truss hangers] [and] [roof truss bracing/spacers].

1.5 SOURCE QUALITY CONTROL

A. Owner will engage a qualified special inspector.

1.6 INSTALLATION

A. Truss Spacing: 24 inches (610 mm) o.c.
SECTION 06 18 00
GLUED-LAMINATED CONSTRUCTION

1.1 QUALITY ASSURANCE

1.2 MATERIALS
A. FSC-certified wood.
B. Structural Glued-Laminated Timber:
   1. Lumber Species: Douglas fir-larch.
   2. Appearance Grade: Industrial.
C. Timber Connectors: Steel, prime painted.
D. Factory Finishing: Sealer.

END OF SECTION 06 18 00
SECTION 06 20 23
INTERIOR FINISH CARPENTRY

1.1 MATERIALS

A. Regional Materials: Extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
   1. Interior trim.
   2. Interior [plywood] [hardboard] [board] paneling.

B. Composite Wood Materials: Urea-formaldehyde free.

C. Adhesives: Low VOC.

D. Preservative Treatment by Pressure Process: [Where indicated] [All interior lumber and plywood] <Insert application>.

E. Fire-Retardant-Treated Materials: [Where indicated] [All interior lumber and plywood] <Insert application>.

F. Interior Standing and Running Trim:
   1. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish): White maple.

1.2 INSTALLATION

A. Board Paneling: Installed [without end joints] [with end joints staggered].

END OF SECTION 06 20 23
SECTION 06 40 23
INTERIOR ARCHITECTURAL WOODWORK

1.1 SUMMARY
A. Flush wood paneling and wainscots.
B. Plastic-laminate cabinets.
C. Solid surfacing and plastic-laminate countertops.

1.2 QUALITY ASSURANCE
A. Quality Standard: AWI, including installation.
B. Mockups for each form of construction and finish.

1.3 MATERIALS
A. FSC-certified wood.
B. Wood Species and Cut for Transparent Finish: White Maple, plain sawn or sliced.
D. Composite Wood Products: Urea formaldehyde free.
E. Composite Wood Materials: Urea formaldehyde free.
F. Adhesives: Urea formaldehyde free.
G. Installation Adhesive: Low VOC.
H. Cabinet Hardware:
   1. Hinges: European style hinges (verify w/EWU).
   3. Locks: Door and drawer.
   5. Shelf Supports: KV brackets and standards.
I. Interior Woodwork Grade: Custom.
J. Plastic-Laminate Cabinets:
   1. Grade: Custom.
   2. AWI Type of Cabinet Construction: Reveal overlay.
K. Plastic-Laminate Countertops:
1. Grade: Custom.
2. Edge Treatment: Self-edged.

L. Solid surface countertops.

M. Shop Finishing:

1. Grade: Same grade as woodwork.

END OF SECTION 06 40 23
SECTION 07 11 13

BITUMINOUS DAMPPROOFING

1.1 SUMMARY

A. Cold-applied, emulsified-asphalt dampproofing applied to the following surfaces:
   1. Exterior, below-grade surfaces of concrete foundation walls.
   2. Back side of concrete and masonry retaining walls, below grade.

1.2 MATERIALS

A. Cold-Applied, Emulsified-Asphalt: Low VOC.

1.3 INSTALLATION

A. Cold-Applied, Emulsified-Asphalt Dampproofing:
   1. Concrete Foundations: Two brush or spray coats, one fibered brush or spray coat, or one trowel coat.
   2. Unexposed Faces of Concrete Retaining Walls: One brush or spray coat.

END OF SECTION 07 11 13
1.1  WARRANTY
   A. Watertightness Warranty: Ten years.
   B. Installer's Warranty: Two years.

1.2  MATERIALS
   B. Sheet Flashing: Uncured neoprene.
   D. Insulation: Extruded polystyrene.

1.3  INSTALLATION
   A. Unreinforced Application: Average wet thickness of 120 mils (3 mm).

END OF SECTION 07 14 16
SECTION 07 19 00
WATER REPELLENTS

1.1 SUMMARY
A. Water-repellent and anti-graffiti coating for the following:
   1. Clay brick masonry.

1.2 PERFORMANCE REQUIREMENTS
A. Water Absorption: Minimum 80 percent reduction.
B. Water-Vapor Transmission: Maximum 10 percent reduction.
C. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate.
D. Chloride-Ion Intrusion in Concrete: 80 percent reduction.

1.3 QUALITY ASSURANCE
A. Mockups for each type and color of water repellent and substrate indicated.

1.4 MATERIALS
A. Penetrating Water Repellent: Silane/siloxane blend, clear.
   1. Solids: 10 percent or more.
   2. VOC Content: 600 g/L or less.
B. Anti-Graffiti Coating: Silane/siloxane blend, penetrating.
   1. To 13 ft. + above the first floor line.

1.5 APPLICATION
A. Manufacturer’s Field Service: Factory-authorized service representative to inspect substrate and instruct Applicator.
B. Application Method: Spray roller or brush.

1.6 FIELD QUALITY CONTROL
A. Testing: By Contractor.
SECTION 07 21 00
THERMAL INSULATION

1.1 INSULATION PRODUCTS

A. Surface-Burning Characteristics: ASTM E 84, and as follows:
   1. Flame-Spread Index: 25 or less where exposed; otherwise, as indicated in Part 2 "Insulation Products" Article.
   2. Smoked-Developed Index: 450 or less.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, with flame-spread index of 75 or less.

C. Foil-Faced Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1, faced on both sides with aluminum foil, with flame-spread index of 75 or less for unfaced core material.

D. Mineral-Fiber-Blanket Insulation: ASTM C 665, Type I, unfaced with fibers manufactured from glass, with flame-spread index of 25 or less.

E. Vented Nailboard:
   1. Manufacturer: Johns Manville.
   2. Description: Rigid insulation board with nailable surface for asphalt shingles.

1.2 ACCESSORIES

A. Vapor Retarder: Reinforced polyethylene, 6 mils (0.15 mm) thick.

B. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed to fit between roof framing members and to provide cross-ventilation between attic spaces and vented eaves.

1.3 INSTALLATION

A. Install insulation in areas and in thicknesses indicated or required to produce R-values indicated. Cut and fit tightly around obstructions and fill voids with insulation.

B. Except for loose-fill insulation and insulation that is friction fitted in stud cavities, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

C. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage. Locate seams at framing members, overlap, and seal with tape.

END OF SECTION 07 21 00
SECTION 07 25 00
WEATHER BARRIERS

1.1 MATERIALS

A. Building wrap.
B. Building-wrap tape.
C. Self-Adhering Flexible Flashing: Butyl rubber or rubberized asphalt.

END OF SECTION 07 25 00
1.1 SUMMARY
   A. Asphalt shingles.
   B. Underlayment.

1.2 QUALITY ASSURANCE
   A. Exterior Fire-Test Exposure: Class A; ASTM E 108 or UL 790.
   B. Mockup of each form of construction.

1.3 WARRANTY
   A. Material Warranty Period: 40 years.
   B. Workmanship Warranty Period: 10 years.
   C. Roofing Installer's Warranty: Five years.

1.4 PRODUCTS
   A. Glass-Fiber-Reinforced Asphalt Shingles: Laminated-strip type.
   B. Underlayment: Felt(s) and self-adhering sheet underlayment, polyethylene faced.
      1. Granular-surfaced valley lining.
   C. Ridge Vents: Rigid, high-density plastic with flexible, mat filter.
   D. Metal Flashing and Trim: Copper.
      1. Types: Apron flashings, step flashings, cricket flashings, open-valley flashings, drip edges and vent pipe flashings.

1.5 INSTALLATION
   A. Underlayment: Double-layer felt(s).
   B. Ice-Dam Membrane: Self-adhering sheet.

D. Valleys: Granular surfaced, open.

END OF SECTION 07 31 13
1.1 SUMMARY
A. Factory-formed and field-assembled concealed-fastener, lap-seam metal panels.

1.2 PERFORMANCE REQUIREMENTS
A. Air Infiltration: ASTM E 283.
B. Water Penetration under Static Pressure: ASTM E 331.
C. Water Penetration under Dynamic Pressure: AAMA 501.1.
D. Structural Performance: ASTM E 1592.
   2. Deflection Limits: 1/240.

1.3 QUALITY ASSURANCE
A. Mockups for each form of construction.

1.4 WARRANTY
A. Materials and Workmanship: Two years.
B. Finishes: 20 years.

1.5 MATERIALS
A. Miscellaneous Metal Framing: Subgirts base or sill angles or channels hat-shaped, rigid furring channels cold-rolled furring channels and Z-shaped furring.

1.6 PRODUCTS
A. Concealed-Fastener, Lap-Seam Metal Panels:
   3. Exterior Finish: 3-coat fluoropolymer.
   4. Reveal Option: One pencil rib.
   5. Coverage: 12”.
   6. Depth: 1-1/2”.
   7. Reveal: None.
B. Accessories: Flashing and trim.

END OF SECTION 07 42 13
1.1 SUMMARY
   A. Mechanically fastened TPO membrane roofing system.
   B. Roof insulation.
   C. Walkway pads.

1.2 PERFORMANCE REQUIREMENTS
   A. Roofing System Design: Uplift pressures calculated according to ASCE/SEI 7.
   B. FM Approvals Listing: Class 1A-90.

1.3 QUALITY ASSURANCE
   A. Exterior Fire-Test Exposure: Class A.
   B. Preinstallation conference.

1.4 WARRANTY
   A. Manufacturer's Materials and Workmanship Warranty: 15 years.
   B. Installer's Warranty: Two years.

1.5 MATERIALS
   A. TPO Membrane Roofing: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
      1. Thickness: 60 mils (1.5 mm), nominal.
      2. Color: As selected from manufacturer’s standard options.
   B. Low VOC adhesives and sealants.
   C. Sheet Flashing: Same as TPO sheet membrane.
   D. Roof Insulation: Composite molded-polystyrene or Polyisocyanurate board.
      1. Tapered Boards: ½ inch per 12 inches.
   E. Walkways: Pads.
1.6 INSTALLATION

A. Roof Insulation: Mechanically fastened.

B. Membrane Roofing: Mechanically fastened.

END OF SECTION 07 54 23
1.1 PERFORMANCE REQUIREMENTS
A. Roof Edge Flashing and Copings: Capable of resisting Wind Zone 1 forces according to FMG Loss Prevention Data Sheet 1-49.

1.2 QUALITY ASSURANCE
A. Quality Standard(s): SMACNA's "Architectural Sheet Metal Manual".

1.3 WARRANTY
A. Fluoropolymer Finishes: 20 years.

1.4 MATERIALS
A. Sheet Metals:
   1. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet with smooth, flat surface.
      a. Coil-Coated Finish: Two-coat fluoropolymer.
   B. Underlayment: Polyethylene sheet.

1.5 PRODUCTS
A. Manufactured Flashing and Trim:
   1. Reglets and Counterflashing: Galvanized steel.
      a. Type: Surface-mounted Masonry.
   B. Formed Low-Slope Roof Fabrications: Including copings base flashing counterflashing flashing receivers roof-penetration flashing and roof-drain flashing.
   C. Formed Wall Fabrications: Including through-wall flashing.
   D. Miscellaneous Formed Fabrications: Including equipment support flashing.
   E. Formed Roof Drainage Fabrications: Hanging gutters, downspouts and gutter guards.

END OF SECTION 07 62 00
SECTION 07 72 53

SNOW GUARDS

1.1 PRODUCTS

A. Flat-Mounted Metal Snow Guard Pads:

1. Material: Manufacturer's standard noncorrosive metal.
2. Finish: Powder coat.

END OF SECTION 07 72 53
SECTION 07 84 13
PENETRATION FIRESTOPPING

1.1 QUALITY ASSURANCE
A. Installer Qualifications: An FM Global-approved firestop contractor or a UL-qualified firestop contractor.
B. Fire-Test-Response Characteristics: UL.

1.2 PENETRATION FIRESTOPPING
A. Penetrations in Fire-Resistance-Rated Walls: F-ratings per ASTM E 814 or UL 1479.
B. Penetrations in Horizontal Assemblies: F- and T-ratings per ASTM E 814 or UL 1479.
C. Penetrations in Smoke Barriers: L-ratings per UL 1479.
D. W-Ratings: Per UL 1479.

1.3 INSTALLATION
A. Identification: Preprinted metal or plastic labels.

1.4 FIELD QUALITY CONTROL
A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E 2174.

1.5 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE
A. Firestopping with No Penetrating Items FS-1: W-L-0000-0999
1. UL.
2. F-Rating: 1 hours.
3. T-Rating: 3 hours.
5. Type of Fill Materials: As required to achieve rating.
1. UL 795.
2. F-Rating: 1 hours.
3. T-Rating: 3 hours.
4. Type of Fill Materials: As required to achieve rating.
C. Firestopping for Nonmetallic Pipe, Conduit, or Tubing: W-L-2000-2999
1. UL.
2. F-Rating: 1 hours.
3. T-Rating: 3 hours.
4. Type of Fill Materials: As required to achieve rating.

D. Firestopping for Electrical Cables: W-L-3000-3999
   1. UL.
   2. F-Rating: 1 hours.
   3. T-Rating: 3 hours.
   5. Type of Fill Materials: As required to achieve rating.

E. Firestopping for Miscellaneous Electrical Penetrants: W-L-6000-6999
   1. UL.
   2. F-Rating: 1 hours.
   3. T-Rating: 3 hours.
   5. Type of Fill Materials: As required to achieve rating.

F. Firestopping for Miscellaneous Mechanical Penetrants: W-L-7000-7999
   1. UL.
   2. F-Rating: 1 hours.
   3. T-Rating: 3 hours.
   5. Type of Fill Materials: As required to achieve rating.

G. Firestopping for Groupings of Penetrants: W-L-8000-8999
   1. UL.
   2. F-Rating: 1 hours.
   3. T-Rating: 3 hours.
   5. Type of Fill Materials: As required to achieve rating.

END OF SECTION 07 84 13
SECTION 07 84 46
FIRE-RESISTIVE JOINT SYSTEMS

1.1 QUALITY ASSURANCE
A. Installer Qualifications: An FM Global-approved firestop contractor or a UL-qualified firestop contractor.
B. Fire-Test-Response Characteristics: UL.

1.2 FIRE-RESISTIVE JOINT SYSTEMS
A. Joints in or between Fire-Resistance-Rated Construction: ASTM E 1966 or UL 2079.
B. Joints at Exterior Curtain-Wall/Floor Intersections: ASTM E 119 or ASTM E 2307.

1.3 INSTALLATION
A. Identification: Preprinted metal or plastic labels.

1.4 FIELD QUALITY CONTROL
A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E 2393.

1.5 FIRE-RESISTIVE JOINT SYSTEMS SCHEDULE
A. Floor-to-Floor, Fire-Resistive Joint Systems:
   1. Assembly Rating: 1 hour 2 hours and 3 hours.
B. Wall-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 1 hour 2 hours and 3 hours.
C. Floor-to-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 1 hour 2 hours and 3 hours.
D. Head-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 1 hour 2 hours and 3 hours.
E. Bottom-of-Wall, Fire-Resistive Joint Systems:
   1. Assembly Rating: 1 hour 2 hours and 3 hours.
F. Wall-to-Wall, Fire-Resistive Joint Systems Intended for Use as Corner Guards:
1. Assembly Rating: 1 hour 2 hours and 3 hours.

G. Perimeter Fire-Resistive Joint Systems:
   1. Integrity Rating: 1 hour 2 hours and 3 hours.

END OF SECTION 07 84 46
SECTION 07 92 00

JOINT SEALANTS

1.1 PRECONSTRUCTION TESTING

A. Preconstruction compatibility and adhesion testing.
B. Preconstruction field-adhesion testing.
C. Field Construction Mock-ups: Each joint type.

1.2 WARRANTY

A. Installer Warranty: Two years.
B. Special Manufacturer's Warranty: 20 years for silicons.

1.3 MATERIALS

A. VOC Content of Interior Sealants:
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.
B. Stain Test: ASTM C 1248.
C. Suitability for Contact with Food: Comply with 21 CFR 177.2600, where applicable.

1.4 JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant:
   1. Type: Single component.
   2. Grade: nonsag.
B. Urethane Joint Sealant:
   1. Type: Single component or multicomponent.
   2. Grade: Pourable.
C. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex.
D. Acoustical Joint Sealant: Nonsag, paintable, nonstaining latex.
E. Joint-Sealant Backing: Cylindrical.

1.5 FIELD QUALITY CONTROL

A. Field-adhesion testing.

END OF SECTION 07 92 00
SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

1.1 SUMMARY
A. Standard hollow metal doors and frames.

1.2 QUALITY ASSURANCE
C. Fire-Rated Doors and Frames: Neutral-pressure testing.

1.3 PRODUCTS
A. Standard Hollow Metal Doors:
   1. Design: Flush panel.
      a. Level 3 and Physical Performance Level A (Extra Heavy Duty).
      b. Model: 2 (Seamless).
   4. Interior Doors: Cold-rolled steel sheet faces.
      a. Level 2 and Physical Performance Level B (Heavy Duty).
      b. Model: 2 (Seamless).
B. Standard Hollow Metal Frames:
      a. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
   2. Interior Frames: Cold-rolled steel sheet; full profile welded.
      a. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.
      b. Frames for Wood Doors: 0.067-inch- (1.7-mm-) thick steel sheet.
      c. Frames for Borrowed Lights: Same as adjacent door frame.
C. Hollow Metal Panels: Same materials, construction, and finish as adjoining hollow metal work.
D. Accessories:
   1. Moldings and stops for glazed lites.
E. Finishes: Factory priming for field painting.
1.4 INSTALLATION

A. Metal-Stud Partitions: Frames filled with insulation.

B. Concrete and Masonry Walls: Frames filled with grout.

END OF SECTION 08 11 13
1.1 QUALITY ASSURANCE
   A. Quality Standard: AWI.
      1. AWI Quality Certification Labels or an AWI letter of licensing for doors.
   B. Fire-Rated Wood Doors: Neutral pressure testing.

1.2 DOOR CONSTRUCTION, GENERAL
   A. Low-Emitting Materials: Made with adhesives and composite wood products that do not contain
      urea formaldehyde.
   B. WDMA I.S.1-A Performance Grade:
      1. Heavy Duty unless otherwise indicated.
      2. Extra Heavy Duty: Classrooms public toilets janitor's closets assembly spaces exits.

1.3 VENEERED-FACED DOORS FOR TRANSIENT FINISH
   A. Interior Solid-Core Doors:
      1. Grade: Premium, with Grade A faces.
      2. Species: Select white maple.
      3. Cut: Plain sliced (flat sliced).
      5. Assembly of Veneer Leaves on Door Faces: Balance match.
      6. Special Matching:
      a. Pair and set match.
      7. Core: Particleboard or Glued wood stave.
      9. WDMA I.S.1-A Performance Grade: As indicated.

1.4 LOUVERS AND LIGHT FRAMES
   A. Louvers: Wood.
      1. Fire-Door Louvers: Galvanized steel, with fusible links.
   B. Light-Opening Frames:
      1. Wood beads.
1.5 PRIMING/FINISHING

A. Transparent Factory Finishes:

1. Grade: Premium.
2. Finish: Catalyzed polyurethane.

END OF SECTION 08 14 16
SECTION 08 31 13

ACCESS DOORS AND FRAMES

1.1 PRODUCTS

A. Flush access doors and frames for walls and ceilings.
   1. Flanges: Concealed.

B. Medium-security flush access doors and frames.
   1. Material: Steel.

C. Finishes:

END OF SECTION 08 31 13
1.1 PERFORMANCE REQUIREMENTS
   A. Engineering design of sliding aluminum-framed glass doors by Contractor.
   B. Basic Wind Speed: [85 mph (38 m/s)] [90 mph (40 m/s)] <Insert value>.
   C. Importance Factor: <Insert factor>.
   D. Exposure Category: [B] [C] [D].

1.2 QUALITY ASSURANCE
      1. Performance Class and Grade: HC[40] [45] [50] <Insert grade>.
   B. Mockups for each form of construction.

1.3 WARRANTY
   A. Door: Three years.
   B. Glazing: 10 years.
   C. Metal Finish: Five years.

1.4 SLIDING DOOR
   A. Glazing: Factory glazed.
   B. Aluminum Finishes: Three-coat high-performance organic coating.

END OF SECTION 08 32 13
SECTION 08 33 23
OVERHEAD COILING DOORS

1.1 DOOR ASSEMBLY

A. Service: Door curtain of painted steel.

B. Hood: Painted steel.

C. Integral Frame, Hood, and Fascia for Counter Door: Painted steel.

D. Electric door operator.

E. Mounting: Face mounted.

END OF SECTION 08 33 23
1.1 SUMMARY
   A. Section Includes:
      1. Side sliding grille.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For sliding grilles. Include plans, elevations, sections, details, attachments to other work, clearances required for operation and accessory items. Show blocking.

1.3 QUALITY ASSURANCE
   A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this Project.

1.4 WARRANTY
   A. Side Sliding Grilles shall be warranted for a period of two (2) years from Substantial Completion against defect in workmanship and materials.

1.5 MANUFACTURERS
   A. Basis-of-Design is Cookson’s “Sentry 66” side sliding grille.
   B. Track: Overhead track is to be 1.3” (33 mm) wide x 1.8” (46 mm) high and is to accept 1-1/8” (29 mm) diameter roller trolleys. Rollers are to bear on 0.27” (7 mm) thick aluminum surface within the track. Track curves, where indicated, are to have 10” (254 mm).
   C. Finish:

1.6 INSTALLATION
   A. Install in accordance with the manufacturer’s shop drawings and instructions.

1.7 ADJUSTING
   A. Adjust units as necessary to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.
END OF SECTION 08 33 36
SECTION 08 41 13
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.1 SUMMARY
A. Exterior and interior storefront framing.
B. Storefront framing for window walls.
C. Exterior and interior manual-swing entrance doors and door-frame units.

1.2 PERFORMANCE REQUIREMENTS
A. Structural Performance:
   1. Wind Loads: As indicated on Drawings.
   2. Seismic Loads: As indicated on Drawings.
B. Deflection of Framing Members:
   1. Deflection Normal to Wall Plane: Limited to L/175.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 or 1/8 inch (3.2 mm), whichever is smaller.

1.3 WARRANTY
A. Materials and Workmanship: Two years.
B. Finish: 10 years.

1.4 MATERIALS
A. Aluminum: Alloy and temper recommended by manufacturer.
B. Steel reinforcement.

1.5 FRAMING SYSTEMS
A. Basis-of-Design Product: Kawneer “451T”.
B. Framing Members: Manufacturer's standard extruded-aluminum framing members.
   2. Glazing System: Comply with requirements in Division 8 Section “Glazing”.
   3. Glazing Plane: As indicated.
C. Brackets and reinforcements.
D. Fasteners and accessories.
E. Concrete and masonry inserts.
F. Concealed Flashing: 0.018-inch (0.457-mm) thick stainless steel.
G. Framing system gaskets and sealants.

1.6 GLAZING SYSTEMS
A. Glazing: As specified in Division 08 Section "Glazing."
B. Glazing gaskets.
C. Spacers and setting blocks.
D. Bond-breaker tape.
E. Glazing Sealants:
   1. Structural sealant.
   2. Weatherseal sealant.

1.7 ENTRANCE DOOR SYSTEMS
A. Entrance Doors:
   1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness “Tuff-Line” 2-inch (50.8-mm) overall thickness.
   2. Door Design: Wide stile.
   3. Glazing stops and gaskets.
B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

1.8 ALUMINUM FINISHES
A. Aluminum Finishes: High-performance organic (three coats).

1.9 ENTRANCE DOOR HARDWARE SETS
A. See Division 8 Section "Door Hardware."

END OF SECTION 08 41 13
SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

1.1 SUMMARY

A. Conventionally glazed aluminum curtain walls installed as unit-and-mullion assemblies, with integral sun shade devices.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Contractor to design glazed aluminum curtain walls.

B. Structural Performance:

1. Wind Loads: As indicated on Drawings.
2. Blast Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to L/175.
2. Deflection Parallel to Glazing Plane: Limited to L/360 or 1/8 inch (3.2 mm), whichever is smaller.

D. Seismic performance.

E. Energy Performance: Glazed aluminum curtain walls shall have energy performance ratings per NFRC.

1. Thermal Transmittance (U-factor): 
   - [0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K)]
   - [0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K)]
   - [0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K)] <Insert value>.

2. Solar Heat Gain Coefficient: [0.35] [0.40] [0.45] <Insert value>.

3. Air Infiltration: [0.30 cfm/sq. ft. (1.50 L/s per sq. m)] <Insert value> at [1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft. (300 Pa)] <Insert value>.

1.3 QUALITY ASSURANCE

A. Energy Performance Standards: Comply with NFRC.

B. Mockups for each form of construction.

1.4 WARRANTY

A. Materials and Workmanship: 10 years.

B. Finish: 10 years.
1.5 BASIS-OF-DESIGN PRODUCT: Kawneer “1600 System1”.

1.6 FRAMING

A. Framing Members: Extruded or formed aluminum.

B. Concealed Flashing: Manufacturer's standard.

C. Framing sealants.

1.7 GLAZING

A. Glazing gaskets.

B. Glazing sealants.

1.8 SUNSCREEN

A. Outrigger: Straight-Square.

B. Louver: Planar.

C. Fascia: Rectangular.

1.9 ALUMINUM FINISHES

A. Aluminum Finishes: High-performance organic (three coats).

1.10 FABRICATION

A. Provisions for field replacement of glazing from exterior.

1.11 FIELD QUALITY CONTROL

A. Testing: By Contractor-engaged agency.

B. Testing Services:
   1. Air Infiltration: ASTM E 783.

END OF SECTION 08 44 13
SECTION 08 51 13
ALUMINUM WINDOWS

1.1 QUALITY ASSURANCE

A. Mockups for each form of construction.

1.2 WARRANTY

A. Windows: 10 years from date of Substantial Completion.
B. Glazing Units: Five years from date of Substantial Completion.
C. Aluminum Finish: 10 years from date of Substantial Completion.

1.3 WINDOW PERFORMANCE REQUIREMENTS

   1. Minimum Performance Class: CW.
B. Thermal Transmittance: \[0.30 \text{ Btu/sq. ft} \times \text{h} \times \text{deg F} (1.71 \text{ W/sq. m} \times \text{K})\] \[0.32 \text{ Btu/sq. ft} \times \text{h} \times \text{deg F} (1.83 \text{ W/sq. m} \times \text{K})\] \[0.35 \text{ Btu/sq. ft} \times \text{h} \times \text{deg F} (2.0 \text{ W/sq. m} \times \text{K})\] \[0.60 \text{ Btu/sq. ft} \times \text{h} \times \text{deg F} (3.43 \text{ W/sq. m} \times \text{K})\] < Insert value > maximum.
C. Solar Heat-Gain Coefficient: \[0.40\] \[0.30\] \[0.27\] < Insert value > maximum.
D. Condensation-Resistance Factor: \[45\] \[52\] < Insert value > complying with AAMA 1503.
E. Sound Transmission Class: \[26\] \[30\] < Insert rating > minimum.
F. Outside-Inside Transmission Class: \[22\] \[26\] \[30\] < Insert rating > minimum.
G. Windborne-Debris Resistance: Passing ASTM E 1886 and requirements of authorities having jurisdiction.

1.4 ALUMINUM WINDOWS

A. Frames and Sashes: Thermally improved aluminum extrusions.
B. Glazing:
   2. Glazing System: Dual.
C. Accessories: [Integral ventilating system/device] [Dividers (false muntins)] [Horizontal louver blinds for dual-glazing systems] [Subsills] [Column covers] [Interior trim] [Panning trim] [Receptor system] < Insert accessory >.
D. Insect Screens: At each operable exterior sash, with aluminum frames and without wickets.


END OF SECTION 08 51 13
SECTION 08 53 13

VINYL WINDOWS

1.1 SUMMARY

A. This Section includes fixed and operable vinyl-framed windows.

1.2 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
   1. LC: Light Commercial.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
   1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide vinyl windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of test size indicated below:
   2. Size indicated on Drawings.

B. Structural Performance: Provide vinyl windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
   1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
      a. Basic Wind Speed: 85 mph (38 m/s).

C. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.
1.4 SUBMITTALS
A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of vinyl window indicated.

1.5 WARRANTY
A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace vinyl windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of vinyl, other materials, and finishes beyond normal weathering.
   e. Failure of insulating glass.

2. Warranty Period:
   a. Window: 10 years from date of Substantial Completion.
   b. Glazing: 10 years from date of Substantial Completion.
   c. Vinyl Finish: Five years from date of Substantial Completion.

1.6 MANUFACTURERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide Pella "Encompass" vinyl window. Subject to compliance with Division 1 Specifications, products from other manufacturer's will be considered.

1.7 WINDOW
A. Window Type: See drawings.
B. AAMA/WDMA Performance Requirements: Provide vinyl windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS unless more stringent performance requirements are indicated.

1. Performance Class and Grade: LC 35.
2. Performance Class: LC.
C. Thermal Transmittance: Provide vinyl windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to NFRC 100.

1. U-Factor: 0.40 Btu/sq. ft. x h x deg F (2.3 W/sq. m x K) or less.
D. Solar Heat-Gain Coefficient (SHGC): Provide vinyl windows with a whole-window SHGC maximum of 0.32, determined according to NFRC 200 procedures.
E. Sound Transmission Class (STC): Provide glazed windows rated for not less than 34 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

F. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test.
   1. Maximum Rate: 0.03 cfm/sq. ft. of area at an inward test pressure of 1.57 lbf/sq. ft. (75 Pa).

G. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test.
   1. Test Pressure: 5.26 psf.

1.8 GLAZING


1.9 HARDWARE

A. General: Provide manufacturer’s standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with vinyl; designed to smoothly operate, tightly close, and securely lock vinyl windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze extruded, cast, or wrought aluminum die-cast zinc with special coating finish or nonmagnetic stainless steel.

1.10 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside and outside of window and provide for each operable exterior sash or ventilator.

1.11 VINYL FINISHES

A. Integral Finish and Color: Uniform, solid, homogeneous interior and exterior.
   1. Color: As selected by Architect from manufacturer's full range.
1.12 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather-tight window installation.

1.13 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer’s written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

END OF SECTION 08 53 13
SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

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

1.2 SUMMARY
A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 8 Section "Standard Steel Doors and Frames" for hardware used with hollow metal frames.
   2. Division 8 Section "Wood Doors" for factory prefitting and factory premachining of doors for door hardware.
   3. Division 8 Section "Aluminum Storefronts" for hardware used with aluminum doors and frames.
   4. Division 16 Section "Access Control and Security System".

1.3 SUBMITTALS
A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
   1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
      a. Type, style, function, size, and finish of each hardware item.
      b. Name and manufacturer of each item.
      c. Fastenings and other pertinent information.
      d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
      e. Explanation of all abbreviations, symbols, and codes contained in schedule.
      f. Mounting locations for hardware.
      g. Door and frame sizes and materials.

1.4 QUALITY ASSURANCE
A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
B. **Supplier Qualifications:** A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

C. **Fire-Rated Openings:** Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels. If automatic self-latching bolts, coordinators, and astragals are required they shall be furnished.

D. **Supplier must be a factory direct distributor of each hardware manufacturer furnished.**

1.5 **PRODUCT HANDLING**

A. Tag each item, or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

PART 2 – PRODUCTS

2.1 **PRODUCT HANDLING:**

A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate door number to match door numbers of approved hardware schedule.

C. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that the count is correct.

D. Deliver individually packaged items at the proper times to the proper locations (shop or project site) for installation.

E. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

2.2 **MANUFACTURERS**

A. The numbers shown in the hardware groups are taken from the catalogs of the following manufacturers and are for the purpose of establishing quality, design, function and finish. Except as listed, no substitutes will be allowed, unless approved by the architect prior to bid opening. No
substitutions will be allowed after bid opening. Requests for approval must be made to the architect. All substitutions must be from hardware distributors, not factory representatives.

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

1. Hinges:
   a. Bommer Industries, Inc.
   b. Hager Hinge Co.
   c. Ives, Div. Ingersoll-Rand
   d. McKinney Products Co.
   e. Stanley Hardware, Div. Stanley Works.

2. Continuous Hinges:
   a. Pemko
   b. Hager Hinge Co.

3. Locks and Latches:
   a. Schlage Lock, Div. Ingersoll-Rand

4. Bolts:
   a. Ives, Div. Ingersoll-Rand
   b. Rockwood Manufacturing Co.
   c. Triangle Brass Manufacturing Company (Trimco).

5. Overhead Closers:
   a. LCN Closers, Div. Ingersoll-Rand

6. Door Control Devices:
   a. Ives, Div. Ingersoll-Rand
   b. Rockwood Manufacturing Co.
   c. Triangle Brass Manufacturing Company (Trimco).

7. Door Trim Units:
   a. Ives, Div. Ingersoll-Rand
   b. Rockwood Manufacturing Co.
   c. Triangle Brass Manufacturing Company (Trimco).

8. Door Stripping and Seals:
   a. National Guard Products, Inc.
   b. Pemko Manufacturing Co., Inc.
   c. Reese Enterprises, Inc.

9. Exit Devices:
a. Von Duprin, Div. Ingersoll-Rand
10. Auto Door Operators:
   a. LCN Closers, Div. Ingersoll-Rand

2.3 MATERIALS AND FABRICATION:

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

B. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified standard applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designation indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

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

F. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.4 HINGES, BUTTS AND PIVOTS:

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

B. Screws: Furnish Phillips flat-head machine screws for installation of units, except furnish Phillips flat-head wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Steel Hinges: Steel pins.
4. Interior Doors: Non-rising pins.
5. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.
D. **Number of Hinges: Sizes and quantities:**

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<thead>
<tr>
<th>Door Size</th>
<th>Hinge Size</th>
<th>Number</th>
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</thead>
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<tr>
<td>Up to 36&quot; wide x up to 7’ high</td>
<td>4” x 4”</td>
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<tr>
<td>Up to 36” wide x up to 7’ high</td>
<td>4-1/2” x 4-1/2</td>
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<td>Up to 42” wide x up to 7’ high</td>
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<td>Up to 48” wide x up to 7’ high</td>
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<tr>
<td>Over 7’ high and 1 hinge per each 24” of height</td>
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E. **Continuous Hinges:** Provide heavy duty full mortise type continuous hinges at all exterior openings and where noted in hardware sets.

2.5 **LOCK CYLINDERS AND KEYING:**

All locksets to be furnished with construction cores for use during construction. Final cores and blank keys shall be furnished by the Contractor and shipped (via certified carrier) directly to the owner. Owner will specify keyway(s) for cores at the time the submittals are being reviewed. Contractor to coordinate shipping of the final cores to the Owner so as to allow Owner a minimum of 90 days to prepare cores for final installation at time of substantial completion. Owner will combine all cores and cut all keys.

B. **Key Quantity:** Furnish 3 change keys for each lock; 5 master keys for each master system; and 5 grandmaster keys for each grandmaster system.

C. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of the number of locks required for the project.

   1. Provide hinged-panel type cabinet, for wall mounting, similar to Telkee AWC-150S.

2.6 **LOCKS, LATCHES AND BOLTS:**

A. **Strikes:** Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware.

   1. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

B. **Lock Throw:** Provide 1/2" minimum throw of latchbolts on single doors, 1" minimum throw of deadbolts. Provide 3/4” minimum throw of latchbolts on UL rated pairs of doors where required by code.

C. **Flush Bolt Heads:** Minimum of 1/2" diameter rods of brass, bronze or stainless steel, with minimum 12” long rod door doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.

D. **Exit Device Dogging:** Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with a keyed dogging device to hold the push bar down and the latch bolt in the open position.

E. **Shim Kits:** On doors with vision panels extending below the exit device mounting height, provide shim kits to space the exit device away from the door sufficient distance to clear the vision panel.
2.7 PUSH/PULL UNITS:

A. Exposed fasteners: Provide manufacturer's standard exposed fasteners for installation; through-bolted for match pairs, but not for single units.

2.8 CLOSERS AND DOOR CONTROL DEVICES:

A. Provide surface mounted door closers on all exterior exits, public corridor doors, doors with security devices and elsewhere as indicated in the hardware schedule or as shown on the drawings.

B. Size of units. Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use. Provide parallel arms for all overhead closers except as otherwise noted. Furnish drop plates and accessories as required for project conditions.

2.9 DOOR TRIM UNITS:

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.

B. Fabricate protection plates (armor, kick or mop) not more than 2" less than door width on stop side and not more than 1/2' less than door width on pull side, x the height indicated.

   1. Plastic Plates: Plastic laminate (polyester), 1/8" (0.125") thick, beveled on all four edges.

2.10 WEATHERSTRIPPING:

A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stock maintained by manufacturer.

2.11 THRESHOLDS:

A. General: Except as otherwise indicated provide standard metal threshold unit of type, size and profile as shown or scheduled.

2.12 HARDWARE FINISHES:

A. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units) for color and texture.

B. Provide finishes which match those established by BHMA or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standard, but in no case less than specified for the applicable units of hardware by referenced standards.
D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI A156.18 "Materials & Finishes Standard", including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

E. Hardware in general to be US26D. Lock trim to be 626. Door closers to be in lacquered finish to match other hardware.

2.12 HARDWARE SETS

A. Hardware sets indicate quantity, item, manufacturer and product designation, size, and finish or color, as applicable.

PART 3 - EXECUTION

3.1 INSTALLATION:

Mount hardware units at heights indicated in Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.

Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and counter sink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

3.2 ADJUST AND CLEAN:

Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustments of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilation equipment.

Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finish during the final adjustment of hardware.

Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials, or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.
END SECTION 08 71 00
1.1 SUMMARY

A. Glazing required for the following:

1. Windows.
2. Doors.
3. Storefront framing.
4. Glazed entrances.
5. Interior borrowed lites.

1.2 WARRANTY

A. Laminated Glass: Not less than five years.

B. Insulating Glass: Not less than 10 years.

1.3 MATERIALS


B. Glazing Gaskets: Dense compression.

C. Silicone Glazing Sealants: Neutral curing, Class 25.
   1. VOC Content: Not more than 250 g/L.


1.4 MONOLITHIC-GLASS TYPES

A. Glass Type: Clear float glass and fully tempered float glass.

1.5 INSULATING-GLASS TYPES

A. Glass Type GL-1: Low-e-coated, clear insulating glass.
   1. Outdoor Lite: Float glass or Fully tempered float glass.
   2. Indoor Lite: Float glass or Fully tempered float glass.

END OF SECTION 08 80 00
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END OF FINISHES LEGEND
SECTION 09 21 16.23

GYPSUM BOARD SHAFT WALL ASSEMBLIES

1.1 GYPSUM BOARD SHAFT WALL ASSEMBLIES
   A. Comply with low-emitting material credit requirements for LEED for Schools.
   B. Fire-Resistance Rating:  2 hours.
   C. STC Rating:  51, minimum.
   D. Stud Depth:  As indicated.
   E. Runner Tracks:  Manufacturer's standard J-profile track.
   F. Firestop Tracks: To allow movement while maintaining continuity of fire-resistance rating.
   G. Room-Side Finish:  As indicated.
   H. Shaft-Side Finish:  As indicated.
   I. Insulation:  Sound attenuation blanket.

1.2 MATERIALS
   A. Gypsum Shaft Liner:  Moisture- and mold-resistant Type X
      1. Recycled Content:  Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent by weight.
      2. Comply with regional material credit requirements for LEED-NC.
   B. Non-Load-Bearing Steel Framing:  ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
   C. Auxiliary Materials:
      1. Trim accessories.
      2. Steel drill screws.
      3. Track fasteners.

END OF SECTION 09 21 16.23
SECTION 09 21 26.43
ACOUSTICAL WALL CONSTRUCTION

1.1 GENERAL

A. DESCRIPTION

1. This Specification addresses special equipment, materials, operations and methods to be used for acoustical wall construction.

B. QUALITY ASSURANCE

1. Substitutions or changes will only be permitted by prior approval by the Architect and Acoustical Consultant.
2. Any discrepancies between the drawings and this document shall be brought to the immediate attention of the architect and acoustical engineer.

1.2 PRODUCTS

A. ACOUSTICAL SEALANT

1. Acoustical Sealant shall be a non-hardening, non-bleeding, non-drying, resilient caulk.
2. Acceptable Products:
3. CP 672 Firestop Joint Spray by Hilti.
4. CP 572 Smoke and Acoustics Spray by Hilti.
5. CP 606 Flexible Firestop Sealant by Hilti.
6. CP 506 Smoke and Acoustics Sealant by Hilti.
8. CP 604 Self-leveling Firestop Sealant by Hilti
9. Fire Barrier Water Tight Sealant 1003 SL by 3M Vibration Control
10. Nelson Firestop Sealant CLK
11. Paintable Fire Rated Acoustical Sealants
12. 790 Silicone Building Sealant by Dow Corning
13. Acoustical Sealant by U.S. Gypsum Company
14. Acoustical Sealant by Tremco

1.3 EXECUTION

A. GYPSUM WALL BOARD

1. Tape and mud all joints between adjacent sheet edges at outermost layer of wallboard.
2. Where two layers (or more) of wallboard are used, stagger all joints between the first layer and the second layer.

B. PENETRATION ISOLATION

1. Penetration requirements identified in this section will be applied to all walls for the following:
   a. All double stud walls
b. Level 5 Ceiling Penetrations

C. RESILIENT SOUND ISOLATION CLIP INSTALLATION

1. Acceptable products:
   a. RSIC-1 by Pac International
   b. Isomax by Kinetics
   c. GenieClip by Pliteq

2. Resilient sound isolation clip shall be installed per manufacturer’s guidelines.

END OF SECTION 09 21 26.43
1.1 MATERIALS

A. Steel Framing for Framed Assemblies:
   1. Steel studs and runners.
   2. Dimpled steel studs and runners.
   3. Slip-Type Head Joints:
      a. Single long-leg runner.
      b. Double runner.
      c. Deflection track.
   4. Firestop track.
   5. Flat strap and backing plate.
   6. Cold-rolled channel bridging.
   7. Hat-shaped, rigid furring channels.
   8. Resilient furring channels.
   9. Cold-rolled furring channels.

B. Suspension Systems:
   1. Wire hangers.
   2. Flat hangers.
   3. Carrying channels.
   4. Furring channels.
   5. Grid suspension systems for ceilings.

END OF SECTION 09 22 16
SECTION 09 29 00

GYPSUM BOARD

1.1 QUALITY ASSURANCE

A. Mockups for the following:
   1. Levels of gypsum board finish for use in exposed locations.

1.2 MATERIALS

A. Interior Gypsum Board:
   1. Gypsum wallboard.
   2. Gypsum board, Type X.
   3. Gypsum ceiling board.
   4. Abuse-resistant gypsum board.
   5. Moisture- and mold-resistant gypsum board.

B. Tile-Backing Panels:
   1. Glass-mat, water-resistant backing board.

C. Trim Accessories:
   1. Interior.

D. Auxiliary materials:
   1. Acoustical Joint Sealant: Low VOC.

E. Finish:
   1. Level 5 where shown on drawings.

END OF SECTION 09 29 00
SECTION 09 30 00
TILING

1.1 TILE PRODUCTS

A. Tile Type: Unglazed ceramic mosaic tile.

B. Tile Type: Glazed wall tile.

1.2 ACCESSORY MATERIALS


B. Elastomeric Sealants: One-part, mildew-resistant silicone Multipart, pourable urethane and Chemical resistant.

C. Metal edge strips.

END OF SECTION 09 30 00
SECTION 09 51 13
ACOUSTICAL PANEL CEILINGS

1.1 SUMMARY
A. This Section includes acoustical and wood panels (for interior and exterior applications) with exposed and concealed suspension systems for ceilings.

1.2 QUALITY ASSURANCE
A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.

1.3 ACOUSTICAL PANELS, GENERAL
A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1.4 PRODUCTS
A. Type and Form (APC-1):
B. Type and Form (APC-2):
C. Linear Wood Slat Ceiling with Concealed Carriers and Acoustical Backing (WPC-1 and WPC-2).

1.5 METAL EDGE MOLDINGS AND TRIM

1.6 METAL SUSPENSION SYSTEMS, GENERAL
A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

1.7 EXAMINATION
A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
1.8 PREPARATION

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

1.9 INSTALLATION

A. Install acoustical panel ceilings to comply with UBC Standard 25-2 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1.10 LINEAR WOOD PANELS

A. Panelized Linear Wood Panels: Assemble as shown in the Reflected Ceiling Plans: see drawings for location of reveals, removable grid and fully accessible panels. Panels shall be fastened together with wood backers, positioned 5-1/2" from the ends and 12" on center, with overlapping attachment to the next panel for support of the system. Wood backers shall be painted black. Direct screw connection through grid to wood backers.

END OF SECTION 09 51 13
SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

1.1 PRODUCTS

A. Resilient Base:
   2. Style: Cove.
   3. Minimum Thickness: 0.125 inch (3.2 mm).
   4. Height: 4 inches (102 mm).
   5. Outside Corners: Job formed.
   6. Inside Corners: Job formed.

B. Resilient Molding Accessory: Rubber.
   1. Carpet edge for glue-down applications.
   2. Nosing for carpet.
   4. Reducer strip for resilient floor covering.
   5. Joiner for tile and carpet.
   6. Transition strips.

C. Installation Materials:
   1. Trowelable leveling and patching compounds.
   2. Adhesives: Low VOC.

END OF SECTION 09 65 13
SECTION 09 65 19

RESILIENT PLANK FLOORING

1.1 PRODUCTS

A. Basis-of-Design Product: LG Hausys Floors “Deco Advantage Wood”.

B. Description

1. Construction:
   a. Polyurethane top layer.
   b. Clear wear layer.
   c. High-Res image layer.
   d. Commercial flooring layer.
   e. Commercial backing layer.

2. Thickness: 120 mil.
3. Size: 7.09” x 36.22” (180 mm x 920 mm).
4. Recycled Content: 14%.

C. Installation Materials:

1. Trowelable leveling and patching compounds.
2. Adhesives.
4. Floor polish.

1.2 FLOOR TILE INSTALLATION

A. Lay tiles square with room axis.

END OF SECTION 09 65 19
TILE CARPETING

1.1 QUALITY ASSURANCE
   A. Mockups for each type of carpet tile installation.

1.2 WARRANTY
   A. Carpet Tile Failure: 10 years.

1.3 PRODUCTS
   A. Carpet Tile (CPT-1):
      1. Fiber: [100 percent nylon 6, 6] [100 percent nylon 6] [100 percent polypropylene]
         [100 percent wool] [80 percent wool; 20 percent nylon 6, 6] [80 percent wool; 20
         percent nylon 6] <Insert percentage> <Insert proprietary fiber type>.
      2. Pile Characteristic: [Level-loop] [Cut] [Cut-and-loop] <Insert construction> pile.
      3. Density: <Insert oz./cu. yd. (g/cu. cm)>.
      4. Pile Thickness: <Insert inches (mm)>.
      5. Total Weight: <Insert oz./sq. yd. (g/sq. m)>.
      6. Size: [18 by 18 inches (457 by 457 mm)] [24 by 24 inches (610 by 610 mm)] [18 by 36
         inches (457 by 914 mm)] [36 by 36 inches (914 by 914 mm)] <Insert dimensions>.
      7. Emissions: Comply with CRI's "Green Label Plus."

   B. Installation Adhesive: VOC content 50 g/L or less.

END OF SECTION 09 68 13
SECTION 09 72 00
WALL COVERINGS

1.1 MATERIALS

A. Vinyl Wall Covering: Type II, Medium Duty per FS CCC-W-408D and CFFA-W-101D, mildew resistant and with stain-resistant coating.
   1. Tackable where indicated.

B. Adhesive: Low Mildew Resistant, non-staining.

1.2 INSTALLATION

A. Install strips in same order as cut from roll.

END OF SECTION 09 72 00
SECTION 09 91 13

EXTERIOR PAINTING

1.1 QUALITY ASSURANCE
A. Mockups for each color and finish.

1.2 PAINT, GENERAL
A. Products MPI listed.

1.3 SOURCE QUALITY CONTROL
A. Testing: By Owner-engaged agency.

1.4 EXTERIOR PAINTING SCHEDULE
A. Steel Substrates:
   1. Water-based light industrial coating system.
   2. Alkyd system.
   3. Quick-drying enamel system.
   4. Aluminum paint system.
B. Galvanized-Metal Substrates:
   1. Latex system.
   2. Water-based light industrial coating system.
   3. Alkyd system.

END OF SECTION 09 91 13
SECTIO N 09 91 23

INTERIOR PAINTING

1.1 QUALITY ASSURANCE
   A. Mockups for each color and finish.

1.2 PAINT, GENERAL
   A. Products MPI listed.
   B. VOC Content: Complying with WSSP.

1.3 SOURCE QUALITY CONTROL
   A. Testing: By Owner-engaged agency.

1.4 INTERIOR PAINTING SCHEDULE
   A. Steel Substrates:
      1. Latex over alkyd primer system.
      2. Water-based dry-fall system.
      3. Institutional low-odor/VOC latex system.
      4. High-performance architectural latex system.
      5. Water-based light industrial coating system.
      6. Alkyd system.
      7. Quick-drying enamel system.
      8. Alkyd dry-fall system.
      9. Aluminum paint system.

   B. Galvanized-Metal Substrates:
      1. Latex over waterborne primer system.
      2. Water-based dry-fall system.
      3. Institutional low-odor/VOC latex system.
      4. High-performance architectural latex system.
      5. Water-based light industrial coating over waterborne primer system.
      6. Aluminum paint system.

   C. Wood Substrates: Including wood trim architectural woodwork doors wood-based panel products.
      1. Transparent finish.

   D. Gypsum Board Substrates:
      1. Latex system.
      2. Institutional low-odor/VOC latex system.
3. High-performance architectural latex system.
4. Water-based light industrial coating system.
5. Alkyd over latex primer system.

END OF SECTION 09 91 23
SECTION 10 11 00

VISUAL DISPLAY SURFACES

1.1 QUALITY ASSURANCE

A. Mockups for each form of construction.
B. Composite wood products made without urea formaldehyde.

1.2 WARRANTY

A. Materials and Workmanship for Porcelain-Enamel Face Sheets: 50 years.

1.3 PRODUCTS

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel.
B. Markerboard Assemblies: Magnetic, porcelain enamel.
D. Visual Display Rails: Cork visual display surface.
F. Markerboard and Tackboard Accessories:
   1. Aluminum frames.
   4. Map rail with display rail, map hooks, clips and flag holder.
G. Aluminum Finishes: Class II, clear anodic.

1.4 FABRICATION


END OF SECTION 10 11 00
SECTION 10 14 00

SIGNAGE

1.1 SUMMARY
A. Plaques (OFOI).
B. Dimensional characters (OFOI).
C. Panel signs (OFOI).

1.2 QUALITY ASSURANCE

1.3 WARRANTY
A. Materials and Workmanship: Five years.

1.4 PRODUCTS
A. Plaques:
   1. Cast Plaques: Bronze with rosette mounting.
B. Dimensional Characters:
   1. Cast Characters: Bronze with concealed stud mounting.
C. Panel Signs:
   1. Interior Panel Signs:
      a. Material: Laminated, etched photopolymer sheet with raised graphics and Braille.
      b. Frame: Unframed.
      c. Mounting: Wall with two-face tape.
      d. Color: As selected by Architect from manufacturer's full range.

1.5 FINISHES
A. Aluminum: Class I, color anodized.
B. Acrylic Sheet: Copy and background and frame colors that are UV and water resistant for five years.
1.6 INSTALLATION

A. Wall-Mounted Signs: Two-face tape.

B. Dimensional Characters: Manufacturer's standard flush mounting.

C. Cast-Metal Plaques: Manufacturer's standard concealed mounting.

END OF SECTION 10 14 00
SECTION 10 21 13

TOILET COMPARTMENTS

1.1 SUMMARY

A. HDPE toilet compartments configured as follows:

1. Toilet-Enclosure Style: Overhead braced with floor anchor.
2. Urinal-Screen Style: Wall hung, flat panel with floor anchor.

1.2 COMPONENTS

A. Brackets (Fittings):

1. Full-Height (Continuous) Type: Stainless steel.

B. Hardware and Accessories: Stainless steel.

END OF SECTION 10 21 13
SECTION 10 21 16

SHOWER AND DRESSING COMPARTMENTS

1.1 SUMMARY

A. Solid-polymer shower compartments with dressing compartments.
   1. Enclosure Style: Overhead braced.

1.2 COMPONENTS

A. Solid-Polymer Panels and Doors: HDPE; with stainless-steel heat-sink strip at exposed bottom edges, and with integral hinges.

B. Brackets (Fittings):
   1. Full-Height (Continuous) Type: Clear-anodized aluminum.
   2. Stirrup Type: Stainless steel.
   3. Dressing-Compartment Brackets: Match toilet-compartment brackets specified in Section 102113 "Toilet Compartments."

C. Hardware and Accessories: Stainless steel.

D. Shower Compartment Openings: Provide with [doors] [headrail with hooks] [curtain rod with hooks] [headrail with hooks and curtain] [curtain rod with hooks and curtain].

E. Seats: [Fixed] [Folding] benches mounted on [enclosure panel] [wall] [or] [floor].

END OF SECTION 10 21 16
SECTION 10 26 00
WALL AND DOOR PROTECTION

1.1 WARRANTY

A. Materials and Workmanship: Five years.

1.2 PRODUCTS

A. Corner Guards:
   1. Surface mounted, resilient plastic type.

B. Impact-Resistant Wall Coverings:

END OF SECTION 10 26 00
SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

1.1 WARRANTY

A. Silver Spoilage for Mirrors: 15 years.

1.2 PRODUCTS

A. Public-Use Washroom Accessories:
   1. Toilet Tissue Dispenser: OFCI.
   2. Paper Towel Dispenser: OFCI.
   3. Waste Receptacle: OKOI.
   4. Liquid-soap dispenser: OFCI.
   5. Grab bar.
   7. Sanitary-napkin disposal unit.
   8. Mirror unit.

B. Private-Use Bathroom Accessories:
   1. Toilet tissue dispenser. OFOI
   2. Robe hook.

C. Warm-air dryers.

D. Childcare Accessories:
   1. Diaper-changing station.

E. Underlavatory guards.

F. Custodial Accessories:
   1. Utility shelf.
   2. Mop and broom holder.

END OF SECTION 10 28 00
1.1 PRODUCTS

A. Fire Protection Cabinet:

1. Type: For fire extinguisher.
2. Construction: Nonrated and rated.
4. Door Style: Vertical duo panel with frame.
5. Door Glazing: Tempered break glass.
6. Accessories: Door locks.
7. Finish: Aluminum, clear anodized.

END OF SECTION 10 44 13
SECTION 10 44 16
FIRE EXTINGUISHERS

1.1 SUMMARY
A. Owner-Furnished Material: Hand-carried fire extinguishers. (OFOI)

1.2 QUALITY ASSURANCE
A. Fire Extinguishers: NFPA 10.

1.3 WARRANTY
A. Materials and Workmanship: Six years.

1.4 PRODUCTS
A. Portable, Hand-Carried Fire Extinguishers:
   1. Multipurpose dry-chemical type, manufacturer's standard container.
   2. Purple K chemical type, manufacturer's standard container.
B. Mounting Brackets: Steel with identification lettering.

END OF SECTION 10 44 16
SECTION 10 50 00
MISCELLANEOUS SPECIALTIES

1.1 SUMMARY

A. This Section includes the following:

1. Gas fireplace insert.
2. TV mounting brackets (OFOI).
3. Skateboard deterrent.

B. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for backing and blocking for surface mounted items and equipment.

1.2 MONITOR AND TV BRACKETS (OFOI)

1.3 SKATE BOARD DETERRENT

1.4 GAS FIREPLACE INSERT

1.5 INSTALLATION GENERAL

1.6 ADJUST AND CLEAN

END OF SECTION 10 50 00
SECTION 10 55 00

POSTAL SPECIALTIES

1.1 SUMMARY
   A. Postal specialties for locations with private mail delivery and collection.
   B. Accessories.

1.2 WARRANTY
   A. Materials and Workmanship: Five years.

1.3 PRODUCTS
   A. Private-Delivery Horizontal Mail Receptacles: Rear loading with door and lock.
      2. Compartment-Door Locks: [Cylinder] [Removable-core type furnished by Owner]
         [Spring-latch keyed to building keying system] [Combination].

END OF SECTION 10 55 00
SECTION 11 31 00
RESIDENTIAL APPLIANCES

1.1 SUMMARY

A. This Section includes the following appliances:

1. Range and oven OF/OI.
2. Range hood CF/CI.
3. Full-Height Refrigerator OF/OI.
5. Microwave OF/OI.

1.2 SUBMITTALS

A. Product Data: For each appliance type required indicating compliance with requirements. Include complete operating and maintenance instructions for each appliance.

1.3 PRODUCTS AND MANUFACTURERS

1.4 EXAMINATION

A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before residential appliance installation.

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

1.5 INSTALLATION

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

1.6 ADJUSTING AND CLEANING

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

END OF SECTION 11 31 00
SECTION 11 52 13

PROJECTION SCREENS

1.1 MATERIALS

A. Manually and Motor Operated Projection Screens:
   1. Bracket-mounted or ceiling-suspended, metal-encased screens.

B. Front-Projection Screen Material: Matte-white viewing surface.
   1. Size: (Manual) 70 by 70 inches (1778 by 1778 mm). (Motorized) 96 x 96 inches (2438 x 2438 mm).

END OF SECTION 11 52 13
SECTION 12 21 13

HORIZONTAL LOUVER BLINDS

1.1 QUALITY ASSURANCE

A. Mockups for each form of construction.

1.2 PRODUCTS

A. Horizontal Louver Blinds, Aluminum Slats:

1. Slat Width: 1 inch (25 mm).
3. Tilt: Full.
4. Ladders: Braided cord.

END OF SECTION 12 21 13
SECTION 12 24 13
ROLLER WINDOW SHADES

1.1 SUMMARY
A. This Section includes roller shades and motorized shade operators.

1.2 QUALITY ASSURANCE
A. Source Limitations: Obtain roller shades through one source from a single manufacturer.

1.3 WARRANTY

1.4 ROLLER SHADES
A. Basis-of-Design Product: Subject to compliance with requirements, provide Mechoshade comparable product.

1.5 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

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

1.6 INSTALLATION
A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Connections: Connection of motorized operators to building electrical system by electrical contractor.

1.7 ADJUSTING
A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

1.8 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 1 Section Demonstration and Training."
SECTION 12 48 13

ENTRANCE FLOOR MATS AND FRAMES

1.1 COMPONENTS

A. Nuway Mats: Nylon-reinforced, fibered surface buffed on rubber strips for interior installations.

B. Recessed frame finishes:
   1. Aluminum: Class II, clear anodic.

END OF SECTION 12 48 13
SECTION 14 21 00

ELECTRIC TRACTION ELEVATORS

1.1 SUMMARY

A. Electric traction passenger elevators.

1.2 WARRANTY

A. Elevator Work: <Insert warranty period>.

1.3 ELEVATORS

A. Basis-of-Design Product: Otis Gen2® gearless traction passenger elevator with Machine Room-less application.
B. Equipment Control: Elevonic® Control System.
C. Drive: Regenerative
D. Quantity of Elevators: 2
E. Elevator Stop Designations: 1,2,3,4,5
F. Stops: 5
G. Openings: 5 at Front, 0 at Rear.
H. Rise: 48 ft 0 in 0
I. Rated Capacity: 3500lbs
J. Rated Speed: 350 feet/minute.
K. Clear Inside Dimensions: 6' 8" x 5' 4 13/16"
L. Cab Height: 8' 0"
M. Door Height: 7' 0"
N. Entrance Type and Width: Single Slide; 3' 6"
O. Main Power Supply: 480 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor.
P. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
Q. Machine Location: Inside the hoistway at the top of the hoistway.
R. Signal Fixtures: Manufacturer’s standard with metal button targets.
S. Controller Location: Controller(s) shall be located adjacent to the hoistway at the top landing in a control room.

T. Performance:
   1. Car Speed: ± 3 % of contract speed under any loading condition or direction of travel.
   2. Car Capacity: Safely lower, stop and hold up to 125% of rated load. (code required)
U. Ride Quality:
1. Vertical Vibration (maximum): 12 – 17 milli-g
2. Horizontal Vibration (maximum): 10 – 15 milli-g
3. Vertical Jerk (maximum): $4.6 \pm 1.0$ ft./sec$^3$ ($1.4 \pm 0.3$ m/sec$^3$)
4. Acceleration/Deceleration (maximum): $1.98 \pm 0.33$ ft./sec$^2$ ($0.6 \pm 0.13$ m/sec$^2$)
5. In Car Noise: 50 – 60 dB(A)
6. Stopping Accuracy: ± 0.2 in. (± 5 mm)
7. Re-leveling Distance: ± 0.4 in. (± 10 mm)

V. Operation: Duplex Collective Operation.

W. Operating Features – Standard
1. Full Collective Operation
2. Anti-nuisance.
3. Fan and Light Protection.
4. Load Weighing Bypass.
5. Independent Service.
7. Firefighters' Service Phase I and Phase II.
8. Top of Car Inspection.

X. Operation Features

Y. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person.
   
   Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

Z. Provide equipment according to seismic zone: Zone 2

1.4 WARRANTY
A. 2 year parts and labor.

END OF SECTION
END OF SECTION 14 21 00
SECTION 22 11 13

FACILITY WATER DISTRIBUTION PIPING

1.1 SUMMARY

A. Water service [Fire-service mains] [Combined water service and fire-service mains] outside the building.

1.2 SUBMITTALS

A. Coordination Drawings.

1.3 QUALITY ASSURANCE

A. Quality Standard for Electrical Components, Devices, and Accessories: NFPA 70.


C. Quality Standard for Plastic Potable-Water-Service Piping: NSF 14.[Include marking "NSF-pw" on piping.]


1.4 MATERIALS

A. Underground Water-Service Piping [NPS 3/4 to NPS 3 (DN 20 to DN 80)] <Insert pipe size range>:
   2. PE pipe and insert fittings.
   3. PE pipe and PE molded heat-fusion fittings.
   4. PVC, Schedule 40 pipe and PVC Schedule 40 socket fittings.
   5. PVC, Schedule 80 pipe and PVC Schedule 80 socket fittings.
   6. RTRP, Class [150] [200] [250] and RTRF.

B. Underground Water-Service Piping [NPS 4 to NPS 8 (DN 100 to DN 200)] <Insert pipe size range>:
   1. Soft copper tube and copper solder-joint fittings.
   2. Ductile-iron, [push-on-joint] [mechanical-joint] pipe and fittings.
   3. Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.
   4. PE, AWWA pipe and PE AWWA fittings.
   5. PVC, Schedule 40 pipe and PVC Schedule 40 socket fittings.
   6. PVC, Schedule 80 pipe and PVC Schedule 80 socket fittings.
   7. PVC, AWWA Class 150 pipe and PVC fittings.
8. PVC, AWWA Class 200 pipe and PVC fittings.
9. RTRP, Class [150] [200] [250] and RTRF.

C. Aboveground and Vault Water-Service Piping [NPS 3/4 to NPS 3 (DN 20 to DN 80)] <Insert pipe size range>:
   2. PVC, Schedule 80 pipe and PVC Schedule 80 socket fittings.
   3. PVC, Schedule 80 pipe and PVC Schedule 80 threaded fittings.
   4. RTRP, Class [150] [200] [250] and RTRF.

D. Aboveground and Vault Water-Service Piping [NPS 4 to NPS 8 (DN 100 to DN 200)] <Insert pipe size range>:
   2. Ductile-iron, grooved-end pipe and ductile-iron grooved-end appurtenances.
   3. PVC, Schedule 80 pipe and PVC Schedule 80 socket fittings.
   4. PVC, Schedule 80 pipe and PVC Schedule 80 threaded fittings.
   5. RTRP, Class [150] [200] [250] and RTRF.

E. Underground Fire-Service-Main Piping:
   1. Ductile-iron, [push-on-joint] [mechanical-joint] pipe and fittings.
   2. Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.
   3. PE, Class [150] [200], fire-service pipe and molded PE fittings.
   4. PVC, AWWA Class [150] [200] pipe listed for fire-protection service.
   5. Fiberglass, AWWA, FMG-approved RTRP, Class [150] [200] and RTRF.

F. Aboveground and Vault Fire-Service Main Piping: Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.

G. Underground Combined Water-Service and Fire-Service-Main Piping:
   1. Ductile-iron, [push-on-joint] [mechanical-joint] pipe and fittings.
   2. Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.
   3. PVC, AWWA Class [150] [200] pipe listed for fire-protection service.
   4. Fiberglass, AWWA, FMG-approved RTRP, Class [150] [200] and RTRF.

H. Aboveground Combined Water-Service and Fire-Service-Main Piping: Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.

I. Special Pipe Fittings: Ductile-iron [rigid expansion joints] [flexible expansion joints] [deflection fittings].

J. Piping Specialties:
   1. Transition fittings.
   2. Tubular-sleeve pipe couplings.
   4. Flexible connectors.
   5. Dielectric fittings.

K. Corrosion-Protection Piping Encasement: [Not required] [Required].
END OF SECTION 22 11 13
SECTION 22 13 13

FACILITY SANITARY SEWERS

1.1 PIPING

A. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: [Service class] [Extra-Heavy class].

B. Hubless Cast-Iron Soil Pipe and Fittings:

1. Couplings: [Heavy-Duty, shielded] [Cast-iron, shielded] [Unshielded] couplings.

C. Ductile-Iron, Gravity Sewer Pipe and Fittings:

1. Fittings: [Standard] [Compact].

D. Ductile-Iron, Pressure Pipe and Fittings: [Push-on] [Mechanical] joint.

1. Fittings: [Standard] [Compact].

E. ABS pipe and fittings.

F. PVC Pipe and Fittings: PVC [cellular-core sewer] [corrugated sewer] [profile sewer] [Type PSM sewer] [gravity sewer] [pressure] [water-service] piping.

G. Fiberglass Pipe and Fittings:

1. Fiberglass Sewer Pipe: [Type 2, polyester] [Type 4, epoxy] resin.

2. Fiberglass Nonpressure Fittings: [Type 1, polyester] [Type 2, epoxy] resin.

H. Concrete Pipe and Fittings:

1. Nonreinforced-Concrete Sewer Pipe and Fittings: [Class 1] [Class 2] [Class 3], with [bell-and-spigot] [tongue-and-groove] ends.


   a. Class II, [Wall A] [Wall B] [Wall C].
   b. Class III, [Wall A] [Wall B] [Wall C].
   c. Class IV, [Wall A] [Wall B] [Wall C].
   d. Class V, [Wall A] [Wall B].

I. Nonpressure-Type Transition Couplings: [Unshielded, flexible] [Shielded, flexible] [Ring-type, flexible] [Nonpressure-type, rigid] couplings.

J. Pressure-Type Pipe Couplings: [150-psig (1035-kPa)] [200-psig (1380-kPa)] <Insert value> minimum pressure rating.

K. Expansion Joints and Deflection Fittings: Ductile-iron, [flexible expansion joints] [expansion joints] [deflection fittings].
1.2 COMPONENTS

A. Backwater Valves:
   1. Cast Iron: [Horizontal] [Combination horizontal and manual gate-valve] [Terminal] type.

B. Cleanouts:
   1. Cast Iron:
      a. Top-Loading Classification(s): [Light Duty] [Medium Duty] [Heavy Duty] [and] [Extra-Heavy Duty].
   2. PVC.

C. Encasement for Piping: [Linear low-density polyethylene film of 0.008-inch (0.20-mm)] [High-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)] minimum thickness.
   1. Form: [Sheet] [Tube].
   2. Color: [Black] [Natural] <insert color>.

D. Manholes: [Standard precast concrete] [Designed precast concrete] [Fiberglass].
   1. Resilient pipe connectors.
   2. [HPDE adjusting rings] [Reinforced-concrete grade rings].
   3. Manhole frames and covers.
   4. Manhole-cover inserts.

END OF SECTION 22 13 13
1.1 SYSTEM DESCRIPTION

1. Section includes vibration isolation components and materials required to isolate the building structure and occupied spaces from vibrating equipment, piping and ductwork.

1.2 SUBMITTALS

1. Contractor shall submit complete product data in accordance with the General Provisions of the Specifications before any materials are delivered to the job site.

2. Contractor shall submit to the Acoustical Consultant shop drawings showing the following information so that isolation system can be checked for compliance with the specifications:
   a. Supported isolation of motor-driven equipment.
   b. Inertia base frames in conjunction with isolation.
   c. Isolation support of air-handling housings.
   d. Isolation support of piping, piping risers, and ductwork.
   e. Penetration isolation of pipes and ductwork through walls, floors or ceilings.
   f. Flexible connections of ductwork and piping to equipment.

3. Each piece of rotating equipment must meet a reasonable criterion for maximum vibration levels at each bearing, while in operation. The criterion is as follows:
   a. Rotating equipment operating peak vibration velocities must not exceed 0.08 in/sec.
   b. If it is discovered that the operating vibration velocities exceed this criterion, the equipment shall be repaired or replaced at no expense to the Owner until approval of the equipment is given by the Acoustical Consultant.

4. Installing Contractor to provide any components or materials not specifically mentioned herein, but necessary to the proper vibration isolation of the equipment.

1.3 QUALITY ASSURANCE

1. Isolators shall operate in the linear portion of their load-versus-deflection curve.

2. The ratio of lateral to vertical isolator stiffness shall be not less than 0.9 nor greater than 1.5.

3. The Contractor shall bring to the attention of the Acoustical Consultant any discrepancies between this Section and other related documents.

1.4 COMPONENTS

1. Type S-1: Bare Spring.
   a. Model SLF by Mason.
   b. Model FDS by Kinetics.
   c. Model SS by Caldyn.
   d. Model SW by Amber Booth.
2. Type S-3: Spring Seismic Restraint.
   a. Model SSLFH by Mason.
   b. Model FHS by Kinetics.
   c. Model FEQ by McDougall Control.
   d. Model JQ by Caldyn.
   e. Model SWSR by Amber Booth.

3. Type N-4: Neoprene Pad.
   a. Model Super W by Mason.
   b. Model RSP by Kinetics.
   c. Model ECPR by Caldyn.

4. Type H-1: Spring Hanger.
   a. Model 30N by Mason.
   b. Model SRH by Kinetics.
   c. Model HH/30 by Caldyn.
   d. Model BSRA by Amber Booth.

5. Type B-1: Integral Structural Steel Frame.
   a. Model WF by Mason.
   f. Model XW by Caldyn.

6. Type B-2: Concrete Inertia Base.
   a. Model K by Mason.
   b. Model CW by Caldyn.

7. Type B-5: Curb Mounted Isolation Base.
   a. Model RSC by Mason.
   b. Model MW,YW by Caldyn.

8. Type E-1: Seismic Restraint.
   a. Model HS-3 by Kinetics.
   b. Model ER by Amber Booth.

   a. Model Z-1225 by Mason.
   b. Model RL-A,RL-C by Caldyn.

10. Type E-3: Seismic Restraint.
    a. Model SCB/SCBH by Mason.
    b. Model Cab/Rig by ISAT.

11. Type WB-1: Neoprene washers and bushings.
    a. Model HG by Mason.
    b. Model TG by Kinetics.
c. Model KT by Caldyn.

12. Type CS-1: Cushion Sleeve.

13. Type FC-1: Flexible Duct.
   b. Model NFN, NF6N by Duro-Dyne.

14. Type FC-2: Neoprene Connection.
   a. Model SFDEJ or SFU by Mason.
   b. Control Assemblies Model ACC by Mason.

15. Acoustical Sealant.
   a. CP 604 Self-leveling Firestop Sealant by Hilti.
   b. Fire Barrier Water Tight Sealant 1003 SL (self-leveling) by 3M Vibration Control.
   c. Nelson Firestop Sealant (CLK).
   f. CP 672 Firestop Joint Spray by Hilti.
   g. CP 606 Flexible Firestop Sealant by Hilt.
   h. 790 Silicone Building Sealant by Dow Corning.
   j. Acoustical Sealant by Tremco.
   k. CP 572 Smoke and Acoustics Spray by Hilti.
   l. CP 506 Smoke and Acoustics Sealant by Hilti.

1.5 PREPARATION

1. Isolate rooftop mechanical equipment from the building structure by means of vibration isolators as scheduled herein and on the Drawings. If there is a conflict between the drawings and the Vibration Isolation Schedule herein, bring this conflict to the Architect and/or the Acoustical Consultant’s attention.

1.6 INSTALLATION

1. Install isolation systems (isolators, bases, and related hardware) in accordance with the manufacturer’s written Installation Instructions. The Contractor shall procure the written installation instructions from the isolator manufacturers.

2. Isolated equipment mounting systems must permit equipment motion in all directions.

3. Vibration isolators must not cause any change in position of equipment or piping resulting in piping stresses or misalignment.

4. Adjust or provide additional resilient restraints to flexibly limit equipment lateral motion to 1/2 inch during startup and operation.

5. Prior to startup, clean out all foreign matter between base, isolator, equipment, and mounting surfaces. Verify that there are no rigid connections between equipment and building structure that degrade the vibration isolation systems specified herein.
6. Align isolator rods to clear the isolator housing.

7. Unless otherwise directed by this document, suspend isolators with the isolator hanger housing attached to, or hung as close as possible to, the structure.

8. Do not use wall, floor, or ceiling penetrations to support pipework or ductwork. Support pipe or duct just prior to and just after the penetration, so that the pipe or duct is centered in penetration.

9. Coordinate piping supports with equipment supports to maintain uniformly efficient isolation, expansion, and contraction, without creating excessive stresses at any equipment connection or in any portion of the piping.

10. All ductwork within the shafts shall not be in contact with the walls and shall be anchored to the building structure at the concrete floor only.

11. Do not allow contact between isolated ducts or pipes and non-isolated equipment or structure. “Isolated ducts or pipes” include the isolated portions of their supports or hangers.

12. Non duct elements should not be in contact with any duct hangers.

13. Provide a minimum 2 inch gap between the top of the ductwork and the underside of the floor structure above within all the mechanical rooms.

14. Bring to the Acoustical Consultant’s attention prior to installation any conflicts with other trades which will result in unavoidable rigid contact with equipment or piping as described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation will be at the responsible Contractor’s expense.

15. Size anchoring bolts to isolators or snubbers withstand seismic lateral shear and tensile failure and isolate bolts from direct contact with the structure using Type WB-1 isolator.

END OF SECTION 23 05 48
SECTION 31 10 00
SITE CLEARING

1.1 SUMMARY

A. Protecting existing vegetation to remain.

B. Removing existing vegetation.

C. Clearing and grubbing obstructions, trees, shrubs, and other vegetation, including grinding stumps and removing roots and debris.

1. Chipping removed tree branches and [stockpiling in areas approved by Architect] [disposing of off-site] <Insert requirement>.

D. Stripping and stockpiling topsoil and [disposing of] [stockpiling] surplus topsoil.

E. Removing existing above- and below-grade site improvements.

F. Disconnecting, capping or sealing, and [removing site utilities] [abandoning site utilities in place].

G. Providing temporary erosion- and sedimentation-control measures.

END OF SECTION 31 10 00
1.1 SUMMARY

A. Preparing subgrades for [slabs-on-grade] [walks] [pavements] [turf and grasses] [and] [plants].

B. Excavating and backfilling for buildings and structures.

C. Drainage course for concrete slabs-on-grade.

D. Subbase course for concrete [walks] [pavements].

E. Subbase course [and base course] for asphalt paving.

F. Subsurface drainage backfill for walls and trenches.

G. Excavating and backfilling trenches for utilities and pits for buried utility structures.

H. Excavating well hole to accommodate elevator-cylinder assembly.

I. Excavation: [Unclassified] [Classified, with unit prices for rock].

1.2 QUALITY ASSURANCE

A. Blasting: Where explosives are allowed, seismographic monitoring provided by independent seismic survey agency during blasting operations.

1.3 MATERIALS

A. Soil Materials:


3. Subbase Material: Graded mixture of gravel, crushed stone, and sand with 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

4. Base Course: Graded mixture of gravel, crushed stone, and sand with 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

5. Engineered Fill: Graded mixture of gravel, crushed stone, and sand with 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

6. Bedding Course: Graded mixture of gravel, crushed stone, and sand with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
7. Drainage Course: Narrowly graded mixture of crushed stone or gravel, coarse-aggregate grading Size 57.
10. Impervious Fill: Clayey gravel and sand mixture.

B. Geotextiles: [Subsurface drainage geotextile] [and] [separation geotextile].

C. Controlled Low-Strength Material: [Low density] [Conventional weight] concrete with [80 psi (550 kPa)] [140 psi (965 kPa)] <Insert value> compressive strength.

D. Geofoam Fill: [Extruded polystyrene board insulation] [molded polystyrene board insulation] [or] [rigid cellular polystyrene geofoam].

E. Warning Tape: [Polyethylene film] [Detectable, polyethylene film].

1.4 EXCAVATION

A. Explosives: [Not allowed] [Allowed subject to written permission from authorities having jurisdiction].


C. Disposal of Surplus and Waste Materials: [Off Owner's property] [Satisfactory soil to designated storage areas on Owner's property; waste materials and unsatisfactory soil off Owner's property].

1.5 FIELD QUALITY CONTROL

A. Special Inspector and Testing Agency: Owner engaged.

END OF SECTION 31 20 00
SECTION 32 12 16

ASPHALT PAVING

1.1 QUALITY ASSURANCE

A. Regulatory Requirements: <Insert applicable standards> of <Insert name of state or local DOT>.

1.2 MATERIALS

A. Asphalt Materials:
   3. Prime Coat: [Cutback asphalt] [Asphalt emulsion].
   5. Fog Seal: Emulsified asphalt.

B. Auxiliary Materials:
   1. Recycled Materials: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled [tires] [asphalt shingles] [and] [glass].
   2. Herbicide.

C. Mixes:
   1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [10] [20] [40] <Insert number> percent or more than [15] [25] [50] <Insert number> percent by weight.
      a. Surface Course Limit: No more than [10] <Insert number> percent by weight.

D. Asphalt Mixes: [Approved by authorities having jurisdiction] [and] [designed according to procedures in A1 MS-2].
   1. Base Course: <Insert mix designation>.
   2. Surface Course: <Insert mix designation>.

E. Emulsified-Asphalt Slurry: ASTM D 3910, [Type 1] [Type 2] [Type 3].

1.3 INSTALLATION

A. Cold Milling: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension>.

B. Patching Hot-Mix Asphalt Pavement: [Base mix for full thickness of patch] [Base mix with surface layer].
C. Patching Portland Cement Concrete Pavement with Hot-Mix Asphalt:
   1. Cracked slabs broken and rolled.
   2. Rocking slabs stabilized with pumped asphalt.
   3. Badly cracked pavement excavated and [filled with base mix for full thickness of patch] [partially filled with base mix, and covered with surface layer].

D. Repairs to Existing Pavements: [Leveling course] [Cracks and joints filled].

E. Hot-Mix Asphalt Paving:
   1. Subgrade proof rolled.
   2. Herbicide applied.
   3. [Prime coat over unbound-aggregate base course] [tack coat over existing asphalt pavement] [and] [geotextile over existing asphalt pavement].
   4. Base Course: <Insert thickness>.
   5. Surface Course: <Insert thickness>.

F. Asphalt curbs.

G. Asphalt Traffic-Calming Devices: Speed [bumps] [humps] [cushions] [and] [tables].

H. Surface Treatment: [Fog seal] [Slurry seal].

1.4 FIELD QUALITY CONTROL

A. Testing Agency: [Owner] [Contractor] engaged.

END OF SECTION 32 12 16
SECTION 32 13 13
CONCRETE PAVING

1.1 SUMMARY
A. Driveways.
B. Roadways.
C. Parking lots.
D. Curbs and gutters.
E. Walks.

1.2 QUALITY ASSURANCE
A. Detectable Warning Installer Qualifications: Approved by manufacturer of stamped concrete paving systems.
B. Quality Standard: ACI 301 (ACI 301M).
C. Mockups to demonstrate surface finish, texture, and color; curing; and standard of workmanship.

1.3 MATERIALS
A. Reinforcement:
   1. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content is not less than [25] <Insert number> percent.
   2. Welded Wire Reinforcement: [Plain] [Epoxy-coated plain] [Galvanized plain] [Deformed] steel.
   3. Reinforcing Bars: [Deformed] [Epoxy-coated deformed] [Galvanized deformed] steel.
   4. Steel bar mats.
   5. Steel Wire: [As drawn, plain] [Epoxy coated, plain] [Galvanized, plain] [Deformed] [Epoxy coated, deformed].
   7. Synthetic Fiber: [Monofilament] [Fibrillated].
B. Concrete:
   1. Portland Cement: ASTM C 150, [gray] [white].
   3. Air-entraining admixture.
   5. Compressive Strength: [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] [3500 psi (24.1 MPa)] [3000 psi (20.7 MPa)] <Insert strength> at 28 days.
C. Detectable Warnings: [Blockouts in concrete for detectable paving units] [Stamped in plastic concrete].

D. Pavement Markings: [Alkyd resin] [Latex] marking paint[ with reflective glass beads].

E. Wheel Stops: [Precast concrete] [Solid, recycled HDPE, rubber, or plastic] with galvanized-steel dowels[ and adhesive].

F. Preformed Traffic-Calming Devices: Speed [bumps] [humps] [and] [cushions] fabricated from solid, recycled [rubber] [plastic] with galvanized-steel mounting hardware[ and adhesive].

1.4 FINISHING AND CURING

A. Finishes: [Burlap] [Medium-to-fine-textured broom] [Medium-to-coarse-textured broom] [Monolithic exposed-aggregate] [Seeded exposed-aggregate] [Slip-resistive aggregate] [Rock-salt] [Pigmented mineral dry-shake hardener] finish.

B. Cure concrete by [moisture curing] [moisture-retaining-cover curing] [curing compound] [or] [a combination of these].

1.5 FIELD QUALITY CONTROL

A. Testing: By [Owner-engaged agency] [Contractor-engaged agency].

END OF SECTION 32 13 13
CONCRETE PAVING JOINT SEALANTS

1.1 PRECONSTRUCTION TESTING

A. Preconstruction compatibility and adhesion testing.

1.2 MATERIALS

A. Colors of Exposed Joint Sealants: [As indicated by manufacturer’s designations] [Match Architect’s samples] [As selected by Architect from manufacturer’s full range] <Insert color>.

B. Joint-Sealant Backer Materials: [Round backer rods for cold- and hot-applied joint sealants] [Backer strips for cold- and hot-applied joint sealants] [Round backer rods for cold-applied joint sealants].

1.3 SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement[<PJS-#>].

1. Location: [Expansion and isolation joints in cast-in-place concrete pavement] [Contraction joints in cast-in-place concrete slabs] <Insert location>.

2. Material: [Single component, nonsag, silicone] [Single component, self-leveling, silicone] [Multicomponent, pourable, traffic-grade, Class 25, urethane] [Hot-applied, single component] <Insert material> joint sealant for concrete.

B. Joint-Sealant Application: Fuel-resistant joints within cement concrete pavement[<PJS-#>].

1. Location: [Expansion and isolation joints in cast-in-place concrete pavement] [Contraction joints in cast-in-place concrete slabs] <Insert location>.

2. Material: [Jet-fuel-resistant, single-component, pourable, traffic-grade, Class 25, modified urethane] [Jet-fuel-resistant, multicomponent, pourable, traffic-grade, Class 12-1/2, modified urethane] [Jet-fuel-resistant, multicomponent, pourable, traffic-grade, Class 25, modified urethane] [Hot-applied, jet-fuel-resistant, single-component] <Insert material> joint sealant for concrete.

C. Joint-Sealant Application: Joints between cement concrete and asphalt pavement[<PJS-#>].

1. Location: [Joints between concrete and asphalt pavement] [Joints between concrete curbs and asphalt pavement] <Insert location>.

2. Material: [Hot-applied, single-component] <Insert material> joint sealant for concrete and asphalt.

D. Joint-Sealant Application: Fuel-resistant joints between cement concrete and tar-concrete pavement[<PJS-#>].

1. Location: [Joints between concrete and tar-concrete pavement] [Joints between concrete curbs and tar-concrete pavement] <Insert location>. 

END OF SECTION 32 13 73
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Brick pavers set in aggregate [bituminous] [and] mortar setting beds.
2. Concrete pavers set in aggregate [bituminous] [and] mortar setting beds.
3. Asphalt-block pavers set in bituminous setting beds.
5. Plastic [Steel] [Aluminum] edge restraints.

1.2 SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Samples for unit pavers [joint materials] [and] edge restraints.

1.3 QUALITY ASSURANCE

A. Mockups: Build mockups for each form and pattern of unit paver.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.

B. Weather Limitations for Bituminous Setting Bed: Install bituminous setting bed only when ambient temperature is above 40 deg F (4 deg C) and when base is dry.

C. Cold-Weather Requirements for Mortar and Grout: Heat materials to provide mortar and grout temperatures between 40 and 120 deg F (4 and 49 deg C). Protect unit paver work against freezing for 24 hours after installation.
PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Brick Pavers: Light-traffic paving brick; ASTM C 902, Class [SX] [MX], Type [I] [II] [III], Application [PS] [PX] [PA]. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.

1. Basis-of-Design Product: The design for brick pavers is based on <Insert manufacturer's name and product>. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

   a. <Insert, in separate subparagraphs, manufacturer's name.>

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

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

   a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation.>

4. Thickness: [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-5/8 inches (41 mm)] [2-1/4 inches (57 mm)] [2-5/8 inches (67 mm)] [As indicated] <Insert dimension>.

5. Face Size: [3-5/8 by 7-5/8 inches (92 by 194 mm)] [3-5/8 by 11-5/8 inches (92 by 295 mm)] [7-5/8 by 7-5/8 inches (194 by 194 mm)] [As indicated] <Insert dimensions>.

6. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

B. Temporary Protective Coating: Precoat exposed surfaces of brick pavers with a temporary protective coating that is compatible with brick, mortar, and grout products.

2.2 CONCRETE PAVERS

A. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936[ and resistant to freezing and thawing when tested according to ASTM C 67], made from normal-weight aggregates.

1. Basis-of-Design Product: The design for concrete pavers is based on <Insert manufacturer's name and product>. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

   a. <Insert, in separate subparagraphs, manufacturer's name.>

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

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

   a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation.>

4. Thickness: [2-3/8 inches (60 mm)] [3-1/8 inches (80 mm)] <Insert dimension>.

5. Face Size and Shape: [3-7/8 inches (98 mm) square] [4-7/16 inches (113 mm) square].
6. Face Size and Shape: [3-7/8-by-7-7/8 inch (98-by-200 mm)] [4-7/16-by-8-7/8 inch (113-by 225-mm)] rectangle.
7. Face Size and Shape: [5-1/2-inch (140-mm) octagon with attached 3-1/2-inch (89-mm) square] [4-1/2-by-9 inch (114-by-229 mm) rectangle with saw-tooth edges] [As indicated] <Insert dimensions and shape>.
8. Color: [As indicated by manufacturer’s designations] [Match Architect’s sample] [As selected by Architect from manufacturer’s full range] <Insert color>.

2.3 ASPHALT-BLOCK PAVERS

A. Asphalt-Block Pavers: Solid units made from asphalt cement complying with ASTM D 312, Type III; inorganic stone dust or cement filler; and coarse aggregate, consisting of clean, hard, unweathered stone crushed into angular particles varying in size up to 3/8 inch (9.5 mm).

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:
2. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   a. Hanover Architectural Products, Inc.
   b. <Insert manufacturer’s name.>

3. Thickness: [1-1/4 inches (32 mm)] [2 inches (51 mm)] <Insert dimension>.
4. Face Size: [4 by 6 inches (102 by 152 mm)] [6 by 6 inches (152 by 152 mm)] [8 by 8 inches (203 by 203 mm)] [8-inch- (203-mm-) wide hexagon] <Insert dimensions>.
5. Finish: [Natural, smooth] [Ground] [Ground and sandblasted].
6. Color: [As indicated by manufacturer’s designations] [Match Architect’s sample] [As selected by Architect from manufacturer’s full range] <Insert color>.

2.4 ROUGH-STONE PAVERS


1. Varieties and Sources: Subject to compliance with requirements, provide [one of] the following:
   a. <Insert name of variety and producer, distributor, or importer.>

2. Granite Color and Grain: [Light gray] [Dark gray] [Buff] [White] [Black] [Pink] <Insert color> with [medium] [fine] grain.
3. Thickness: [1-1/4 inches (32 mm)] [2 inches (51 mm)] [3 inches (76 mm)] [4 inches (102 mm)] [4 inches (102 mm), plus or minus 1/2 inch (13 mm)] <Insert dimension>.
4. Face Size: [4 by 4 inches (100 by 100 mm), plus or minus 1/2 inch (13 mm)] [3 to 5 inches (75 to 125 mm) by 8 to 12 inches (200 to 300 mm)] [As indicated] <Insert dimensions>.

2.5 ACCESSORIES

A. Plastic Edge Restraints: Triangular PVC extrusions [1-3/4 inches (45 mm) high by 3-1/2 inches (89 mm) wide] [3-1/8 inches (79 mm) high by 9-1/2 inches (241 mm) wide]; rigid type
for straight edges and flexible type for curved edges, with pipe connectors and 3/8-inch (9.5-mm) diameter by 12-inch (300-mm-) long steel spikes.

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:
2. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   a. BRICKSTOP Corporation.
   b. Dimex Corporation.
   c. PAVE TECH Inc.
   d. Ryerson, J. T. & Son, Inc.
   e. <Insert manufacturer's name.>

B. Steel Edge Restraints: Painted steel edging [3/16 inch (4.8 mm) thick by 4 inches (100 mm) high] [1/4 inch (6.4 mm) thick by 5 inches (125 mm) high] with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and steel stakes 15 inches (380 mm) long for each loop.

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:
2. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   b. Collier Metal Specialties, Inc.
   c. J. D. Russell Company (The).
   d. Ryerson, J. T. & Son, Inc.
   e. Sure-Loc Edging Corporation.
   f. <Insert manufacturer's name.>

3. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

C. Aluminum Edge Restraints: [Straight, 1/8-inch- (3.2-mm-) thick by 4-inch- (100-mm-) high] [Straight, 3/16-inch- (4.8-mm-) thick by 4-inch- (100-mm-) high] [L-shaped, 1/8-inch- (3.2-mm-) thick by 1-3/8-inch- (35-mm-) high] [L-shaped, 3/16-inch- (4.8-mm-) thick by 2-1/4-inch- (57-mm-) high] extruded-aluminum edging with loops pressed from face to receive stakes at 12 inches (300 mm) o.c., and aluminum stakes 12 inches (300 mm) long for each loop.

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:
2. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
   a. BRICKSTOP Corporation.
   b. Curv-Rite, Inc.
   c. Permaloc Corporation.
   e. <Insert manufacturer's name.>

D. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.
2.6 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with [ASTM D 448 for Size No. 8] [ASTM D 2940, base material] [requirements in Division 31 Section "Earth Moving" for base course].

B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

C. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

D. Drainage Geotextile: Nonwoven needle-punched geotextile made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following:
   1. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
   2. Permittivity: 0.5 per second, minimum; ASTM D 4491.

2.7 BITUMINOUS SETTING-BED MATERIALS

A. Primer for Base: ASTM D 2028, cutback asphalt, grade as recommended by unit paver manufacturer.

B. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.

C. Asphalt Cement: ASTM D 3381, Viscosity Grade AC-10 or Grade AC-20.

D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.

E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

2.8 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144.

D. Latex Additive: Water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

E. Water: Potable.
2.9 GROUT MATERIALS

A. Polymer-Modified Grout: ANSI A118.7, sanded grout; in color indicated.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering polymer-modified grouts that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturer: Subject to compliance with requirements, provide polymer-modified grout by one of the following:

   c. Bostik Findley Inc.
   d. C-Cure.
   e. Custom Building Products.
   f. DAP Inc.
   g. Jamo Inc.
   h. Laticrete International, Inc.
   i. MAPEI Corp.
   j. SGM.
   k. Summitville Tiles, Inc.
   l. TEC Incorporated; H. B. Fuller Company.
   m. <Insert manufacturer's name.>

3. Product Type: Dry mix, containing ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients.

4. Product Type: Two-component mix, containing liquid-latex and prepackaged dry-grout mix.

5. Product Type: Either dry mix, containing ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients, or two-component mix, containing liquid-latex and prepackaged dry-grout mix.

B. Grout Colors: [As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range] <Insert color>.

C. Water: Potable.

2.10 BITUMINOUS SETTING-BED MIX

A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate, unless otherwise indicated. Heat mixture to 300 deg F (149 deg C).

2.11 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement or cement and sand with [latex additive] [water] to a creamy consistency.

D. Latex-Modified, Portland Cement Setting-Bed Mortar: Comply with written instructions of latex-
additive manufacturer to produce stiff mixture with a moist surface when bed is ready to receive
pavers.

E. Latex-Modified, Portland Cement Slurry Bond Coat: Mix portland cement, sand, and latex
additive to comply with written instructions of latex-additive manufacturer.

F. Polymer-Modified Grout Mix: Proportion and mix grout ingredients according to grout
manufacturer's written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors
and textures.

B. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit
adjoining work neatly. Use full units without cutting where possible.
   1. For concrete pavers, a block splitter may be used.

C. Joint Pattern: [Running bond] [Herringbone] [Basket weave] [As indicated] [Match and
continue existing unit paver joint pattern].

D. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8
inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or
indicated slope, for finished surface of paving.

E. Expansion and Control Joints: Provide foam filler as backing for sealant-filled joints. Install joint
filler before setting pavers.

F. Expansion and Control Joints: Provide joint filler at locations and of widths indicated. Install
joint filler before setting pavers. Make top of joint filler flush with top of pavers.

G. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

3.2 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least [95] <Insert number> percent of [ASTM D 698]
[ASTM D 1557] laboratory density.

B. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.

C. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12
inches (300 mm).

D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care
that moisture content remains constant and density is loose and constant until pavers are set
and compacted.

E. Treat leveling course with herbicide to inhibit growth of grass and weeds.
F. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars.

G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz.

H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

3.3 BITUMINOUS SETTING-BED APPLICATIONS

A. Apply primer to concrete slab or binder course immediately before placing setting bed.

B. Prepare for setting-bed placement by locating 3/4-inch- (19-mm-) deep control bars approximately 11 feet (3.3 m) apart, to serve as guides for striking board. Adjust bars for accurate setting of paving units to finished grades indicated.

C. Place bituminous setting bed between control bars. Spread mix at a minimum temperature of 250 deg F (121 deg C). Strike setting bed smooth, firm, even, and not less than 3/4 inch (19 mm) thick. Add fresh bituminous material to low, porous spots after each pass of striking board. Carefully fill depressions that remain after removing depth-control bars.

1. Roll setting bed with power roller to a nominal depth of 3/4 inch (19 mm). Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated. Complete rolling before mix temperature cools to 185 deg F (85 deg C).

D. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of 1/16 inch (1.6 mm). Proceed with setting of paving units only after adhesive is tacky and surface is dry to touch.

E. Place pavers carefully by hand, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. If additional leveling of paving is required, and before treating joints, roll paving with power roller.

F. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

3.4 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing setting bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch (1.6-mm) thickness for bond coat.

C. Apply mortar bed over bond coat immediately after applying bond coat. Spread and screed to subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Mix and place only that amount of mortar that can be covered with pavers before initial set. Cut back and discard setting-bed material that has reached initial set before placing pavers.
E. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

F. Place pavers before initial set of cement occurs. Immediately before placing pavers, apply uniform 1/16-inch- (1.5-mm-) thick, slurry bond coat to bed or to back of each paver.

G. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

H. Spaced Joint Widths: Provide [3/8-inch (10-mm)] [1/2-inch (13-mm)] [3/4-inch (19-mm)] nominal joint width with variations not exceeding plus or minus [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [3/16 inch (4.5 mm)].

I. Grout joints as soon as possible after initial set of setting bed.
   1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
   2. Tool exposed joints slightly concave when thumbprint hard.

J. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by grout or liquid-latex manufacturer.

K. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
   1. Remove temporary protective coating from brick pavers as recommended by protective coating manufacturer and as acceptable to unit paver and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

END OF SECTION 32 14 00
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Piping.
   3. Automatic control valves.
   4. Automatic drain valves.
   5. Sprinklers.
   6. Quick couplers.
   7. Controllers.

1.2 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be [automatic operation with controller and automatic control] [manual operation with manual] valves.

B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available land records indicate the following soil conditions:
   a. Type: [Coarse] [Medium] [Fine] <Insert type>.
   b. Texture:
      1) Sand: <Insert number> percent.
      2) Silt: <Insert number> percent.
      3) Clay: <Insert number> percent.
   c. Particle Size:
      1) Sand: <Insert number> mm.
      2) Silt: <Insert number> mm.
      3) Clay: <Insert number> mm.
   d. Structure: [Single grained] [Granular] [Platy] [Blocky] <Insert structure>.
   e. Density: <Insert lb/cu. ft. (kg./cu. m)>
   f. Moisture Content: <Insert number> percent.
   g. Infiltration Rate: <Insert gph (L/s)>. 
D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: [200 psig (1380 kPa)] <Insert value>.
2. Circuit Piping: [150 psig (1035 kPa)] <Insert value>.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. Qualification Data: For qualified Installer.
C. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
D. Operation and Maintenance Data: For sprinklers, controllers and automatic control valves as well as other system components.

1. Provide the Owner with three (3) final copies of the Operation and Maintenance Manual for the system. One preliminary copy of the manuals shall be submitted to the Architect for review and approval prior to issuing the two final copies to the Owner. Manuals shall be provided to the Owner prior to the instruction/training session.

2. Manuals shall include as a minimum.

a. A master index at the beginning of the manual. Provide tab index sheets separating sections within the manual; correlated to the index.

b. A section containing the name, address, and phone number of the Architect, General Contractor, all subcontractors, and all material Suppliers. The listing enclosed shall be numbered or otherwise keyed to the other sections of the manual so that each system component or material item can easily be associated with the appropriate supplier and installer.

c. A section containing a general description of the system, the intended sequence of operation, and the “Record Drawings”.

d. A section containing the operational procedures such as Winterization and spring start-up, and recommended spare parts listings.

e. A section containing technical information about each and every component of the system. This information shall include catalog data clearly marked as to specific model number and/or style device used, exploded parts diagrams for assembled components such as control valves and sprinkler heads, and wiring/control diagrams for all parts of the system.

f. A section containing all manufacturer’s and contractors’ warranties, test reports, and inspection certificates.

E. Record Documents

1. Record accurately and legibly all changes, additions, deletions, substitutions, and other irrigation system modifications on a clean set of Construction Documents. Update and review record documents on a daily basis for review with Landscape Architect at site observation meetings.

a. Indicate locations, sizes and kinds of equipment installed.
b. Dimension from two (2) permanent points of reference (building corners, sidewalk, or road intersections, etc.) the location of all pertinent items including, but not limited to the following items:
   1) Connection to water lines.
   2) Connection to electrical power.
   3) Gate/Isolation valves.
   4) Routing of sprinkler pressure lines (dimension max. 100’ along routing).
   5) Significant changes in routing of lateral lines from those indicated on Drawings.
   6) Sprinkler control valves.
   7) Routing of control wiring.
   8) Yard hydrants and quick coupling valves.

2. Controller Charts:
   a. Record Drawings shall be approved by the Landscape Architect/Owner before controller charts are prepared.
   b. Submit three (3) controller charts for each controller.
   c. Show the area controlled by the automatic controller. It shall be a reduced drawing (11x17”) of the actual as-built system. The reduction must be completely legible at the reduced size.
   d. Chart shall be a blueline print, or Xerox ‘type’ copy. Each zone or area of coverage shall be color coded (one color per zone) and shall be easily identifiable at the reduced size.
   e. Once approved, hermetically seal chart between 2 pieces of plastic (20 mil) and either securely mount to wall near controller enclosure, or as otherwise directed by Owner.

3. Provide one copy of the completed full size drawings and the reduced (laminated) copies to the Owner, and one copy of the completed full-size drawings to the Architect at the completion of the work. The Contractor may provide electronic copies in lieu of paper copies if allowed.

1.4 INSTRUCTION AND TRAINING

A. Upon completion of the installation, provide a minimum of 4 hours of instruction to the Owner’s personnel in the correct maintenance, operation and repair of the system and all its components. Instructions shall include a visual inspection and locating tour of the system. The Operations and Maintenance Manuals shall be completed and provided to the Owner prior to the instruction period. The Owner will make the Manuals available for use during the instruction periods.

1.5 FIRST WINTERIZATION AND SPRING START-UP

A. The Winterization and the following Spring Start-up shall be conducted in the presence of the Owner’s designated personnel and shall be considered as supplemental training to the initial 4 hours.

B. First Winterization
   1. Close the isolation valve in the irrigation main line ahead of the quick coupler at the irrigation stub out.
   2. Insert quick coupling quill, connected to the air compressor at this location.
3. Following the start of the air compressor, program the irrigation controls through three complete cycles or until all the water has been forced out of the system.

4. Notify the Owner that the irrigation system is secured for the winter season.

C. Spring Start-up

1. Upon notification by the Owner, return to the work site and start up the irrigation system as follows:

   a. Visually inspect the system for winter damage and repair/replace any damaged devices, piping, etc.
   b. Schedule with the Owner to have the cross connection backflow assembly device put back into service.
   c. Open the isolation valve upstream of the double-check valve/meter location and then charge the system and allow the water to flow until the air is removed from the manual drain valve.
   d. Close the manual drain valve and verify that the cross connection backflow assembly device is functioning correctly.
   e. Open the system valve downstream of the double-check valve/meter, and charge the system to the zone control valves. Allow the water to flow to the furthest outlet locations to drive the air out of the system mains.
   f. Open each zone valve manually and allow the water to flow until all the air is out of the controlled zone. Verify that each outlet is functioning correctly, if not, adjust or repair/replace as necessary.
   g. Put the controls into automatic mode, and run the entire system through at least one complete cycle to verify correct operation of all components of the system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers that include a certified irrigation designer qualified by The Irrigation Association.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping 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 piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 MAINTENANCE AND WARRANTY

A. Maintenance Period: 60 days from the accepted date of Substantial Completion for the entire project.

B. Warranty Period: All work shall be warranted for one full year from the accepted date of Substantial Completion for the entire project.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. A minimum of one (1) each of every type of sprinkler or drip emitter; one (1) of each type of electronic control valve; one (1) each of any keys required to operate underground valves.
PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.

C. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
   1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

D. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

E. Hard Copper Tube: [ASTM B 88, Type L (ASTM B 88M, Type B),] [and] [ASTM B 88, Type M (ASTM B 88M, Type C),] water tube, drawn temper.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

F. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; [SIDR 11.5] [and] [SIDR 15].
   1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

G. PVC Pipe: ASTM D 1785, PVC 1120 compound, [Schedule 40] [Schedule 80] [Schedules 40 and 80].
   1. PVC Socket Fittings: ASTM D 2466, [Schedule 40] [Schedule 80] [Schedules 40 and 80].
   2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
   3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
H. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, [SDR 21][SDR 26].
   1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
   2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and
tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick unless
otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-
duty brazing unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to
ASTM B 813.

E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to
ASTM F 656.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping
system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

A. Curb Valves:
   1. Description:
   a. Standard: AWWA C800.
   b. NPS 1 (DN 25) and Smaller Pressure Rating: [100 psig (690 kPa) minimum]
      [150 psig (1035 kPa)].
   c. NPS 1-1/4 to NPS 2 (DN 32 to DN 50) Pressure Rating: [80 psig (550 kPa)
      minimum] [150 psig (1035 kPa)].
   d. Body Material: Brass or bronze with ball or ground-key plug.
   e. End Connections: Matching piping.
   f. Stem: With wide-tee head.

B. Curb-Valve Casing:
   1. Standard: Similar to AWWA M 44 for cast-iron valve casings.
   2. Top Section: Telescoping, of length required for depth of burial of curb valve.
   3. Barrel: Approximately 3-inch (75-mm) diameter.
   4. Plug: With lettering "WATER."
   5. Bottom Section: With base of size to fit over valve.
   6. Base Support: Concrete collar[ or wooden frame].

C. Shutoff Rods for Curb-Valve Casings: Furnish [one] [two] <Insert number> steel, tee-handle
shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted
end matching curb valve for Project.
D. Brass Ball Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Jenkins Valves.
   c. DynaQuip Controls.
   d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
   e. Hammond Valve.
   f. Jamesbury; a subsidiary of Metso Automation.
   g. Jomar International, LTD.
   h. KITZ Corporation.
   i. Legend Valve.
   j. Marwin Valve; a division of Richards Industries.
   k. Milwaukee Valve Company.
   l. NIBCO INC.
   m. Red-White Valve Corporation.
   n. RuB Inc.
   o. <Insert manufacturer's name>.

3. Description:

   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Forged brass.
   f. Ends: Threaded or solder joint if indicated.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full[ or regular, but not reduced].

E. Bronze Ball Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. American Valve, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. Crane Co.; Crane Valve Group; Crane Valves.
   d. Hammond Valve.
   e. Lance Valves; a division of Advanced Thermal Systems, Inc.
   f. Legend Valve.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Red-White Valve Corporation.
3. Description:
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded or solder joint if indicated.
   g. Seats: PTFE or TFE.
   h. Stem: Bronze.
   i. Ball: Chrome-plated brass.
   j. Port: Full or regular, but not reduced.

F. Iron Ball Valves:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   a. American Valve, Inc.
   b. Conbraco Industries, Inc.; Apollo Valves.
   c. KITZ Corporation.
   d. Sure Flow Equipment Inc.
   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   f. <Insert manufacturer's name>.

3. Description:
   b. CWP Rating: 200 psig (1380 kPa).
   d. Body Material: ASTM A 126, gray iron.
   e. Ends: Flanged.
   f. Seats: PTFE or TFE.
   g. Stem: Stainless steel.
   h. Ball: Stainless steel.
   i. Port: Full.

G. Plastic Ball Valves:
1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available 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, Inc.
   c. Colonial Engineering, Inc.
   d. Fischer, George Inc.
   e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
f. IPEX Inc.
g. Jomar International, LTD.
h. KBI (King Bros. Industries).
i. Legend Valve.
j. NIBCO INC.
k. Sloane, George Fischer, Inc.
l. Spears Manufacturing Company.
m. Thermoplastic Valves Inc.
n. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
o. <Insert manufacturer's name>.

2. Description:
   b. Pressure Rating: [125 psig (860 kPa) minimum] [150 psig (1035 kPa)].
   c. Body Material: PVC.
   d. Type: Union.
   e. End Connections: Socket or threaded.
   f. Port: Full.

H. Iron Gate Valves, Resilient Seated:
   1. Description:
      b. Pressure Rating: [200 psig (1380 kPa)] [250 psig (1725 kPa)] minimum.
      c. Body Material: Ductile or gray iron with bronze trim.
      d. End Connections: Mechanical joint or push-on joint.
      e. Interior Coating: Comply with AWWA C550.
      g. Operator: Stem nut.
      h. Disc: Solid wedge with resilient coating.

I. Iron Gate Valve Casings:
   2. Top Section: Adjustable extension of length required for depth of burial of valve.
   3. Barrel: Approximately 5-inch (125-mm) diameter.
   4. Plug: With lettering "WATER."
   5. Bottom Section: With base of size to fit over valve.
   6. Base Support: Concrete collar[ or wood frame].

J. Operating Wrenches for Iron Gate Valve Casings: Furnish [one] [two] <Insert number> steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.

2.4 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

- Buckner; a division of Storm Manufacturing Group Inc.
- Ceres Products Company.
- Champion Irrigation Products.
- Netafim USA.
- Superior Controls Co., Inc.
- Toro Company (The); Irrigation Division.
- Weathermatic.
- <Insert manufacturer's name>.

3. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

B. Plastic, Automatic Control Valves:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

- Buckner; a division of Storm Manufacturing Group Inc.
- Ceres Products Company.
- Champion Irrigation Products.
- Dig Corporation.
- Greenlawn Sprinkler Company.
- Hit Products Corporation.
- Hunter Industries Incorporated.
- Irritrol Systems.
- Nelson, L. R. Corporation.
- Netafim USA.
- Olson Irrigation Systems.
- Orbit Irrigation Products, Inc.
- Rain Bird Corporation.
- Superior Controls Co., Inc.
- Toro Company (The); Irrigation Division.
- Weathermatic.
- <Insert manufacturer's name>.

3. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 AUTOMATIC DRAIN VALVES

A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig (17 to 20 kPa).
2.6 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Exposed, Impact-Drive Rotary Sprinklers:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Champion Irrigation Products.
   c. Nelson, L. R. Corporation.
   d. Orbit Irrigation Products, Inc.
   e. Senninger Irrigation, Inc.
   f. <Insert manufacturer's name>.

3. Description:

   b. Mounting: Aboveground, exposed on riser.

4. Capacities and Characteristics:

   a. Flow: <Insert gpm (L/s)>.
   b. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   c. Radius: <Insert feet (m)>.
   d. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)] <Insert size>.

C. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

   a. Buckner; a division of Storm Manufacturing Group Inc.
   b. Champion Irrigation Products.
   c. Hunter Industries Incorporated.
   d. Irritrol Systems.
   e. K-RAIN Manufacturing Corporation.
   f. Nelson, L. R. Corporation.
   g. Rain Bird Corporation.
   h. Toro Company (The); Irrigation Division.
   i. Weathermatic.
   j. <Insert manufacturer's name>.

3. Description:
a. Body Material: ABS.
b. Nozzle: [ABS] [Brass].
c. Retraction Spring: Stainless steel.
d. Internal Parts: Corrosion resistant.

4. Capacities and Characteristics:
   a. Flow: <Insert gpm (L/s)>.
   b. Pop-up Height: <Insert inches (mm)> aboveground to nozzle.
   c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   d. Radius: <Insert feet (m)>.
   e. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

D. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
      a. Buckner; a division of Storm Manufacturing Group Inc.
      b. Ceres Products Company.
      c. Champion Irrigation Products.
      d. Nelson, L. R. Corporation.
      e. Toro Company (The); Irrigation Division.
      f. <Insert manufacturer's name>.

3. Description:
   a. Case: ABS.
   b. Pop-up Height: Approximately 3 inches (75 mm).
   c. Sprinkler Construction: ABS and other corrosion-resistant metals.

4. Capacities and Characteristics:
   a. Nozzle: [ABS] [Brass].
   b. Flow: <Insert gpm (L/s)>.
   c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   d. Radius: <Insert feet (m)>.
   e. Inlet: [NPS 3/4 (DN 20)] [NPS 1-1/4 (DN 32)].

E. Plastic, Surface Spray Sprinklers:
   1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
      a. Ceres Products Company.
      b. Champion Irrigation Products.
c. Hit Products Corporation.
d. <Insert manufacturer's name>.

3. Description:
   a. Body Material and Flange: ABS.
   b. Pattern: Fixed, with flow adjustment.

4. Capacities and Characteristics:
   a. Nozzle: [ABS] [Brass].
   b. Flow: <Insert gpm (L/s)>.
   c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   d. Radius: <Insert feet (m)>.
   e. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

F. Plastic, Surface, Pop-up Spray Sprinklers:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   a. Ceres Products Company.
   b. Champion Irrigation Products.
   c. Hit Products Corporation.
   d. <Insert manufacturer's name>.

3. Description:
   a. Body Material and Flange: ABS.
   b. Pattern: Fixed, with flow adjustment.

4. Capacities and Characteristics:
   a. Pop-up Height: [1-1/4 or 1-1/2 inches (32 or 38 mm)] [1-3/4 or 2 inches (44 or 51 mm)] <Insert value>.
   b. Nozzle: [ABS] [Brass].
   c. Flow: <Insert gpm (L/s)>.
   d. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   e. Radius: <Insert feet (m)>.
   f. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

G. Plastic, Pop-up Spray Sprinklers:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
3. Description:
   a. Body Material: ABS.
   b. Nozzle: [ABS] [Brass].
   c. Retraction Spring: Stainless steel.
   d. Internal Parts: Corrosion resistant.
   e. Pattern: Fixed, with flow adjustment.

4. Capacities and Characteristics:
   a. Nozzle: [ABS] [Brass].
   b. Flow: <Insert gpm (L/s)>.
   c. Pop-up Height: <Insert inches (mm)> aboveground to nozzle.
   d. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   e. Radius: <Insert feet (m)>.
   f. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

H. Plastic Shrub Sprinklers:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Buckner; a division of Storm Manufacturing Group Inc.
   b. Ceres Products Company.
   c. Champion Irrigation Products.
   d. Dig Corporation.
   e. Hunter Industries Incorporated.
   f. Orbit Irrigation Products, Inc.
   g. Senninger Irrigation, Inc.
   h. Toro Company (The); Irrigation Division.
   i. Weathermatic.
   j. <Insert manufacturer's name>.

2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   a. Buckner; a division of Storm Manufacturing Group Inc.
   b. Ceres Products Company.
   c. Champion Irrigation Products.
   d. Dig Corporation.
   e. Hunter Industries Incorporated.
   f. Orbit Irrigation Products, Inc.
   g. Senninger Irrigation, Inc.
   h. Toro Company (The); Irrigation Division.
   i. Weathermatic.
   j. <Insert manufacturer's name>.

3. Description:
   a. Body Material: ABS or other plastic.
   b. Pattern: Fixed, with flow adjustment.
4. Capacities and Characteristics:

   b. Flow: <Insert gpm (L/s)>.
   c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
   d. Radius: <Insert feet (m)>.
   e. Mounting Height: <Insert inches (mm)> aboveground to nozzle.
   f. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

2.7 QUICK COUPLERS

   A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

   1. Locking-Top Option: Vandal-resistant locking feature. Include [one] [two] <Insert number> matching key(s).

2.8 CONTROLLERS

   A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

   B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:

       1. Buckner; a division of Storm Manufacturing Group Inc.
       2. Champion Irrigation Products.
       3. Hit Products Corporation.
       5. Irritrol Systems.
       8. Netafim USA.
       9. Orbit Irrigation Products, Inc.
       11. Superior Controls Co., Inc.
       12. Toro Company (The); Irrigation Division.
       13. Weathermatic.

   C. Description:

       1. Controller Stations for Automatic Control Valves: Each station is variable from approximately [5 to 60] <Insert numbers> minutes. Include switch for manual or automatic operation of each station.
       2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and [two] <Insert number> matching keys; include provision for grounding.
a. Body Material: [Enameled-steel sheet metal] [Stainless-steel sheet metal] [Molded plastic].
b. Mounting: [Freestanding type for concrete base] [Surface type for wall].

3. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and [two] matching keys.
   a. Body Material: [Enameled-steel sheet metal] [Stainless-steel sheet metal] [Molded plastic].
   b. Mounting: [Freestanding type for concrete base] [Surface type for wall].

5. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
   a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
   c. Surge Protection: Metal-oxide-varistor type on each station and primary power.

6. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
7. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
   a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
   b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
   c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

8. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches (900 by 600 by 100 mm) thick, and 6 inches (150 mm) greater in each direction than overall dimensions of controller. Include opening for wiring.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:
   1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
      a. Size: As required for valves and service.
      b. Shape: [Round] [Square] [Rectangular].
      c. Sidewall Material: [PE] [PE, ABS, or FRP] <Insert material>.
      d. Cover Material: [PE] [PE, ABS, or FRP] <Insert material>.
         1) Lettering: "[VALVE BOX] [IRRIGATION] <Insert lettering>.

B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 3 inches (75 mm) maximum.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

B. Install warning tape directly above pressure piping, [12 inches (300 mm)] <Insert value> below finished grades, except 6 inches (150 mm) below subgrade under pavement and slabs.

C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from [3/4 to 3 inches (19 to 75 mm)] <Insert value>, to [12 inches (300 mm)] <Insert value> below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

D. Provide minimum cover over top of underground piping according to the following:
   1. Irrigation Main Piping: Minimum depth of [36 inches (900 mm)] <Insert value> below finished grade, or not less than [18 inches (450 mm)] <Insert value> below average local frost depth, whichever is deeper.
   2. Circuit Piping: [12 inches (300 mm)] <Insert value>.
   3. Drain Piping: [12 inches (300 mm)] <Insert value>.
   4. Sleeves: [24 inches (600 mm)] <Insert value>.

3.2 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.

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

F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.

G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.

H. Install underground thermoplastic piping according to ASTM D 2774[ and ASTM F 690].

I. Install expansion loops in control-valve boxes for plastic piping.

J. Lay piping on solid subbase, uniformly sloped without humps or depressions.

K. Install ductile-iron piping according to AWWA C600.

L. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.
3.3  JOINT CONSTRUCTION

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

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

C. 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.

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

E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.


G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.

I. PVC Piping Solvent-Cemented 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. 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.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.4  VALVE INSTALLATION

A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.

B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
   1. Install valves and PVC pipe with restrained, gasketed joints.

C. Aboveground Valves: Install as components of connected piping system.

D. Throttling Valves: Install in underground piping in boxes for automatic control valves.
E. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed.

B. Install sprinklers at manufacturer's recommended heights.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.6 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install interior controllers on [floor] [concrete bases] [wall].
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below[ or beside] piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
   1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Any irrigation product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 ADJUSTING
A. Adjust settings of controllers.
B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than [1/2 inch (13 mm)] above, finish grade.

3.10 PIPING SCHEDULE
A. Install components having pressure rating equal to or greater than system operating pressure.
B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
C. Aboveground irrigation main piping, [NPS 4 (DN 100) and smaller] <Insert pipe size range>, shall be one of the following:
   1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
   2. [Type L (Type B)][Type M (Type C)] hard copper tube, wrought- or cast-copper fittings, and brazed [soldered] joints.
   3. [Schedule 40][Schedule 80], PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
   4. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

D. Underground irrigation main piping, [NPS 4 (DN 100) and smaller] <Insert pipe size range>, shall be one of the following:
   1. NPS 3 and NPS 4 (DN 80 and DN 100) ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.
   2. Type L (Type B) soft copper tube, wrought-copper fittings, and brazed joints.
   3. [Schedule 40][Schedule 80], PVC pipe and socket fittings, and solvent-cemented joints.
   4. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
   5. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

E. Circuit piping, [NPS 2 (DN 50) and smaller] <Insert pipe size range>, shall be one of the following:
1. SIDR 7 [SIDR 9], PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

F. Circuit piping, [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>, shall be [one of] the following:

1. SIDR 7 [SIDR 9], PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

G. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

H. Risers to Aboveground Sprinklers and Specialties: [Type L (Type B)] [Type M (Type C)] hard copper tube, wrought-copper fittings, and [brazed] [soldered] joints.

I. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.

J. Drain piping shall be [one of] the following:

1. SIDR 9, 11.5, or 15, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

3.11 VALVE SCHEDULE

A. Underground, Shutoff-Duty Valves: Use the following:

1. NPS 2 (DN 50) and Smaller: Curb valve, curb-valve casing, and shutoff rod.
2. NPS 3 (DN 80) and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

B. Aboveground, Shutoff-Duty Valves:

1. NPS 2 (DN 50) and Smaller: [Brass] [Brass or bronze] [Bronze] [Plastic] ball valve.
2. NPS 2-1/2 (DN 65) and Larger: Iron ball valve.

C. Throttling-Duty Valves:

1. NPS 2 (DN 50) and Smaller: [Bronze] [Plastic] automatic control valve.
2. NPS 2 (DN 50) and Smaller: [Brass] [Brass or bronze] [Bronze] [Plastic] ball valve.
3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): [Bronze] [Plastic] automatic control valve.
4. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): Iron ball valve.
D. Drain Valves:

1. **NPS 1/2 and NPS 3/4 (DN 15 and DN 20):** Automatic drain valve.

2. **NPS 1/2 and NPS 3/4 (DN 15 and DN 20):** [Brass] [Brass or bronze] [Bronze] [Plastic] ball valve.

3. **NPS 1 to NPS 2 (DN 25 to DN 50):** [Brass] [Brass or bronze] [Bronze] [Plastic] ball valve.

END OF SECTION 32 84 00
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Final grade topsoil for finished landscaping.

B. Related Sections:
   1. Section 31 22 13 - Rough Grading: Site contouring.
   2. Section 31 23 17 - Trenching: Backfilling trenches.
   3. Section 31 23 23 - Fill: Backfilling at building areas.
   4. Section 32 92 19 – Turf and Grasses.
   5. Section 32 93 00 – Exterior plantings
   6. Section 32 84 00 – Planting Irrigation

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedure.

B. Samples: Submit, in air-tight containers, 5lb sample of each type of topsoil
   1. Amended soil for stormwater infiltration swales.
   2. Amended soil for turf and landscape plantings.

C. Manufacturer's Certificate: product certificates for each amendment added.

1.3 QUALITY ASSURANCE

A. Coordinate the delivery and storage of imported soils.

B. Perform Work in accordance with State, Municipality and Public Work’s agencies that have jurisdiction of this type of work.

C. Comply with approved standard practices at all times of construction activities.

PART 2 - PRODUCTS

2.1 MATERIAL

A. PLANTING SOILS

1. Planting Soil: Imported topsoil mix. Clean of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Planting soil blend shall be classified Loam to Silty loam. Planting soil shall be prepared off site the blend shall contain the following:

   a) A PH range of 5.5 to 7.0.

   b) Organic content of 4%-6%.
**B. INfiltration Swale soils**

1. Topsoil for use in infiltration drainage swales sides and bottoms. Topsoil in drainage areas shall be clean sand, free draining capable of meeting swale infiltration rate as determined by the storm drainage design.

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Division 1: Verification of existing conditions before starting work.

B. Verify building and trench backfilling have been inspected and approved.

C. Verify substrate base has been contoured and compacted and approved.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1/21 inch in size. Remove contaminated subsoil.

C. Prepare subsurface to depth as indicated in sections 3.7 Schedules; where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

D. Verify subgrade has been ripped, contoured and properly compacted according to the grading plan(s). Ensure that no landscape areas have been compacted to more than 85% relative to the subsoil types encountered.

3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting, is required, to thickness as indicated. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, building, and completed hardscape work to prevent damage.

E. Lightly compact placed topsoil.

F. Remove surplus subsoil and topsoil from site.

G. Leave stockpile area and site clean and raked, ready to receive landscaping.
3.5 TOLERANCES
   A. Section 01 40 00 - Quality Requirements: Tolerances.
   B. Top of Topsoil: Plus or minus 1/2 inch of required depth including final finished treatment.

3.6 PROTECTION OF INSTALLED WORK
   A. Division 1: Execution and Closeout Requirements: Requirements for protecting finished Work.
   B. Prohibit construction traffic over topsoil.

3.7 SCHEDULES
   A. Compacted topsoil thicknesses:
      2. Sod: 4 inches less the thickness of the sod.
      3. Shrub Beds: 6 inches and to within 3 inches of finished grades.

END OF SECTION 32 91 19
SECTION 32 92 00
TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Seeding.
   2. Sodding.

1.2 DEFINITIONS
A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
B. Finish Grade: Elevation of finished surface of planting soil.
C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
I. Surface Soil: Whatever soil is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Certification of grass seed.
   1. Certification of each seed mixture for turfgrass sod.

C. Product certificates.

1.4 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   1. Pesticide Applicator: State licensed, commercial.

B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
   1. The soil-testing laboratory shall oversee soil sampling.
   2. Report suitability of tested soil for turf growth.
      a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.6 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
   1. Seeded Turf: [60] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
      a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
   2. Sodded Turf: [30] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA’s “Journal of Seed Technology; Rules for Testing Seeds” for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species as follows:

1. Full Sun: <Insert species>.
2. Sun and Partial Shade: Proportioned by weight as follows:
   a. <Insert number> percent <Insert species>.
   b. <Insert number> percent <Insert species>.
   c. <Insert number> percent <Insert species>.
3. Shade: Proportioned by weight as follows:
   a. <Insert number> percent <Insert species>.
   b. <Insert number> percent <Insert species>.
   c. <Insert number> percent <Insert species>.

C. Grass Seed Mix: Proprietary seed mix as follows:

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
   a. <Insert manufacturer's name; product name or designation>.

2.2 TURFGRASS SOD

A. Turfgrass Sod: [Certified] [Approved] [Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects], complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows:

1. Full Sun: <Insert species>.
2. Sun and Partial Shade: Proportioned by weight as follows:
   a. <Insert number> percent <Insert species>.
   b. <Insert number> percent <Insert species>.
   c. <Insert number> percent <Insert species>.
3. Shade: Proportioned by weight as follows:
   a. <Insert number> percent <Insert species>.
   b. <Insert number> percent <Insert species>.
   c. <Insert number> percent <Insert species>. 
2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
   2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through [1-inch (25-mm)] [3/4-inch (19-mm)] [1/2-inch (12.5-mm)] sieve; soluble salt content of [5 to 10] <Insert range or value> decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
2.5 FERTILIZERS


B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.6 PLANTING SOILS

A. Planting Soil: [ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content] [Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process] [Existing, in-place surface soil.] [Imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes]. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with the following soil amendments[ and fertilizers] in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Topsoil by Volume: [1:4] [1:3] [1:2] <Insert ratio>.
2. Ratio of Loose [Sphagnum] [Muck] Peat to Topsoil by Volume: <Insert ratio>.
4. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
5. Weight of [Sulfur] [Iron Sulfate] [Aluminum Sulfate] per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
6. Weight of Agricultural Gypsum per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
7. Volume of Sand Plus 10 Percent [Diatomaceous Earth] [Zeolites] per 1000 Sq. Ft. (92.9 Sq. m): <Insert volume>.
8. Weight of Bonemeal per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
9. Weight of Superphosphate per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
10. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
11. Weight of Slow-Release Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.

2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of \[2\text{ to }5\] decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

2.8 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of \([4\text{ inches (100 mm)}]\) \([6\text{ inches (150 mm)}]\) \([8\text{ inches (200 mm)}]\) <Insert depth>. Remove stones larger than \([1\text{ inch (25 mm)}]\) \([1\text{ to }2\text{ inches (38 mm)}]\) \([2\text{ inches (50 mm)}]\) <Insert size> in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply [superphosphate] <Insert type> fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
3. Spread planting soil to a depth of \([4\text{ inches (100 mm)}]\) \([6\text{ inches (150 mm)}]\) \([8\text{ inches (200 mm)}]\) <Insert depth> but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
   a. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least \([6\text{ inches (150 mm)}]\) \([8\text{ inches (200 mm)}]\). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top \([4\text{ inches (100 mm)}]\) \([6\text{ inches (150 mm)}]\) of soil. Till soil to a homogeneous mixture of fine texture.
   a. Apply [superphosphate] <Insert type> fertilizer directly to surface soil before loosening.
3. Remove stones larger than 1 inch (25 mm) [1-1/2 inches (38 mm)] [2 inches (50 mm)] in any dimension and sticks, roots, trash, and other extraneous matter.

4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

D. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SEEDING

A. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 2 lb/1000 sq. ft. (0.9 kg/92.9 sq. m) [3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m)] [5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m)] <Insert rate>.

C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) <Insert rate> to form a continuous blanket [1-1/2 inches (38 mm)] <Insert thickness> in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

E. Protect seeded areas from hot, dry weather or drying winds by applying [compost mulch] [peat mulch] [planting soil] within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch (4.8 mm) <Insert thickness>, and roll surface smooth.

3.3 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs[ or steel staples] spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.4 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain height appropriate for species without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings.

C. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer’s written recommendations. Coordinate applications with Owner’s operations and others in proximity to the Work. Notify Owner before each application is performed.

3.5 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding [90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm)] <Insert coverage>.

2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

END OF SECTION 32 92 00
SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plants.
   2. Planting soils.

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

H. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

B. Samples of mineral mulch.

C. Product certificates.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.4 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.

1. The soil-testing laboratory shall oversee soil sampling.
2. Report suitability of tested soil for plant growth.
   a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.

C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

D. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

C. Handle planting stock by root ball.

D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

E. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate
aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.6 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
   b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of [Planting Completion] [Substantial Completion] <Insert starting time>:
   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 <Insert number> months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 [Nine] [Six] [Three] <Insert number> months.
   c. Annuals: [Three] [Two] <Insert number> months.

1.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.

1. Maintenance Period for Trees and Shrubs: 12 [Six] [Three] months from date of [planting completion] [Substantial Completion] <Insert starting time>.

2. Maintenance Period for Ground Cover and Other Plants: Six [Three] months from date of [planting completion] [Substantial Completion] <Insert starting time>.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

C. [Annuals] [and] [Biennials]: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm
ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery[ and that are in bud but not yet in bloom].

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
   2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through [1-inch (25-mm)] [3/4-inch (19-mm)] [1/2-inch (13-mm)] sieve; soluble salt content of [5 to 10] <Insert range or value> decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS


B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: [5-gram] [10-gram] [21-gram] <Insert size> tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

A. Planting Soil <Insert drawing designation>: [ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content] [Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process] [Existing, in-place surface soil.] [Imported topsoil or manufactured topsoil from off-site sources; do not obtain from agricultural land, bogs or marshes]. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix soil with the following soil amendments[ and fertilizers] in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Topsoil by Volume: [1:4] [1:3] [1:2] <Insert ratio>.
2. Ratio of Loose [Sphagnum] [Muck] Peat to Topsoil by Volume: <Insert ratio>.
4. Weight of Lime per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
5. Weight of [Sulfur] [Iron Sulfate] [Aluminum Sulfate] per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
6. Weight of Agricultural Gypsum per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
7. Volume of Sand Plus 10 Percent [Diatomaceous Earth] [Zeolites] per 1000 Sq. Ft. (92.9 Sq. m): <Insert volume>.
8. Weight of Bone meal per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
9. Weight of Superphosphate per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
10. Weight of Commercial Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.
11. Weight of Slow-Release Fertilizer per 1000 Sq. Ft. (92.9 Sq. m): <Insert weight>.

2.6 MULCHES

A. Organic Mulch: [Shredded hardwood] [Ground or shredded bark] [Wood and bark chips] [Pine straw] [Salt hay or threshed straw] [Pine needles] [Peanut, pecan, and cocoa-bean shells] <Insert mulch type>.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of [2 to 5] <Insert range or value> decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

C. Mineral Mulch: [Rounded riverbed gravel or smooth-faced stone] [Crushed stone or gravel] [Marble chips] [Granite chips] <Insert stone type>.

1. Size Range: [1-1/2 inches (38 mm) maximum, 3/4 inch (19 mm) minimum] [3/4 inch (19 mm) maximum, 1/4 inch (6.4 mm) minimum] <Insert size range>.
2. Color: [Uniform tan-beige color range acceptable to Architect] [Readily available natural gravel color range] <Insert color>.

2.7 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.8 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of [4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)] [12 inches (300 mm)] <Insert depth>. Remove stones larger than [1 inch (25 mm)] [1-1/2 inches (38 mm)] [2 inches (50 mm)] <Insert size> in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. **Apply [superphosphate]** <Insert type> fertilizer directly to subgrade before loosening.

2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

3. Spread planting soil to a depth of [4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)] <Insert depth> but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

**B. Finish Grading:** Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.2 EXCAVATION FOR TREES AND SHRUBS

**A. Planting Pits and Trenches:** Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter.
2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

**B. Subsoil and topsoil removed from excavations [may] [may not] be used as planting soil.

### 3.3 TREE, SHRUB, AND VINE PLANTING

**A.** Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

**B.** Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

**C.** Set stock plumb and in center of planting pit or trench with root flare [1 inch (25 mm) above] [2 inches (50 mm) above] <Insert dimension> adjacent finish grades.

1. Use planting soil <Insert drawing designation> for backfill.
2. **Balled and Burlapped:** After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. **Balled and Potted [Container-Grown]:** Carefully remove root ball from container without damaging root ball or plant.
4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
5. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside
the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

7. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Bare-Root Stock: Set and support bare-root stock in center of planting pit or trench with root flare [1 inch (25 mm) above] [2 inches (50 mm) above] <Insert dimension> adjacent finish grade.

1. Use planting soil <Insert drawing designation> for backfill.
2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.4 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

3.5 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines [9 inches (225 mm) apart] [12 inches (300 mm) apart] [18 inches (450 mm) apart] [24 inches (600 mm) apart] [as indicated] in even rows with triangular spacing.

B. Use planting soil <Insert drawing designation> for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.
3.6 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of [6 inches (150 mm)] [12 inches (300 mm)] and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees[ and Tree-like Shrubs] in Turf Areas: Apply [organic] [mineral] mulch ring of [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> average thickness, with [12-inch (300-mm)] [24-inch (600-mm)] [36-inch (900-mm)] <Insert dimension> radius around trunks or stems. Do not place mulch within [3 inches (75 mm)] [6 inches (150 mm)] <Insert distance> of trunks or stems.

2. [Organic Mulch] [and] [Mineral Mulch] in Planting Areas: Apply [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> average thickness of mulch [extending 12 inches (300 mm) beyond edge of individual planting pit or trench] [and] [over whole surface of planting area], and finish level with adjacent finish grades. Do not place mulch within [3 inches (75 mm)] [6 inches (150 mm)] <Insert distance> of trunks or stems.

3.7 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use practices to minimize the use of pesticides and reduce hazards.

D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 329300
SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

1.1 PIPING

A. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: [Extra-Heavy] [Service] class.

B. Hubless cast-iron oil pipe and fittings with [CISPI-trademarked] [heavy-duty] [cast-iron] shielded couplings.

C. Ductile-iron, culvert pipe and [standard] [compact] fittings.

D. Ductile-iron, [push-on] [mechanical]-joint pressure pipe and [push-on] [mechanical]-joint [standard] [compact] fittings.

E. Corrugated steel pipe and fittings.

F. Corrugated aluminum pipe and fittings.

G. ABS pipe and fittings.

H. Corrugated PE pipe and fittings.

I. PVC Pipe and Fittings: [Cellular-core] [Corrugated-sewer] [Profile-sewer] [Type PSM sewer] [Gravity-sewer] [Pressure] [Water-service] piping.

J. Fiberglass pipe and fittings.

K. Concrete Pipe and Fittings: [Nonreinforced] [Reinforced]-concrete sewer pipe and fittings.

L. Nonpressure Transition Couplings: [Unshielded flexible] [Shielded flexible] [Ring-type flexible].

M. Pressure pipe couplings.

N. Expansion Joints and Deflection Fittings: Ductile-iron [flexible expansion joints] [expansion joints] [deflection fittings].

1.2 COMPONENTS

A. Backwater Valves: [Cast iron] [Plastic].

B. Cleanouts: [Cast iron] [Plastic].

C. Drains: [Cast-iron area] [and] [cast-iron trench] [steel trench].

D. Encasement for Piping: PE film.

E. Manholes: [Standard precast concrete] [Designed precast concrete] [Fiberglass].

1. Resilient pipe connectors.
2. [Adjusting] [Grade] rings.
3. [Ductile-iron] [Gray-iron] manhole frames and covers.

F. Polymer-Concrete, Channel Drainage Systems: [Sloped-invert] [Narrow-width, level-invert] [Wide-width, level-invert] type.
   1. Drainage Specialties: [Large catch basins] [small catch basins] [oil interceptors] [and] [sediment interceptors].

G. Plastic, Channel Drainage Systems: [Fiberglass] [PE].

H. Catch Basins: [Standard precast] [Designed precast] concrete.
   1. Ductile-iron frames and grates.

I. Stormwater Inlets: [Curb] [gutter] [and] [combination] type.

J. Stormwater Detention Structures: Cast-in-place concrete with ductile-iron manhole frames and covers.

K. Pipe Outlets: [Head wall] [riprap basins] [filter stone] [and] [energy dissipaters].

L. Dry Wells: [Precast, perforated concrete rings] [Manufactured PE side panels and top cover] [Constructed-in-place aggregate].

M. Stormwater Disposal Systems: [Chamber] [Pipe] type.

END OF SECTION 33 41 00
PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS – STANDARDS AND CODES

A. Materials used under this Contract, unless specifically noted otherwise, shall be new and of the latest and most current model line produced by the manufacturer. Outdated “new” equipment is not acceptable. Each item of equipment and material shall conform to the latest Standard Specifications of the American Society for Testing Materials and shall conform to any applicable standards of the United States Department of Commerce.

B. Motor and equipment name plates as well as applicable UL and AGA labels shall be in place when Project is turned over to the Owner.

C. Motor efficiencies shall meet or exceed the requirements of the applicable energy code.

D. All electrically driven or connected equipment shall be provided with UL or equivalent label and/or listing in accordance with the requirements of the NEC.

E. Equipment shall be UL listed as an assembly where listing/labeling program is available for that type of equipment.

F. All control panels shall be provided with UL or equivalent label and/or listing in accordance with the requirements of the NEC and applicable local electrical codes.

G. Fuel fired equipment shall be listed by a nationally recognized testing laboratory for use with the particular fuel type.

H. All pressure vessels and relief valves shall be furnished in accordance with applicable Washington State Boiler and Unfired Pressure Vessel Laws. This shall include rating and stamped in accordance with the ASME Boiler and Pressure Vessel Code where required by Code authorities or State Law.

2.2 EQUIPMENT/MATERIAL SUBSTITUTIONS

A. Throughout these specifications and drawings, various materials, equipment, apparatus, etc., are specified or scheduled by manufacturer, brand name, type or catalog number. Such designation is to establish standards of desired quality and construction and shall be the basis of design and the bid.

B. Substitutions will not be permitted without written approval. (Refer to Section 01 60 00.)

C. Where two or more manufacturer designations are listed in these specifications, choice will be optional with the Contractor except that where more than one manufacturer is listed and only one manufacturer’s catalog number is specified or only one manufacturer scheduled on the drawings (basis of design), that standard of quality, dimensional characteristics, capacities, and construction shall be maintained by materials or equipment supplied by the other manufacturer(s).

D. Substituted equipment with efficiencies less than 95 % of the basis of design efficiency shall not be considered equal to the basis of design.
E. If the Mechanical Contractor uses manufacturers other than the basis of design, the Contractor shall be responsible for:

1. Insuring the substituted item will fit the available space while allowing proper maintenance access
2. Any changes required by other Contractors caused by the substituted equipment
4. Changes in structural design due to weight differences

F. In the event other than specified equipment is used and will not fit job site conditions, this Contractor shall assume responsibility for replacement with items indicated as the basis of design.

2.3 EQUIPMENT SUBSTITUTIONS – ELECTRICAL CHARACTERISTICS

A. Products furnished other than the basis of design shall have similar electrical characteristics as the scheduled or specified equipment. The Contractor shall be responsible for any electrical changes caused by products not in accordance with this requirement.

2.4 SUBMITTALS FOR REVIEW (REFER TO SECTION 01 33 00)

A. Shop drawings, catalog information and material schedules shall be submitted for approval on all specified materials and equipment in Mechanical prior to ordering.

B. Provide specific wiring diagrams for all equipment requiring electrical or control wiring. Upon approval, copies of these diagrams shall be forwarded to pertinent contractors.

C. Furnish complete shop drawing/catalog data for equipment and materials to be used in the work for review. Allow sufficient time for developing shop drawings, processing and review time so that the installation will not be delayed.

D. Shop drawings shall be reviewed, approved and stamped by the Contractor prior to submitting to Owner’s Representative for approval. Submittals without such approval will be returned without review.

E. Submit data in accordance with Section 013300 and in accordance with this section. Data shall be black and white, on 8½×11 inch or 11×17 inch, single, one-sided sheets suitable for copying. Diagrams and drawings larger than 11×17 inch shall be submitted in reproducible form. Drawings and catalog data must be clean, neat copies. Fax material or other poor quality copies will not be acceptable.

F. Where choices of options and accessories are available or specified, provide written description of what is to be furnished. If necessary, list page numbers where submitted items are described.

G. State sizes, capacities, brand names, motor horsepower, electrical characteristics, accessories, materials, gauges, dimensions, and other pertinent information.

H. Underline applicable data.

I. If material or equipment is not as specified or submittal is not complete, it will be rejected. Only complete submittal including all applicable specification sections will be reviewed.
J. Catalog data or shop drawings for equipment which are noted as being reviewed shall not supersede Contract Documents.

K. Review comments shall not relieve the Contractor from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Contractor from responsibility for errors in items submitted.

L. Check work described by catalog data with Contract Documents for deviations and errors.

M. Submit four (4) copies of each shop drawing. One stamped copy will be retained by the Engineer, one will be retained by the Architect, one will be retained by the Owner and a single stamped and reviewed copy will be returned to the Contractor. The Contractor shall be responsible for distribution of required number of reviewed copies to parties other than the Owner’s Representative(s).

N. Submittals shall be bound in a black 3-ring binder with the project name on the cover. Provide index tabs for each specification section in same order and using same name as appears in the Specifications. Shop drawings and submittal information shall be provided for all required Mechanical equipment in a single submittal.

1. Exceptions:
   a. Fire protection and EMCS submittals may be provided independently, but status of submittals shall be kept up to date in submittal table.
   b. At the discretion of the Owner’s Representative, partial project submittals may be allowed. In such a case, the first submittal shall be provided in a 3-ring binder per the requirements noted above with all applicable tabs and sufficient space for all project mechanical submittals.

O. Operation and maintenance data for individual equipment shall also be provided subsequent to approval of equipment submittals in a separate binder meeting the same requirements as the submittal binder. Refer to Section 20 10 06 for operation and maintenance data requirements.

P. All submittals and re-submittals as required shall be provided with a cover page incorporating a table similar to that provided at the end of this section. The appropriate box(es) shall be checked on each line item for all submittals.

END OF SECTION 20 10 00
PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Adhesives shall meet or exceed VOC limits of South Coast Air Quality Management (SCAQMD) Rule # 1168. See table below.

B. Sealants and fillers shall meet or exceed VOC limits of Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 51. See tables below.

1. Substrate Adhesives

<table>
<thead>
<tr>
<th>Substrate Adhesives</th>
<th>VOC Limit (g/l)</th>
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<tbody>
<tr>
<td>Metal to metal</td>
<td>30</td>
</tr>
<tr>
<td>Plastic foams</td>
<td>120</td>
</tr>
<tr>
<td>Porous material except wood</td>
<td>120</td>
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<tr>
<td>Wood</td>
<td>30</td>
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<tr>
<td>Fiberglass</td>
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2. Adhesives, Welding & Installation

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<th>Adhesives, Welding &amp; Installation</th>
<th>VOC Limit (g/l)</th>
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<tbody>
<tr>
<td>Non-vinyl backed installation</td>
<td>150</td>
</tr>
<tr>
<td>Carpet pad installation</td>
<td>150</td>
</tr>
<tr>
<td>Wood flooring installation</td>
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<tr>
<td>Ceramic tile installation</td>
<td>130</td>
</tr>
<tr>
<td>Dry wall and panel installation</td>
<td>200</td>
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<tr>
<td>Subfloor installation</td>
<td>200</td>
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<tr>
<td>Rubber floor installation</td>
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<tr>
<td>VCT &amp; asphalt tile installation</td>
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<tr>
<td>PVC welding</td>
<td>510</td>
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<td>CPVC welding</td>
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<td>ABS welding</td>
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<td>Plastic cement welding</td>
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<td>Cove base installation</td>
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<td>Adhesive primer for plastic</td>
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<td>All others</td>
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3. Sealants

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<tr>
<td>Architectural</td>
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<td>Roadways</td>
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<td>Roofing material installation</td>
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<td>PVC welding</td>
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<td>Other</td>
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4. Sealant Primers

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<tr>
<th>Sealant Primers</th>
<th>VOC Limit (g/l)</th>
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<tr>
<td>Architectural (non-porous)</td>
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<td>Architectural (porous)</td>
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<td>Other</td>
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END OF SECTION 20 10 01
SECTION 20 10 04
EXCAVATION AND BACKFILL

PART 2 - (NOT USED)

END OF SECTION 20 10 04
SECTION 20 10 05
SEISMIC PROVISIONS

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Refer to Section 20 10 00:
   1. Amber Booth
   2. Mason Industries

2.2 VIBRATION ISOLATION
A. Refer to Sections 22 05 48 and 23 05 48 for systems and equipment requiring vibration isolation. Seismic restraints shall factor vibration of spring isolation equipment.

2.3 BASEMOUNTED EQUIPMENT:
A. A restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum 1/4” thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4” clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test.
   1. Where the manufacturer determines that the equipment is furnished with a base assembly that is sufficiently rigid to allow direct anchoring to the floor and basemounted spring isolators are not required (22 05 48 and 23 05 48), provide details for direct mounting of the equipment to the floor or curb or roof structure.
B. Manufacturer (Refer to Section 20 10 00):
   1. Amber/Booth restraint type ER
   2. Mason

2.4 SUSPENDED EQUIPMENT
A. A restraint assembly for suspended equipment, piping or ductwork consisting of high strength galvanized steel aircraft cable. Cable must have Underwriters Laboratories listed certified break strength, and shall be color-coded for easy field verification. Secure cable to structure and to braced component through bracket or stake eye specifically designed to exceed cable restraint rated capacity. Cable must be manufactured to meet or exceed minimum materials and standard requirements per AISI Manual for structural applications of steel cables and ASTM A603. Break strengths must be per ASTM E-8 procedures. Safety factor of 1.5 may be used when prestretched cable is used with end connections designed to meet the cable break strength. Otherwise safety factor 3.76 must be used. Cables shall be sized for a force as listed in section 1.3. Cables shall be installed to prevent excessive seismic motion and so arranged that they do not engage during normal operation.
B. Manufacturer (Refer to Section 20 10 00):

1. Amber/Booth restraint type LRC.
2. Mason

END OF SECTION 20 10 05
SECTION 20 10 06
PROJECT FINALIZATION

PART 2 - (NOT USED)

END OF SECTION 20 10 06
SECTION 20 10 07
TESTING, ADJUSTING, AND BALANCING

PART 2 - (NOT USED)

END OF SECTION 20 10 07
SECTION 20 10 09
MECHANICAL COMMISSIONING SUPPORT

PART 2 - (NOT USED)

END OF SECTION 20 10 09
SECTION 21 13 13 SPRINKLER SYSTEMS

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and Equipment: All materials and equipment in the system shall be new and current products of a manufacturer regularly engaged in the production of such materials and equipment. Where two or more pieces of equipment are required to perform interrelated functions, they shall be products of one manufacturer.

B. Approval Guides: Unless otherwise indicated, all products shall be listed in the latest publication of the Underwriters Laboratory Fire Protection Directory or the Factory Mutual Approval Guide.

2.2 PIPE

A. Schedule of Pipe: All pipe shall be ferrous, and shall meet the requirements of NFPA 13. All threaded pipe shall be schedule 40. Schedule 40 substitutes will not be accepted. Schedule 10 pipe is permitted for grooved mains where internally and externally galvanized pipe is used.

B. Underground pipe and fittings shall be in accordance with Division 2, NPFA 13 and local requirements.

2.3 FITTINGS AND COUPLINGS

A. Threaded Fittings: Threaded fittings shall be cast iron class 125, rated for 175 psi. cold water working pressure and shall conform to ANSI B16.4, ASTM 126 and ANSI B2.1 NPT.

B. Grooved Fittings: 90's, 45's, Tees, and reducers shall be malleable iron or ductile. The fittings shall be by Gustin Bacon, Gruvlok, Victaulic, or approved equal.

C. Adapter Flanges: Adapter flanges (fittings) shall be cast iron/class 125 conforming to ANSI B 16.1, with a rust inhibiting coating. The adapter flanges shall be by Gustin Bacon, Gruvlok, Victaulic, or approved equal.

D. Grooved Couplings: Grooved couplings and reducers shall be malleable or ductile iron conforming to ASTM A 47.

E. Plain End Couplings: Plain-end couplings are permitted when installed in complete conformance with their listings.

2.4 HANGERS AND SUPPORTS

A. Hangers: Provide hangers to support all piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet the requirements of NFPA 13.

B. Pipe Rings: Pipe rings to be zinc coated Grinnell figure 69 or equal.

2.5 EARTHQUAKE BRACING

A. Earthquake bracing shall be with a pipe clamp and pipe with a swivel type anchor or similar to those illustrated in NFPA 13. Other types of bracing may be used when UL-listed or FM approved.
2.6 VALVES

A. Butterfly Valves: Butterfly valves shall be Central Model A with integral tamper switch or Gruvlok Model 7700 FP with integral tamper switch, or approved equal. Externally mounted tamper switches are also permissible.

B. Drain Valves: Drain valves shall be screw in bonnet bronze globe valves, rated to 175 psi non shock cold water working pressure by Nibco, United or approved equal. Low point drain valves shall have, in addition, a ¾ inch brass nipple with ¾ inch male hose threads and cap.

2.7 BACKFLOW PREVENTER

A. The backflow preventer is provided under Division 2.

2.8 CHECK VALVES

A. Check valves shall be grooved, iron body, bronze seat, stainless steel clapper with a replaceable rubber seal and 175 psi non shock cold water working pressure. Viking model D, Central model 90 or approved equal.

2.9 SPRINKLERS

A. Provide residential sprinklers in residential portions of the facility.

B. Provide quick response sprinklers throughout non-residential areas.

C. Sprinklers in ceilings shall be glass bulb, white, with white recessed escutcheon.

D. Sprinklers in residents’ rooms shall be sidewall sprinklers.

E. Spare Sprinklers: Provide spare sprinklers and escutcheons for each type and style of sprinkler used in accordance with NFPA 13 and proportioned based upon the number of each type and style of sprinkler used on the project.

2.10 SPARE SPRINKLER CABINET

A. Provide a spare sprinkler cabinet to accommodate the required number of spare sprinklers and escutcheons. Include a wrench for each type of sprinkler in the cabinet.

2.11 SPRINKLER HEADGUARD

A. Provide UL Listed sprinkler headguards for sprinkler heads subject to mechanical damage or for any sprinkler lower than 7 feet above the floor.

2.12 PRESSURE GAUGE

A. Provide a 3½ inch diameter, bourdon type pressure gauge, 0 200 lbs, ¼ inch soft metal seat globe valve with arrangements for draining pipe between gage and valve, located at each floor control assembly or riser.

2.13 WALL ESCUTCHEON

A. Provide plastic split ring type escutcheons. Escutcheons are only required where wall penetrations are exposed.
2.14  FIRE ALARM AND RELATED EQUIPMENT

A. Equipment in this section shall be provided, installed, and adjusted by the sprinkler Contractor. Conduit, wiring, and terminations, shall be by others.

B. Waterflow Switch: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig (1725-kPa) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

C. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

D. Pressure Switches: UL 753; electrical-supervision-type, high and low air pressure switch for monitoring pressure in the dry pipe system. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Electric Bell: Provide UL-listed 120 volt electric bell, mounted on exterior wall in locations noted on plans.

2.15  SIGNS

A. Provide all control, drain and test valves with signs identifying the type of valve and the area affected by the valve. Signs shall be three layer etched plastic with white letters on a red background to identify valves above ceilings or behind access doors. Lithographed metal plates may be used in unfinished spaces or above ceilings. Provide hydraulic design information plates as required by NFPA 13.

2.16  FIRESTOPPING MATERIAL

A. Firestopping material is to be UL classified Bio Fireshield BFS100, 200 caulk or approved equal. See Specification Section 07841 for firestopping requirements.

END OF SECTION 21 13 13
PART 2 - PRODUCTS

2.1 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight
   1. Fittings: Cast iron
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets

B. Cast Iron Pipe: CISPI 301, hubless, service weight
   1. Fittings: Cast iron
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies

C. No-hub couplings
   1. Approved Manufacturers (refer to Section 20 10 00
      a. Husky SD 2000
      b. Clam-All Hi Torque 80
   2. Materials: The worm gear drive clamps shall have a hexagon head to accept a 5/16 inch socketed torque wrench. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Sealing rings shall be molded into the gasket and positioned under each torquing band. Couplings shall meet the performance requirements of coupling standard FM 1680 class 1.
   3. Corrugated Couplings
      a. Shield constructed of 304 corrugated stainless steel with a minimum thickness of 0.010”.
      b. Coupling pipe sizes 1 ¼” through 4” shall have 4 bands.
      c. Couplings for pipe sizes 5” through 10” shall have 6 bands.
   4. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum shield thickness of 28 gauge.
      a. Couplings sizes 1 1/2” through 4” shall have 2 bands
      b. Couplings sizes 5” through 10” shall have 4 bands.

D. Schedule 40 DWV ABS Pipe: ASTM D2661 or ASTM D2751
   1. Fittings: ABS
   2. Joints: ASTM D2235, solvent weld

E. Schedule 40 DWV PVC Pipe: ASTM D2665 or ASTM D3034
   1. Fittings: PVC
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement

2.2 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight
1. Fittings: Cast iron  
2. Joints: ASTM C564, neoprene gasket system or lead and oakum

B. Cast Iron Pipe: CISPI 301, hubless, service weight  
   1. Fittings: Cast iron  
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies

C. Steel Pipe: ASTM A53 Schedule 40, galvanized  
   1. Cast Iron Fittings: ASME B16.4, threaded fittings  

D. ABS Pipe: ASTM D2661  
   1. Fittings: ABS  
   2. Joints: ASTM D2235, solvent weld

E. PVC Pipe: ASTM D2729 or ASTM D2665  
   1. Fittings: PVC  
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement

F. No-hub couplings  
   1. Approved Manufacturers (refer to Section 20 10 00):  
      a. Husky SD 2000  
      b. Clam-All Hi Torque 80  
   2. Materials: The worm gear drive clamps shall have a hexagon head to accept a 5/16 inch socketed torque wrench. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Sealing rings shall be molded into the gasket and positioned under each torquing band. Couplings shall meet the performance requirements of coupling standard FM 1680 class 1.  
   3. Corrugated Couplings  
      a. Shield constructed of 304 corrugated stainless steel with a minimum thickness of 0.010".  
      b. Coupling pipe sizes 1 ¼" through 4" shall have 4 bands.  
      c. Couplings for pipe sizes 5" through 10" shall have 6 bands.  
   4. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum shield thickness of 28 gauge.  
      a. Couplings sizes 1 1/2" through 4" shall have 2 bands  
      b. Couplings sizes 5" through 10" shall have 4 bands.

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Tubing: ASTM B42, hard drawn, Type K  
   1. Fittings: ASME B16.22 wrought copper and bronze  
   2. Joints: AWS A5.8, BCuP silver braze  
   3. Wrap for Underground Piping: Calpico Inc. pipe wrapping polyvinyl tape, 20 mil thickness, with identification per IAPMO.

B. Copper Tubing: ASTM B42, annealed, Type K
1. Fittings: none
2. Joints: none

C. Ductile Iron Pipe: AWWA C151
   1. Fittings: AWWA C110, Ductile iron, standard thickness
   2. Joints: AWWA C111, rubber gasket with ¾ inch diameter rods

2.4 WATER PIPING, ABOVE GRADE
   A. Copper Tubing: ASTM B88, Type L, hard drawn
      1. Fittings: ASME B16.22, wrought copper and bronze
      2. Joints: ASTM B32, solder, Grade 95TA

2.5 STORM WATER PIPING, (ROOF DRAINAGE; RDL AND ODL) BURIED WITHIN 5 FEET OF BUILDING
   A. Cast Iron Pipe: ASTM A74, service weight
      1. Fittings: Cast iron
      2. Joints: ASTM C564, neoprene gasket system
   B. Cast Iron Pipe: CISPI 301, hubless, service weight
      1. Fittings: Cast iron
      2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies
   C. Schedule 40 DWV ABS Pipe: ASTM D2680 or ASTM D2751
      1. Fittings: ABS
      2. Joints: ASTM D2235, solvent weld
   D. Schedule 40 DWV PVC Pipe: ASTM D2665
      1. Fittings: PVC
      2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement
   E. Schedule 40 DWV PVC Pipe: ASTM D3034 or SDR 35
      1. Fittings: PVC
      2. Joints: ASTM F477, elastomeric gaskets
   F. No-hub couplings
      1. Approved Manufacturers (refer to Section 20 10 00):
         a. Husky SD 2000
         b. Clam-All Hi Torque 80
      2. Materials: The worm gear drive clamps shall have a hexagon head to accept a 5/16 inch socketed torque wrench. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Sealing rings shall be molded into the gasket and positioned under each torquing band. Couplings shall meet the performance requirements of coupling standard FM 1680 class 1.
3. **Corrugated Couplings**
   a. Shield constructed of 304 corrugated stainless steel with a minimum thickness of 0.010”.
   b. Coupling pipe sizes 1 ¼” through 4” shall have 4 bands.
   c. Couplings for pipe sizes 5” through 10” shall have 6 bands.

4. **Smooth shielded couplings** shall have a 304 stainless steel shield with a minimum shield thickness of 28 gauge.
   a. Couplings sizes 1 1/2” through 4” shall have 2 bands
   b. Couplings sizes 5” through 10” shall have 4 bands.

2.6 **STORM WATER PIPING, (ROOF DRAINAGE; RDL AND ODL) ABOVE GRADE**

A. **Cast Iron Pipe: ASTM A74 service weight**
   1. Fittings: Cast iron
   2. Joints: ASTM C564, neoprene gasket system

B. **Cast Iron Pipe: CISPI 301, hubless, service weight**
   1. Fittings: Cast iron
   2. Joints: CISPI 310, Neoprene gaskets and stainless steel clamp-and-shield assemblies

C. **Steel Pipe: ASTM A53 Schedule 40, galvanized**
   1. Cast Iron Fittings: ASME B16.4, threaded fittings

D. **ABS Pipe: ASTM D2661**
   1. Fittings: ABS
   2. Joints: ASTM D2235, solvent weld

E. **PVC Pipe: ASTM D2665 or ASTM D2729**
   1. Fittings: PVC
   2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement

F. **No-hub couplings**
   1. Approved Manufacturers (refer to Section 20 10 00):
      a. Husky SD 4000
      b. Clam-All Hi Torque 80
   2. Materials: The worm gear drive clamps shall have a hexagon head to accept a 5/16 inch socketed torque wrench. The gaskets shall be manufactured using neoprene rubber meeting the requirements of ASTM C-564. Sealing rings shall be molded into the gasket and positioned under each torquing band. Couplings shall meet the performance requirements of coupling standard FM 1680 class 1.
   3. **Corrugated Couplings**
      a. Shield constructed of 304 corrugated stainless steel with a minimum thickness of 0.0151”.
      b. Coupling pipe sizes 1 ¼” through 4” shall have 4 bands.
      c. Couplings for pipe sizes 5” through 10” shall have 6 bands.
4. Smooth shielded couplings shall have a 304 stainless steel shield with a minimum shield thickness of 28 gauge.
   a. Couplings sizes 1 1/2” through 4” shall have 2 bands
   b. Couplings sizes 5” through 10” shall have 4 bands.

2.7 INDIRECT WASTE AND COOLING COIL CONDENSATE DRAIN PIPING:
   A. Type M copper tubing with soldered Joints. Min. size ¾”
   B. 

2.8 PROPANE GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING
   A. Steel Pipe: ASTM A53 Schedule 40 black
      1. Fittings: ASTM A234/A234M, forged steel welding type, with AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape
      2. Joints: ANSI B31.4, ASME Sec 1, welded

2.9 PROPANE GAS PIPING, ABOVE GRADE
   A. Steel Pipe: ASTM A53 Schedule 40 black
      1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, forged steel welding type
      2. Joints: NFPA 58, threaded or welded to ANSI B31.4, ANSI B31.9, ASME Sec 1

2.10 COOLING COIL CONDENSATE DRAIN PIPING:
   A. Type L copper tubing with soldered joints. Min. size ¾”

2.11 MAKE-UP WATER PIPING: HARD COPPER TUBE, TYPE L; WROUGHT-COPPER OR CAST COPPER ALLOY PRESSURE FITTINGS; COPPER UNIONS, BRONZE FLANGES AND SOLDER JOINTS WITH ALLOY SN 95 SOLDER.

2.12 FLANGES, UNIONS, AND COUPLINGS
   A. Pipe Size 2 inches and under:
      1. Ferrous pipe: Class 150 malleable iron threaded unions
      2. Copper tube and pipe: Class 150 bronze unions with soldered joints
   B. Pipe Size over 2 inches:
      1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets
      2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets

2.13 DIELECTRIC PIPE FITTINGS:
   A. Dielectric Unions: Factory-fabricated, union assembly for 250 psig minimum working pressure at a 180°F temperature.
1. Manufacturers: Epco Sales, Inc.; Watts Industries, Inc. – Water Products Division or Zurn Industries, Inc. – Wilkins Division.

B. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.

1. Manufacturers: Epco Sales, Inc. or Watts Industries, Inc. – Water Product Division.

C. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or Phenolic gasket, Phenolic or polyethylene bolt sleeves, Phenolic washers, and steel backing washers.
   a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
   b. Manufacturers: Advance Products & Systems, Inc.; Calipco, Inc. or Pipeline Seal and Insulator, Inc.

D. Dielectric Couplings: Galvanized-Steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225°F temperature.

1. Manufacturers: Calpico, Inc. or Lochinvar Corp.

E. Dielectric Nipples: Electroplated steel nipple, having inert and non-corrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225°F temperature. Nipples shall be listed by IAPMO/UPC and SBCCI PST and ESI.

1. Manufacturers: Precision Plumbing Products, Inc.; Sioux Chief Manufacturing Co., Inc.; Perfection Corp. or Victaullic Co. of America.

2.14 GENERAL VALVES

A. Manufacturers (Refer to Section 20 10 00):

1. Crane
2. Jenkins
3. Powell
4. Milwaukee
5. Grinnell
6. Stockham
7. Hammond
8. Nibco
9. Walworth
10. Watts

B. Gate Valves

1. Up to and including 2 inches:
   a. MSS SP-80, Class 125, bronze body, bronze trim, non-rising stem, handwheel, inside screw, solid wedge disc, solder or threaded ends

2. 2½ inches and larger:
   a. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor—OS&Y.

C. Globe Valves
1. Up to and including 2 inches:
   a. MSS SP-80 Class 150, bronze body, bronze trim, handwheel, Teflon disc, solder or threaded ends

2. 2½ inches and larger:
   a. MSS SP-85 Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

D. Ball Valves

1. Up to and including 3 inches:
   a. MSS SP-110, Class 150, 400 psi, bronze two piece body, chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder or threaded ends with union.

E. Gas Stops

1. Up to and including 2 inches:
   a. Butterfly ("Butterball") bronze body, lever handle, stainless steel disc and stem, vitron seal, 200 psi working pressure, MSS SP-67, AGA certified and UL listed for gas service.

2. 2½ inches and larger:
   a. Square head stop, standard pattern, cast iron body and plug, non-lubricated, inert packing material, threaded ends with union. Hays No. 7005 or equal.

F. Plug Valves (Gas Shutoff Valves)

1. 2½ inches and larger:
   a. MSS SP-78, 150 psi, cast iron body and plug, non-lubricated, Teflon packing, flanged ends. Provide lever operator or wrench.

G. Butterfly Valves

1. 2 inches and larger:
   a. MSS SP-67, 200 psi, bronze body, 316 stainless steel disc, resilient replaceable Buna N seat, wafer or lug ends, extended neck, stainless steel stem, infinite position lever handle with memory stop. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

H. Swing Check Valves

1. Up to and including 2 inches:
   a. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends

2. 2½ inches and larger:
   a. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends

I. Spring Loaded Check Valves (Pump Discharge)

1. Up to 2 inches:
a. Class 125, cast bronze. Stainless steel stem, Buna Disc, Teflon seat ring, beryllium copper spring, screwed ends

2. 2½ inches and larger:
   a. 125 lb. wafer or flanged cast iron body, renewable bronze seat and disc, stainless steel spring

2.15 WATER SOLENOID VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. ASCO Series 8221
   
B. UL listed C.S.A. certified, minimum 125 psi operating pressure differential at 180 °F.

C. Brass body, Buna N seals and discs

D. Type 1, general purpose solenoid enclosure

E. Normally open operation, 120 volt, AC coils

F. Slow closing

2.16 TEMPERATURE AND PRESSURE RELIEF VALVES

A. Temperature and Pressure Relief:
   1. Manufacturers (Refer to Section 20 10 00):
      a. Watts
      b. Wilkins
      c. Bell & Gossett
   

2.17 STRAINERS

A. Up to 2 inches:
   1. Manufacturers (Refer to Section 20 10 00):
      a. Watts
      b. Wilkins
      c. Spirax Sarco
   
   2. Threaded brass body for 125 psi, at 400 °F, Y pattern with 3/64 inch stainless steel perforated screen

B. 2½ inches to 4 inch:
   1. Manufacturers (Refer to Section 20 10 00):
      a. Watts
      b. Wilkins
2. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen

C. 5 inches and larger:

1. Manufacturers (Refer to Section 20 10 00):
   a. Watts
   b. Wilkins

2. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen

2.18 FLOW CONTROL BALANCE VALVES (CIRCUIT SETTERS):

A. Manufacturers (Refer to Section 20 10 00):

1. Bell and Gossett “Circuit Setter Plus”
2. Taco
3. Armstrong

B. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate and indicating pointer—Brass or bronze body.

2.19 GAS PRESSURE REGULATORS

A. Manufacturers (Refer to Section 20 10 00):

1. Fisher
2. Jordan
3. Rockwell

B. Spring loaded with internal relief valve. Cast iron body rated for 150 psi (non operational) with screened vent.

C. Size, capacity and pressure requirements in accordance with drawings

2.20 GAS SOLENOID VALVES

A. Manufacturers (Refer to Section 20 10 00):

1. Asco

B. C.S.A., AGA or UL certified to handle natural or LP gas as indicated.

C. Brass body, Buna N seals and discs

D. Type 1, general purpose solenoid enclosure

E. Normally closed operation, 120 volt, AC coils

2.21 GAS QUICK DISCONNECT COUPLINGS

A. AGA certified for natural and LP gas
B. **Socket**
   1. Female configuration with internal valve. Valve to be closed upon removal of plug and open with insertion of plug.
   2. Locking sleeve to release/hold plug
   3. Automatic high temperature safety shutoff

C. **Plug**
   1. Male configuration to mate with socket

D. **O-Ring seals**

E. **Brass construction**

2.22 **ACCESS DOORS**

A. Materials shall be in accordance with Section 08 31 13.

**END OF SECTION 22 05 03**
PART 2 - PRODUCTS

2.1 AREA DRAINS
A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade
B. Assembly: ANSI A112.21.2; lacquered cast iron body with sump; strainer; membrane flange and membrane clamp with integral gravel stop; adjustable under deck clamp; roof sump receiver; accessories: refer to schedule on drawings.

2.2 BACKFLOW PREVENTERS
A. Manufacturers (Refer to Section 20 10 00):
   1. Watts
   2. Febco
   3. Wilkins
B. Reduced Pressure Backflow Preventers: ANSI/ASSE 1013; AWWA C506; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
C. Double Check Valve Assemblies: ANSI/ASSE 1012; AWWA C506; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
D. See schedule on drawings for additional types of Backflow prevention devices.

2.3 BACK WATER VALVES
A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade
B. ANSI A112.21.2; lacquered cast iron body and cover; brass valve; 6 inch extension sleeve; access cover.

2.4 CLEANOUTS
A. Manufacturers (Refer to Section 20 10 00):
1. J.R. Smith
2. Zurn
3. Wade

B. General: Cleanouts shall be heavy iron bodies with taper thread-bronze plugs. ASME A112.21.1m. They shall be full size of the pipe to 4 inches and not less than 4 inches for larger pipe. Cleanout extensions shall have flush frames and brass removable cover plates. Extensions to floor shall be made by using 1/8 bends.

C. Floor Cleanouts: Coated cast iron body; scoriated heavy duty nickel bronze top; fully adjustable and secured to body; gasket sealed iron closure plug; Cleanouts in tiled terrazzo or similar paved floors: J.R. Smith #4180; Cleanouts installed in ceramic tile floors: J.R. Smith #4040; Cleanouts installed in floors with asphalt, vinyl or linoleum: J.R. Smith #4140.

1. Cleanouts in other finished areas shall have round tops.
2. Cleanouts installed above grade shall have flange and flashing clamp.
3. Cleanouts in carpeted areas shall be furnished with carpet marker: J.R. Smith #4160.
4. Cleanouts in unfinished areas shall have heavy duty cast iron covers.
5. All cleanouts shall have vandal-proof screws.

D. Wall Cleanouts: Coated cast iron cleanout tee; gasket sealed iron plug; shallow type; round, stainless steel wall cover with center vandal-proof screw.

E. Exposed Cleanouts: Lead seal plug with gasketed iron plug or tapped cast iron fitting with gasketed iron plug.

F. Exterior Cleanouts: Cleanouts in sewers outside building proper shall be of 4 inch cast iron pipe brought up to finish grade with cast iron cap recessed 1/4 inch in 18×18×6 inch concrete block. Block shall have beveled edge and shall be set flush with top of finish grade. Cleanout shall be equal to J.R. Smith #4255.

G. All cleanouts shall be vandal proof.

2.5 DOWNSPOUT NOZZLES

A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade

B. Bronze round with straight offset bottom section

2.6 FLOOR DRAINS

A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade

B. ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange; weep holes; reversible clamping collar; refer to schedule on drawings for accessories.

C. All floor drains shall be vandal proof.
2.7 FLOOR SINKS
A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade
B. Square lacquered cast iron body with integral seepage pan; vitrified glass coated interior; aluminum dome strainer; clamp collar; nickel bronze frame and full half grate.
C. Floor sinks shall be vandal proof.

2.8 FROST PROOF WALL HYDRANTS
A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade
B. ANSI/ASSE 1019; non-freeze; self-draining type with chrome plated polished bronze wall plate lockable recessed box; hose thread spout; T-handles removable key; and integral vacuum breaker

2.9 INTERIOR HOSE BIBBS
A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith
   2. Zurn
   3. Wade
   4. Woodford
B. All brass construction with lock-shield, loose key, or wheel handle (see schedule on drawings) and stuffing box and replaceable disc. Hose bibbs shall have ¾ inch inlet and ¾ inch hose connection and shall be fitted with a non-removable vacuum breaker in conformance with ANSI/ASSE 1011.
C. Hose bibbs in finished areas shall be smooth, chrome plated with finish flanges.
D. Hose bibbs in unfinished areas shall be rough brass finished.

2.10 MIXING VALVES
A. Manufacturers (Refer to Section 20 10 00):
   1. Symmons
   2. Leonard
B. Valve Assembly: All bronze and stainless steel components; Thermostatic action with bellows mounted out-of-water; Removable cartridge with strainers; Integral check stops; outlet valve and dial thermometer; All material rough chrome finish; Assembly to be furnished with wall bracket for exposed installation; See schedule on drawings.
2.11 RECESSED WASHING MACHINE VALVE BOX

A. Manufacturers (Refer to Section 20 10 00):

1. Guy Gray

B. Plastic preformed rough-in box with brass long shank valves with wheel handles; socket for 2 inch waste; slip in finishing cover.

2.12 ROOF AND OVERFLOW, PARAPET AND CANOPY/CORNICE DRAINS

A. Manufacturers (Refer to Section 20 10 00):

1. J.R. Smith
2. Zurn
3. Wade

B. Roof and Overflow Drains: ANSI A112.21.2; lacquered cast iron body with sump; metal dome strainer; membrane flange and membrane clamp with integral gravel stop; adjustable under deck clamp; roof sump receiver; coordinate with roofing type; refer to schedule on drawings. Overflow drains shall have 2 inch high dam.

C. Parapet Drains: Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated nickel bronze sloping flush grate.

D. Canopy/Cornice Drains: Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated nickel bronze flat strainer.

2.13 TRAP PRIMERS

A. Manufacturers (Refer to Section 20 10 00):

1. J.R. Smith Fig. 2699/Sloan F-72-A1
2. Zurn
3. Wade

B. Mechanical Type Primer: Cast bronze construction with integral vacuum breaker or air break.

C. Flush valve adapter trap primer assembly: chrome plated tubing; compression fittings and escutcheons.

D. Modified lavatory trap assembly: Designed complete with chrome plated tubing, compression fittings and escutcheons.

E. Automatic metering type: Designed to operate on pressure drop in piping serving fixture. Device shall be completely serviceable and installed in accessible location.

2.14 TRAP PRIMERS (ELECTRONIC)

A. Manufacturers (Refer to Section 20 10 00):

1. PPP or approved equal
B. Electronic metering type: Designed to operate off of a timed device and solenoid valve. Device shall be completely serviceable and installed in accessible location.

C. ETP-1 pre-assembled and prepiped with ¾" bronze female NPT, WOG rated inlet ball valve; ¾" brass electronic solenoid valve and type “L” copper manifold with ½” brass compression fittings.
   1. Provide unit with 1” air gap and electronic controller fully assembled in a NEMA#1 metal enclosure with cover for surface or recess mounting.
   2. Provide with floor drain distribution units (outlet openings) with ½” compression fittings.
   3. Electronic trap primer shall deliver a minimum 2 oz. water at 20 PSI per drain served; install trap priming valve a minimum 12” above the floor for every 20 feet of run to p-trap.
   4. Provide with optional distribution unit as required to supply up to (4) four p-traps.

D. ETP-2 pre-assembled and prepiped with ¾” bronze female NPT, WOG rated inlet ball valve; ¾” brass electronic solenoid valve and type “L” copper manifold with ½” brass compression fittings.
   1. Provide unit with vacuum breaker, electronic controller fully assembled in a NEMA#1 metal enclosure with cover for surface or recess mounting.
   2. Provide with calibrated manifold (up to 30 outlet openings) with ½” compression fittings.
   3. Electronic trap primer shall deliver a minimum 2 oz. water at 20 PSI per drain served; install trap priming valve a minimum 12” above the floor for every 20 feet of run to p-trap.
   4. Provide water supply to unit from reduced pressure type backflow preventer, provided separately from trap primer.

2.15 WATER HAMMER ARRESTORS

A. Manufacturers (Refer to Section 20 10 00):
   1. J.R. Smith Series 5000
   2. Zurn

B. ANSI A112.26.1; stainless steel construction; bellows type sized in accordance with PDI WH-201; precharged suitable for operation in temperature range 34 to 250 °F and maximum 150 psi working pressure. Units shall bear PDI seal of approval.

END OF SECTION 22 05 04
PART 2 - PRODUCTS

2.1 MANUFACTURERS (REFER TO SECTION 20 10 00):

A. Allis Chalmers
B. Century
C. Baldour
D. Marathon
E. General Electric
F. Westinghouse

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors less than 250 Watts, for intermittent service: Equipment manufacturer’s standard and need not conform to these specifications.

B. Motors which are to be controlled from a variable frequency drive shall be designed and constructed for full compatibility with the drive.

C. Electrical Service:
   1. Unless indicated otherwise on equipment schedules, motors shall be supplied as with the following electrical characteristics:
      a. Motors ½ horsepower and smaller: 115 single phase, 60 Hz
      b. Motors larger than ½ horsepower shall be three phase and shall be rated as specified and scheduled

D. Design for continuous operation in 104 °F environment.

E. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

F. Explosion-Proof Motors: UL approved for hazard classification. Provide when scheduled on the drawings.

G. Visible Nameplate: Indicating manufacturer’s name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

H. Nominal Efficiency: All motors shall be NEMA “premium efficiency” type. Exception: Motors for smoke control exhaust fans. Motors shall also meet or exceed required efficiency of the State energy code.

I. Two-Speed Motors:
1. Furnish when scheduled on drawings
2. Two winding (1800/1200 rpm) or (1800/900 rpm) as scheduled

J. Invertor Duty Motors (For Use with Variable Frequency Drives):
   1. Provide where scheduled on the drawings
   2. Motors shall meet NEMA MG-1 Part 31 requirements. Nameplates shall state motors are “inversion duty”. Motors shall be suitable for variable torque and have a 10:1 speed ratio.
   3. Critical vibration frequencies are not within operating range of controller output.
   4. Temperature rise: Match rating for class B insulation.
   5. Insulation: Class H.

K. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS
   A. Starting Torque: Exceeding one fourth of full load torque
   B. Starting Current: Up to six times full load current
   C. Multiple Speed: Through tapped windings
   D. Open Drip-proof and Enclosed Air Over Enclosure: Class F insulation, rated for 311 °F maximum temperature, NEMA Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS
   A. Starting Torque: Three times full load torque
   B. Starting Current: Less than five times full load current
   C. Pull-up Torque: Up to 350 % of full load torque
   D. Breakdown Torque: Approximately 250 % of full load torque
   E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
   F. Drip-proof and Enclosed Motor Enclosures: Class F insulation, rated for 311 °F maximum temperature, NEMA Service Factor, prelubricated sleeve or ball bearings.

2.5 THREE PHASE POWER - SQUIRREL-CAGE MOTORS
   A. Starting Torque: Between 1 and 1½ times full load torque
   B. Starting Current: Six times full load current
C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors

E. Insulation System: NEMA Class F or better

F. NEMA Service Factor

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.

I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

J. Sound Power Levels: To NEMA MG 1

K. Part Winding Start Where Indicated: Use of winding to reduce locked rotor starting current to approximately 60 % of full winding locked rotor current while providing approximately 50 % of full winding locked rotor torque.

L. Weatherproof Epoxy (where indicated) Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.6 ENCLOSED MOTOR CONTROLLERS (MOTOR STARTERS)

A. Enclosed Motor Controllers (starters) and switches are not under Mechanical unless specifically specified with a particular mechanical equipment item.

1. Exception: Variable frequency drives furnished under Section 23 09 23.

END OF SECTION 22 05 13
PART 2 - PRODUCTS

2.1 PRESSURE GAUGES (WATER SERVICE)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Trerice
      2. Weiss
      3. Weksler
      4. Tel Tru
   B. Basis of Design: Trerice Series 600C
   C. Construction: ASME B40.1; 4½ inch dial; hermetically sealed; field liquid fillable; cast aluminum case; brass tube and socket; brass movement; painted aluminum dial with black graduations on white background; suitable for outdoor use; psi scale as appropriate for intended use; full scale accuracy of plus or minus 1%.

2.2 PRESSURE GAUGES (STEAM SERVICE)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Trerice
      2. Weksler
      3. Weiss
      4. Tel Tru
   B. Basis of Design: Trerice Series 450 LFSS
   C. Construction: ASME B40.1; 4½ inch dial; hermetically sealed; field liquid fillable; fiberglass reinforced polypropylene case; solid front and blowout back type 316 stainless steel bourdon tube; painted aluminum dial with black graduations on white background; suitable for outdoor use; psi scale as appropriate for intended use; full scale accuracy of plus or minus 1%.

2.3 PRESSURE GAUGE TAPPINGS
   A. ¼ inch NPT brass ball valve rated for 250 psig; brass pressure snubber with ¼ inch NPT connections.
   B. For steam systems, provide ¼ inch cast iron syphon, NPT angle or straight pattern.

2.4 STEM TYPE THERMOMETERS AND SUPPORTS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Duro
      2. Trerice
      3. Weiss
4. Weksler
5. Tel Tru

B. Basis of Design: Trerice Series A401

C. Construction: Adjustable angle; red appearing mercury; lens front tube; clear acrylic window up to 300 °F and double strength above 300 °F; ¾ inch long NPT brass stem with 2½ inch insertion length; cast aluminum case with enamel or epoxy finish; cast aluminum adjustable joint with positive locking device; scale to suit application; well to suit service; full scale accuracy within 2 %; Fahrenheit scale as appropriate for intended use.

D. Supports: Brass separable sockets for thermometer stems with or without extensions as required.

2.5 TEST PLUGS AND KITS

A. Test Plug:

1. Manufacturers (Refer to Section 20 10 00):
   a. Flow Design
   b. MG Piping Products
   c. Pete’s Plugs
   d. Sisco
   e. Trerice

2. Construction: ¼ inch NPT or ½ inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 °F; nordel core for temperatures up to 350 °F; viton core for temperatures up to 400 °F; brass extension for insulated pipe.

B. Test Kit:

1. Manufacturers: Same as noted above for Test Plugs.
2. Internally padded and fitted carrying case; two (2) 3½ inch diameter pressure gauges - scale range: 0 to 100 psi; two (2) gauge adapters with 1/8 inch type 316 stainless steel probes; two (2) 1 inch dial thermometers with 5 inch stem and external calibration - scale range: 25 to 125 °F; two (2) 1 inch dial thermometers with 5 inch stem and external calibration - scale range: 0 to 220 °F.

END OF SECTION 22 05 15
PART 2 - PRODUCTS

2.1 EXTERNALLY PRESSURIZED GUIDED EXPANSION JOINT

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex

B. Basis of Design: Hyspan Series 3500.

C. Construction: Inner pipe and outer wall shroud housing - ASTM A53 standard wall pipe; laminated bellows - ASTM A240, T304, or T321 welded to pipe; tapped steel flanges; flange and rings - ASTM A36 - guide ring maintains alignment of inner pipe and housing and prevents contact of the bellows and pipe; 150 psig design pressure; 225 psig test pressure; 850 °F maximum working temperature.

D. Provide with drain port located at bottom of housing for steam applications.

2.2 PIPE ALIGNMENT GUIDES

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex

B. Basis of Design: Hyspan Series 9500.

C. Construction: Heavy gauge pressed steel construction - fusion welded; all surfaces coated with protective enamel paint.

2.3 PIPE ANCHORS

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex

B. Basis of Design: Metraflex Structural Cradle for I-Beam Beam Anchors for high thrust loads.

   1. Construction: Painted steel; designed for bolting or welding to pipe as applicable.

C. Basis of Design: Model PA anchor clamps for no thrust expansion joints for use on uninsulated piping systems.
D. Basis of Design: Model PAPI anchor clamps for high thrust loads for use on insulated piping systems.

2.4 PIPE EXPANSION LOOPS

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex Metraloop (Basis of Design)

B. Construction: Pipe materials of construction and fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Rigid pipe and connections shall meet the requirements of the piping system in which the expansion loop is being installed; stainless steel inner hose and double-braided outer sleeve flexible pipe for steel piping systems; bronze inner hose and braided bronze outer sleeve flexible pipe for copper piping systems; 150 psig design pressure; 225 psig test pressure; 850 °F maximum working temperature.

C. Flexible loops shall impart no thrust loads to system support anchors or structure.

D. Configuration: Two flexible pipe sections connected with a 180° bend at one end and provided with a 90° elbow at the other end of each of the flexible pipe sections. Exceptions:
   1. Configuration shall be different when required by the specific installation (i.e. when installed at a 90° bend in the piping system, which would require 135° bends in lieu of 90° bends).
   2. Nested configurations may be utilized in parallel pipe runs to keep all expansion/seismic devices in one location. Nested configurations require (2) 90° bends with straight pipe in a loop fashion in lieu of the 180° bend.

E. Provide with drain/air release plug on 180° bend.

F. Factory supplied center support nut.

G. Certifications:
   1. Gas pipe shall be CSA/AGA certified.
   2. For potable water systems, connectors and construction shall be UL classified in accordance with ANSI/NSF 61-1977 standards.
   3. For Medical Gas applications, loops shall be cleaned, capped and certified for use in medical oxygen, vacuum, and compressed air systems. For sealed systems (such as oxygen service), the loops shall be supplied with drain/air release plugs. Loops for medical gas systems shall be accepted by the California Office of Statewide Health Planning and Development (OSHPD) for use in hospitals.

H. Install in accordance with the manufacturers written instructions.

I. Loops used for thermal expansion shall be installed with pipe guides located within 15 pipe diameters of each side of the loop. Loops anchored on one side require only one guide on the traveling side. When spanning a building seismic expansion joint, guides are not required.

J. Install in a neutral, pre-compressed or pre-extended condition as required for the application.

K. Provide pipe alignment guides on both sides of expansion loop, in locations as recommended by expansion loop manufacturer.
END OF SECTION 22 05 16
SECTION 22 05 29
SUPPORTS, ANCHORS, CURBS, SEALS, AND FLASHINGS

PART 2 - PRODUCTS

2.1 FLASHING

A. Flexible Flashing: 47 mil galvanized steel shell and base, rigid insulation, mitered 3 inch cant, wood nailer, with variable step to match roof insulation and gravel

B. Metal Flashing: 26 gauge galvanized steel

C. Metal Counterflashing: 22 gauge thick galvanized steel

D. Lead Flashing: Waterproofing - 5 pounds/foot² sheet lead; soundproofing - 1 pounds/foot² sheet lead; flexible flashing - 47 mil thick sheet butyl; compatible with roofing

E. Caps: Steel; 22 gauge minimum; 16 gauge at fire resistant elements

2.2 INSERTS

A. Construction: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment; top slot for reinforcing rods; lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 MECHANICAL RUBBER PIPE SEALS

A. Manufacturers (Refer to Section 20 10 00):
   1. Thunderline Corporation
   2. Advance Products and Systems

B. Basis of Design: “LINK-SEAL” as manufactured by Thunderline Corporation

C. General: Modular; mechanical type; consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between pipe and wall sleeve.

D. Working Approach: Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Bolts and nuts shall be of stainless steel construction. Tightening of bolts shall cause the rubber sealing elements to expand forming a watertight joint between the pipe and wall opening.

E. Wall Sleeves: Century-Line high impact thermoplastic as manufactured by Thunderline Corp. or equal as provided by approved manufacturers. Sleeve shall have a water stop and anchor plate at least 4 inches larger than the main outside diameter.

F. Capacities: Factory tested and designed to withstand 50 feet of water pressure with no water penetration.
2.4 **PIPE HANGERS AND SUPPORTS**

**A. Manufacturers** (Refer to Section 20 10 00):

1. Grinnell/Anvil
2. ERICO/Michigan Hanger
3. Crane
4. Fee and Mason

**B. Fire Protection Piping**

1. Conform to NFPA 13 NFPA 14
2. Hangers for Pipe Sizes $\frac{1}{2}$ to $1\frac{1}{2}$ inches: Carbon steel, adjustable swivel, split ring
3. Hangers for Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods
5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook
6. Wall Support for Pipe Sizes 4 inches and over: Welded steel bracket and wrought steel clamp
7. Vertical Support: Steel riser clamp Angle ring
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support
9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated
10. Hangers shall be UL listed

**C. Plumbing Piping – DWV**

1. Conform to MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes $\frac{1}{2}$ to $1\frac{1}{2}$ inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

**D. Plumbing Piping – Water**

1. Conform to MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes $\frac{1}{2}$ to $1\frac{1}{2}$: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

7. Multiple or Trapeze Hangers for Hot pipe Sizes 6 inches and over: Steel channels with welded spacers and hanger rods, cast iron roll.

8. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.


10. Wall Support for Hot Pipe Sizes 6 inches and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.


12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

E. Refrigerant Piping

1. Conform to MSS SP58, MSS SP69, and MSS SP89.

2. Hangers for Pipe Sizes ½ to 1½ inches: Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipes Sizes 2 inches and over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.


8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.


F. Natural Gas, Compressed Air Piping

1. Conform to MSS SP58, MSS SP69, and MSS SP89.

2. Hangers for Pipe Sizes ½ to 8 inches: Carbon steel, plated adjustable swivel, ring.

3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.


5. Roof Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

G. Pipe Riser Clamps
1. Steel and Cast Iron Pipe: Extension pipe or riser clamp; carbon steel; black or galvanized finish.
   a. Basis of design: Grinnell Fig 261.

2. Copper Pipe: Copper tubing riser clamp; carbon steel; copper finish.
   a. Basis of design: Grinnell Fig CT-121.

2.5 HANGER RODS
   A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.6 PIPE INSULATION SHIELDS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Grinnell
      2. Fee & Mason
      3. M-Co
      4. Pipe Shields, Inc
      5. Kin-Line
   B. Hot Piping (insulated pipe, 2 ½” and larger): Protection saddle type; size to suit thickness of insulation; curved carbon steel plate; Grinnell Fig 160, 161, 162.
   C. Hot Piping (up to 2”): Insulation protection shield type; carbon steel; galvanized finish; Grinnell Fig 167.
   D. Cold Piping: Insulation protection shield type; carbon steel; galvanized finish; Grinnell Fig 167.

2.7 RESILIENT CLAMPS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Hydra-Zorb
   B. Construction: Resilient cushion with clamps and anchoring channel.

2.8 SLEEVES
   A. Sleeves for Pipes through Non-fire Rated Floors: 18 gauge thick galvanized steel.
   B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.
   C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07270.
   D. Sleeves for below grade piping passing under footings: Class 52; ductile iron.
   E. Sleeves for below grade piping passing through exterior walls - Mechanical Rubber Pipe Seals.
   F. Stuffing Insulation: Glass fiber type; non-combustible; 3 lb. density.
G. Fire Safeing Sealant: Intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250 °F. It shall have ICBO, BOCA I approved ratings to 3 hours per ASTM E814 (UL 1479). 3M Fire Barrier Caulk, Putty, strip and sheet forms.

2.9 ROOF PIPE SUPPORTS

A. General: Provide roof pipe supports for all gas piping, refrigerant piping, non-potable make-up water piping and cooling coil condensate drain piping as indicated on the Plumbing Drawings and as required.

B. Product Description: Roof pipe supports shall be compression molded rubber composite of 100% recycled rubber and polyurethane prepolymer. Physical properties of the rubber composite shall be as follows:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Density</td>
<td>0.6 oz./cu. in.</td>
<td>(ASTM C 642)</td>
</tr>
<tr>
<td>2. Durometer Hardness</td>
<td>65A ± 7.</td>
<td>(ASTM C 2240)</td>
</tr>
<tr>
<td>3. Tensile Strength (Main structural areas)</td>
<td>210 psi.</td>
<td>(ASTM C 412)</td>
</tr>
<tr>
<td>4. Compression Deformation</td>
<td>10% at 70 psi, 68° F</td>
<td>(ASTM C 395)</td>
</tr>
<tr>
<td>5. Brittleness at Low Temperature</td>
<td>-40°F</td>
<td>(ASTM C 746)</td>
</tr>
<tr>
<td>6. Freeze and thaw when exposed to deicing chemicals: No loss after 50 cycles.</td>
<td>(ASTM C 672)</td>
<td></td>
</tr>
<tr>
<td>7. Coefficient of thermal expansion:</td>
<td>At least 8 x 10-6 in/in.°F</td>
<td>(ASMT C 531)</td>
</tr>
<tr>
<td>8. Weathering 70 hours at 12.°F.</td>
<td></td>
<td>(ASTM C 573)</td>
</tr>
<tr>
<td>a. Hardness Retained:</td>
<td>100% (±5%)</td>
<td></td>
</tr>
<tr>
<td>b. Compressive Strength</td>
<td>100% (±5%)</td>
<td></td>
</tr>
<tr>
<td>c. Tensile Strength</td>
<td>100% (±5%)</td>
<td></td>
</tr>
<tr>
<td>d. Elongation Retained:</td>
<td>100% (±5%)</td>
<td></td>
</tr>
<tr>
<td>9. Finish. Black with reflective yellow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Manufacturer:

1. Copper B-Line, Rubber C-Port as manufactured by Clearline Technologies or an approved equal.

END OF SECTION 22 05 29
PART 2 - PRODUCTS

2.1 GENERAL ISOLATORS

A. Manufacturers (Refer to Section 20 10 00):

1. Amber Booth
2. Kinetics
3. Korfund
4. Mason Industries
5. Isolators provided by the manufacturer of isolated equipment as an accessory to that equipment are acceptable when indicated in these specifications or on the drawings to be provided with isolation equipment as an accessory to the equipment.

B. Neoprene Waffle Pads: Minimum ¾ inch thick; maximum loading 40 psi.

1. Basis of Design: Mason “Super W”

C. Inertia Bases: Concrete filled base sized to support equipment without overhanging structural steel members that form perimeter framing. Concrete shall be in accordance with Section 03 30 00. Cutout in center may be provided with structural member interior section to adjust base weight if necessary. Total mass of base shall not be less than two times the total weight of all equipment mounted on base unless otherwise indicated. Submit calculations for base deflection. Deflection shall be in accordance with 1995 ASHRAE Handbook, Vibration Isolation. Furnish with preset embedded anchor bolts and pipe sleeves for fan and motor slide rail or other equipment attachment. Size base to support suction elbow of end suction pumps and suction and discharge elbow of horizontal split case pumps, unless flexible neoprene elbows are used. Use T-shape where necessary to conserve weight and size.

1. Basis of Design: Mason Industries, type BMKK Base

D. Inertia Bases: Concrete filled base sized to support equipment without overhanging structural steel members that form perimeter framing. Concrete shall be in accordance with Section 03 30 00. Cutout in center may be provided with structural member interior section to adjust base weight if necessary. Total mass of base shall not be less than two times the total weight of all equipment mounted on base unless otherwise indicated. Submit calculations for base deflection. Deflection shall be in accordance with 1995 ASHRAE Handbook, Vibration Isolation. Furnish with preset embedded anchor bolts and pipe sleeves for fan and motor slide rail or other equipment attachment. Size base to support suction elbow of end suction pumps and suction and discharge elbow of horizontal split case pumps, unless flexible neoprene elbows are used. Use T-shape where necessary to conserve weight and size.

1. Basis of Design: Mason Industries, type BMK/K Base

2.2 FLEXIBLE PIPE CONNECTORS

A. Flexible Pipe Connectors - Neoprene
1. Flexible neoprene connector manufactured of multiple plies of kevlar fabric and neoprene both molded and cured in hydraulic rubber presses.
2. Connector to have no steel wire, metal braiding, or rings as pressure reinforcement.
3. Straight connector to have twin-sphere cross-section.
4. Elbow connector to have single sphere cross-section forming the corner of the joint.
5. Connector with diameter less than 2½ inches may have threaded ends.
6. Connector 2½ inches diameter and larger to have floating steel flanges recessed to lock the connector’s raised face neoprene flanges.
7. Connector to be installed on the equipment side of the shut-off valves.
8. Connector to be rated at a minimum of 150 psi at 220 degrees F.
9. Straight connector to be installed with twin spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure.
10. Connector to be equipped with control cables with end fittings isolated from the anchoring plated by means of washers and bushings designed for a maximum of 1000 psi for sizes 8 inches and larger, operating at pressures above 100 psi.
11. Acceptable Products:
   a. Model SFDEJ or SFU by Mason
   b. Control Assemblies Model ACC by Mason

B. Flexible Pipe Connectors: Stainless Steel Hose

1. Braided flexible stainless steel hose.
2. Hose to be rated at a minimum of 250 psi at 250 degrees F.
3. Hose to be installed horizontally and parallel to equipment shaft.
4. Hose to have a minimum length of 18 inches.
5. Hose for 2 inch pipe size and smaller to be equipped with male nipple fittings.
6. Hose for 2½ inch pipe size and larger to be equipped with fixed steel flanges.
7. Hose to be selected for operating pressure with 4:1 minimum safety factor.
8. Acceptable Products:
   a. Model BSS by Mason
   b. Hyspan

END OF SECTION 22 05 48
PART 2 - PRODUCTS

2.1 NAMEPLATES
   A. Description: Laminated three-layer plastic with engraved white letters on black background

2.2 PIPE MARKERS
   A. Manufacturers: (Refer to Section 20 10 00):
      1. W.H. Brady
      2. Seton
      3. Marking Services, Inc.
   B. Color and Lettering: Conform to ASME A13.1
   C. Plastic Pipe Markers: Factory fabricated; flexible; semi-rigid plastic; preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
   D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
   E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape; minimum 6 inch wide by 4 mil thick; manufactured for direct burial service.

2.3 TAGS
   A. Description: Brass or Aluminum with stamped letters; tag size minimum 1½ inch diameter with smooth edges. Provide ¼” letters for piping system abbreviation and ½” sequenced numbers. Provide 1/8” hole for fastener.

2.4 TAG CHART
   A. Description: Typewritten letter size list in aluminum frame, plastic laminated. Chart shall include valve number, service and location.

END OF SECTION 22 05 53
SECTION 22 07 00
PLUMBING INSULATION

PART 2 - PRODUCTS

2.1 CELLULAR FOAM INSULATION (PIPING)

A. Manufacturers (Refer to Section 20 10 00):
   1. Armstrong, Armaflex-AP
   2. Halstead

B. Insulation: ASTM C534; flexible; cellular elastomeric; molded or sheet; k factor: ASTM C177, 0.27 Btu·in/(h·ft²·°F) at 75 °F; -70 °F minimum service temperature; 220 °F maximum service temperature; maximum moisture absorption: ASTM D1056, 5.0 percent (pipe) by weight; 6.0 percent (sheet) by volume; moisture vapor transmission: ASTM E96, 0.10 perm-inches.

C. Connection: Waterproof vapor barrier contact adhesive compatible with the insulation. Armstrong 520 adhesive or approved equal.

2.2 GLASS FIBER INSULATION (PIPING)

A. Manufacturers (Refer to Section 20 10 00):
   1. Schuller, Micro-Lok, AP-T Plus
   2. Knauf
   3. Owens Corning

B. Insulation: ASTM C547; rigid molded; noncombustible; k factor: ASTM C177, 0.24 Btu·in/(h·ft²·°F) at 75 °F; 850 °F maximum service temperature; 0.2 percent maximum moisture absorption by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn; bonded to aluminized film with pressure sensitive tape lap sealing system; moisture vapor transmission: ASTM E96; 0.02 perm-inches.

2.3 HYDROUS CALCIUM SILICATE INSULATION

A. Manufacturers (Refer to Section 20 10 00):
   1. Schuller, Thermo-12 Gold

B. Insulation: ASTM C533; rigid molded; asbestos free; gold color; k factor: ASTM C177 and C518 0.40 Btu·in/(h·ft²·°F) at 300 °F; 1200 °F maximum service temperature; 15 pounds/foot³ density.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Insulating Cement: Compatible with insulation

E. Finish: Re-wettable fabric glass cloth with adhesive. Claremont Diplag 95 or approved equal; 15 ounces/yard²; 0.04 inches thick.
2.4 JACKETS AND FITTING COVERS (PIPING)

A. PVC Plastic Jacket and Fitting Covers (Interior Applications):
   1. Manufacturers (Refer to Section 20 10 00):
      a. Zeston 2000
   2. Jackets and fitting covers: ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F; maximum service temperature: 450 °F; thickness: 20 mil.
   3. Jackets and fitting covers (vapor barrier jackets): ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F; maximum service temperature: 450 °F; moisture vapor transmission - ASTM E96 - 0.002 perm-inches; thickness: 20 mil.
   4. Connections: Pressure sensitive color matching vinyl tape

B. Aluminum Jacket (Exterior Applications): ASTM B209
   1. Manufacturers (Refer to Section 20 10 00):
      a. Childers
      b. Pabco
   2. Jacket: Thickness: 0.016 inch sheet; finish: smooth; joining: Longitudinal slip joints and 2 inch laps.
   3. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
   4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.5 INSERTS AND SHIELDS

A. Inserts: Heavy density insulation which will not crush from weight of pipe. Locate between shield and pipe. Inserts are furnished in this Section 22 07 00 and installed in Section 22 05 29.

B. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insulation. Shields are furnished and installed under Section 22 05 29.

2.6 GLASS FIBER INSULATION (EQUIPMENT)

A. Manufacturers (Refer to Section 20 10 00):
   1. Schuller - Pipe and Tank Insulation
   2. Owens Corning

B. Insulation: Semi-rigid, noncombustible; k factor: ASTM C335 0.27 Btu-in/(h·ft²·°F) at 75 °F; maximum service temperature: 650 °F; density: 3.0 pounds/foot³.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film with pressure sensitive tape lap sealing system; moisture vapor transmission: ASTM E96; 0.02 perm-inches.
2.7 LACE-ON BLANKETS (EQUIPMENT)

A. Manufacturers (Refer to Section 20 10 00):

1. Insulation
   a. Kaowool Cerablanket

2. Fabric
   a. JP Stevens Glass-Tex Fabric Style 9987
   b. Alpha Maritex Style 3200-SA

B. Materials: 0.008 inch thick type 304 stainless steel knitted wire mesh inner liner 8 pounds/foot³ density insulation, ½ inch thick; oil and water resistant exterior protective fabric.

C. Construction: Blankets shall be sewn together. Lacing anchors shall be 2½ inch stainless steel secured with 12 gauge stainless steel washers. Blankets shall have stainless steel wire installed for draw cords.

END OF SECTION 22 07 00
PART 2 - PRODUCTS

2.1 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers (Refer to Section 20 10 00):
   1. Amtrol
   2. Taco

B. Construction: Welded steel; tested and stamped in accordance with Section 8D of ASME Code; supplied with National Board Form U-1; rated for working pressure of 125 psig; with heavy duty butyl rubber diaphragm or bladder; and steel legs or saddles. Full acceptance type with inspection.

C. Accessories: Pressure gauge and air-charging fitting; tank drain; precharge to 12 psig unless indicated otherwise on the drawings.

D. Refer to schedule on drawings for model numbers, size, etc.

2.2 DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers (Refer to Section 20 10 00):
   1. A.O. Smith
   2. State
   3. Ruud
   4. Bradford White

B. Refer to schedule on drawings for model numbers, size, capacities, accessories.

C. Tank: Welded steel, ASME labeled for working pressure of 125 psig, steel support saddles, tappings for accessories, threaded connections of stainless steel, access manhole.

D. Lining: Corrosion-resistant concrete approximately 3/4 inch thick 0.015 inches epoxy 0.024 inches self-priming polymer epoxy, continued into flanged connections.

E. Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged; flanged collar for heat exchanger; manway fitting.

F. Accessories: Tank drain, water inlet and outlet, thermometer range of 40 °F to 200 °F, ASME pressure relief valve suitable for maximum working pressure.

G. Tank shall be factory insulated meeting ASHRAE 90.1.

2.3 IN-LINE CIRCULATOR PUMPS

A. Manufacturers (Refer to Section 20 10 00):
   1. B&G
2. Taco  
3. Paco  
4. Armstrong  

B. Construction: Bronze casing; 125 psig working pressure; replaceable impeller assembly; no mechanical seals.  

C. Refer to schedule on drawings for model numbers, size, capacities, accessories.  

D. Impeller: Bronze.  

E. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.  

F. Seal: Carbon rotating against a stationary ceramic seat.  

2.4 POINT OF USE ELECTRIC WATER HEATER:  

A. The point-of-use water heater shall be digitally controlled microprocessor electric tankless water heater with factory preset temperatures. The element assembly shall be Celcon plastic with stainless steel heating coils. Comply with UL499.  

1. Water heater shall be Chronomite Laboratories, Inc. no other manufacturer accepted.  

2.5 STEAM-FIRED STORAGE WATER HEATER  

A. Storage Tank  

1. Pre-Krete Copper lined with nonferrous shell fitting  
2. Horizontal or vertical as scheduled  
3. 150 psi working pressure  
4. ASME labeled  
5. Man-way cleanout  
6. Insulated to meet ASHRAE 90A, enclosed in baked enamel finish steel jacket  

B. Steam Heating Section  

1. Anticipation Control  
2. Pilot operated control valve  
3. Condensate line strainer  
4. Steam line strainer  
5. Main steam trap  
6. Auxiliary drip trap  

C. Tube Bundle  

1. Copper Cupro-nickel tubing  
2. Nonferrous tube sheet and baffles  
3. Cast iron steam chamber  

D. Servicing/Access  

1. Heater capable of being disassembled and heat exchanger removed without breaking water connections.  
2. Shall have easy access to individual tubes without moving heater from installed position.
E. Circulating Pump
   1. All bronze in-line or base mounted sized by manufacturer to match heater capacity.

F. Accessories
   1. Tank and heater ASME temperature and pressure relief valves
   2. Thermometer and pressure gauge
   3. Drain valves and isolation valves

G. Assembly shall be pre-wired to control panel for single point electrical connection

H. Accepted Manufacturers
   1. Patterson-Kelley series 500
   2. PVI
   3. Weben-Jarco

END OF SECTION 22 30 00
SECTION 22 31 00
EQUIPMENT INSTALLED ONLY

PART 2 - PRODUCTS

2.1 MATERIALS

A. Furnish material and incidentals required to connect equipment to the plumbing system.
   1. Supply and waste piping
   2. Stops
   3. Traps and escutcheons
   4. Adapters and fittings
   5. Continuous waste piping
   6. Pressure regulating valves as indicated on drawings

B. Exposed piping and fittings shall be chrome plated or stainless steel.

C. Unless otherwise noted, faucets, strainers, tailpieces and specialty items will be furnished with equipment.

END OF SECTION 22 31 00
PART 2 - PRODUCTS

2.1 COUNTER-MOUNTED LAVATORIES (VITREOUS CHINA)

A. Lavatory

1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard
   b. Kohler
   c. Crane
   d. Eljer

2. ANSI A112.19.2; vitreous china self-rimming counter top lavator; drillings on 4 inch or 8 inch centers as scheduled on drawings; front overflow; soap depression; seal of putty, caulkling, or concealed vinyl gasket

B. Faucet

1. Manufacturers (Refer to Section 20 10 00):
   a. Chicago
   b. moen

2. Chrome plated brass body with manually adjustable hot/cold single lever actuation; adjustable limit stop; replaceable ceramic disc cartridge type; 1/2 gpm flow restriction with aerator; vandal resistant.

C. Supplies

1. Manufacturers (Refer to Section 20 10 00):
   a. Brass Craft
   b. Dearborn Brass
   c. Chicago

2. Chrome plated combination supply fitting with open grid strainer; chrome plated P-trap and are with extension.

2.2 ELECTRIC WATER COOLERS

A. Manufacturers (Refer to Section 20 10 00):

1. Elkay
2. Haws
3. Oasis

B. ARI 1010; electric water cooler with stainless steel top; surface, semi-recessed, recessed, or handicapped mounted as indicated in the drawings on the schedules; vinyl on steel or stainless steel body as indicated in the drawings on the schedules; elevated anti-squirt bubbler with stream guard; automatic stream regulator; push button; mounting bracket; refrigerated with integral air cooled condenser and stainless steel grille.
2.3 FLOOR-MOUNTED FLUSH VALVE WATER CLOSETS

A. Water Closet
   1. Manufacturers (Refer to Section 20 10 00):
      a. American Standard
      b. Crane
      c. Eljer
   2. ANSI A112.19.2; floor-mounted; siphon jet; vitreous china closet bowl; elongated rim; 1½ inch top spud; china bolt caps

B. Flush Valve
   1. Manufacturers (Refer to Section 20 10 00):
      a. Sloan ‘Royal'
   2. ANSI A112.18.1; exposed chrome plated; diaphragm type with oscillating handle; escutcheon; seat bumper; integral screwdriver stop and vacuum breaker; 1.6/1.1 gallon dual flush volume; dual filter bypass

***OR***

C. Sensor-Operated Flush Valve
   1. Manufacturers (Refer to Section 20 10 00):
      a. Sloan
      b. Zurn
   2. ANSI A112.18.1; concealed rough brass or exposed chrome plated as indicated on the drawings in the schedules; diaphragm type with low voltage or battery operated solenoid operator as indicated on the drawings in the schedules; infrared sensor and over-ride button in chrome plated plate; wheel handle stop and vacuum breaker; maximum 1.6/1.1 gallon dual flush volume

D. Seat
   1. Manufacturers (Refer to Section 20 10 00):
      a. Bemis
      b. Church
      c. Beneke
      d. Olsonite
   2. Solid white plastic; open front; extended back; brass bolts; without cover, check hinge.

2.4 FLOOR-MOUNTED SERVICE SINKS

A. Sink
   1. Manufacturers (Refer to Section 20 10 00):
      a. Stern Williams
      b. Fiat
      c. Florestone
   2. Molded stone; floor mounted; with minimum 1 inch wide shoulders; stainless steel guard; stainless steel strainer.
B. Trim
1. Manufacturers (Refer to Section 20 10 00):
   a. Stern Williams
2. Exposed wall type supply; spout wall brace; vacuum breaker; hose end spout; strainer; eccentric adjustable inlets; integral screwdriver stops with covering caps and adjustable threaded wall flanges; 5 feet of ½ inch diameter plain end reinforced rubber hose; hose clamp; mop hanger.

2.5 FLOOR-MOUNTED TANK TYPE WATER CLOSETS
A. Water Closet
1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard
   b. Crane
   c. Eljer
2. ANSI A112.19.2; floor-mounted; vitreous china; reverse trap; whirlpool action; close-coupled closet combination with rim; insulated vitreous china closet tank with fittings and lever flushing valve; bolt caps; vandalproof cover locking device
B. Seat
1. Manufacturers (Refer to Section 20 10 00):
   a. Bemis
   b. Church
   c. Beneke
   d. Olsonite
2. Solid white plastic; open front; cover; brass bolts.
C. Supplies
1. Manufacturers (Refer to Section 20 10 00):
   a. Brasscraft
   b. Dearborn

2.6 SHOWERS
A. Shower
1. Manufacturers (Refer to Section 20 10 00):
   a. Aquatic
   b. Lasco
   c. Kohler
2. ANSI A117.1; ANSI-Z124.2; cross-linked cast acrylic; reinforced with fiberglass molded shower module; built-in soap shelves; center drain
B. Shower Valve
1. Manufacturers (Refer to Section 20 10 00):
   a. Moen
b. Symmons  
c. Leonard  
d. Grohe  

2. ANSI A112.18.1; concealed shower supply with pressure balanced mixing valves, integral service stops, bent shower arm with flow control and adjustable spray ball joint shower head with maximum 1.5 gpm flow, and escutcheon. Provide ADA mounting as required

***OR***

3. ANSI A112.18.1; chrome plated vandal-proof institutional head with integral wall bracket; built-in 1.5 gpm flow control

2.7 STAINLESS STEEL SINKS

A. Sink  
1. Manufacturers (Refer to Section 20 10 00):  
a. Elkay  
b. Just  
2. ANSI A112.19.3; 18 gauge Type 302 stainless steel; self-rimming and undercoated; ledge back drilled for trim

B. Faucet  
1. Manufacturers (Refer to Section 20 10 00):  
a. Chicago  
b. Moen  
2. Chrome plated cast brass body and tubular brass swing spout with manually adjustable hot/cold lever(s); replaceable ceramic disc type; 2.5 gpm flow restriction with swivel aerator. Single or dual lever handle, with or without retractable sprayer/hose assembly as scheduled on drawings.

C. Supplies  
1. Manufacturers (Refer to Section 20 10 00):  
a. Brass Craft  
b. Dearborn Brass  
c. Chicago  
2. Chrome plated P-trap with clean-out plug and arm with escutcheon.

2.8 TUBS

A. Tub  
1. Manufacturers (Refer to Section 20 10 00):  
a. Aquatic  
b. American Standard  
c. Eljer  
d. Crane
2. ANSI A112.19.4; recessed porcelain bonded steel bath with integral overflow; lift and turn stopper assembly end drain outlet; integral apron and tiling flange for above floor rough-in installation

B. Faucet

1. Manufacturers (Refer to Section 20 10 00):
   a. Moen
   b. Chicago

2. Combination thermostatic/pressure balancing, mixing valve; solid brass and chrome plated fill and mixing valve; hot water limit stop; vandal-proof complete.

2.9 WALL-MOUNTED FLUSH VALVE WATER CLOSETS

A. Water Closet

1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard
   b. Crane
   c. Eljer

2. ANSI A112.19.2; wall hung; siphon jet; vitreous china closet bowl; elongated rim; 1½ inch top spud; china bolt caps

B. Flush Valve

1. Manufacturers (Refer to Section 20 10 00):
   a. Sloan ‘Royal’

2. ANSI A112.18.1; exposed chrome plated; diaphragm type with oscillating handle; escutcheon; seat bumper; integral screwdriver stop and vacuum breaker; 1.6/1.1 gallon dual flush volume; dual filter bypass

***OR***

C. Sensor-Operated Flush Valve

1. Manufacturers (Refer to Section 20 10 00):
   a. Sloan
   b. Zurn

2. ANSI A112.18.1; concealed rough brass or exposed chrome plated as indicated on the drawings in the schedules; diaphragm type with low voltage or battery operated solenoid operator as indicated on the drawings in the schedules; infrared sensor and over-ride button in chrome plated plate; wheel handle stop and vacuum breaker; maximum 1.6/1.1 gallon dual flush volume

D. Seat

1. Manufacturers (Refer to Section 20 10 00):
   a. Church
   b. Beneke
   c. Olsonite

2. Solid white plastic; open front; extended back; brass bolts; without cover, check hinge.
E. Wall-Mounted Carrier

1. Manufacturers (Refer to Section 20 10 00):
   a. J.R. Smith
   b. Zurn

2. ANSI A112.6.1; adjustable cast iron frame; integral drain hub and vent; adjustable spud; lugs for floor and wall attachment; threaded fixture studs with nuts and washers

3. Vertical Carriers: J.R. Smith 100, 200, and 400 Series

4. Horizontal Carriers: J.R. Smith 100 Series

2.10 WALL-MOUNTED LAVATORIES (VITREOUS CHINA)

A. Lavatory

1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard
   b. Kohler
   c. Crane
   d. Eljer

2. ANSI A112.19.2; vitreous china wall hung lavatory; 4 inch high back; drillings on 4 inch or 8 inch centers as scheduled on drawings; rectangular basin with splash lip; front overflow; and soap depression

B. Faucet

1. Manufacturers (Refer to Section 20 10 00):
   a. Chicago
   b. Moen

2. Chrome plated brass body with manually adjustable hot/cold single lever actuation; adjustable limit stop; replaceable ceramic disc cartridge type; 1/2 gpm flow restriction with aerator; vandal resistant.

C. Supplies

1. Manufacturers (Refer to Section 20 10 00):
   a. Brass Craft
   b. Dearborn Brass
   c. Chicago

2. Chrome plated combination supply fitting with open grid strainer; chrome plated P-trap and with extension.

D. Wall-Mounted Carrier

1. Manufacturers (Refer to Section 20 10 00):
   a. J. R. Smith
   b. Zurn

2. ANSI A112.6.1; cast iron and steel frame with tubular legs; lugs for floor and wall attachment; threaded studs for fixture hanger; concealed arm supports; bearing plate and studs
3. J.R. Smith Fig 700 frame wall application
4. J.R. Smith Fig 720, 722, or 727 for masonry wall application

2.11 WALL-MOUNTED SERVICE SINKS

A. Sink

1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard
   b. Eljer

2. ANSI A112.19.1; porcelain enameled (inside only) cast iron roll-rim sink; 12 inch high back; concealed hanger; chrome plated strainer; stainless steel rim guard; cast iron P-trap with adjustable floor flange

B. Trim

1. Manufacturers (Refer to Section 20 10 00):
   a. American Standard

2. Exposed wall type supply; spout wall brace; vacuum breaker; hose end spout; strainer' eccentric adjustable inlets; integral screwdriver stops with covering caps and adjustable threaded wall flanges; 5 feet of ½ inch diameter plain end reinforced rubber hose; hose clamp; mop hanger.

END OF SECTION 22 40 00
SECTION 22 70 00
SNOW MELT SYSTEM

PART 2 - PRODUCTS

2.1 RADIANT HEATING PIPING INSTALLED IN SLAB

A. Manufacturers:
   1. Rehau
   2. Wirsbo
   3. Heatlink USA

B. General
   1. Flexible PEX piping system for use in district heating or other heat transfer applicators.
   2. Shipped in 300 foot rolls to eliminate need for below grade fittings. No below grade fittings will be allowed.

C. Service Pipe
   1. Material: All radiant floor heating piping shall be high density cross-linked polyethylene manufactured using the peroxide method of cross-linking (PEXa) and with an approved cell classification in accordance with ASTM D3350. Pipe shall conform with ASTM F876 and CSA B137.5, and be certified by CSA or equivalent testing organization.
   2. Temperature and Pressure Ratings:
      a. Piping shall be rated for 100 PSIG gauge pressure at 180°F temperature and 80 PSIG gauge pressure at 200°F temperature.
      b. Maximum 230 °F temperature (short term).
      c. International Standard Organization (ISO) permits extrapolation of endurance characteristics for permanent operating temperatures of up to 158 deg F for a minimum service life of 50 years.
      d. Melt temperature of 266 °F.
   3. Oxygen Diffusion Barrier: Piping shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to less than 0.10 mg/l/day at 104°F water temperature, in accordance with DIN 4726.
   4. Bend Radius: The minimum bend radius for cold bending of the pipe shall not be less than five (5) times the outside diameter. Bends with a radius less than shall require the issue of a bending template as supplied by the pipe manufacturer, and/or the use of hot air.

D. Fittings:
   1. Fittings shall be manufactured of dezincification resistant brass and shall be supplied by the piping manufacturer as part of a proven cataloged system. Manifold fittings shall be compression nut style with split compression-sleeve fittings.
   2. Fittings shall be certified to ASTM F877 and CSA B137.5 as part of the manufacturer’s PEX piping system.

E. Rigid In-Ground or Under Slab Insulation
   1. By others.
F. Accessories
   1. Galvanized wire mesh grid, RailFix support, insulation screwclips, factory approved tie down and fastening system

G. Combination Snow/Ice Sensor, Slab Sensor and Melting Controls: Provided, installed and wired under Section 23 09 23, Energy Management and Control Systems.

H. Electric Snow Melt Boiler: Provided, installed and wired under Section 23 52 63, Electric Boilers.

I. Snow-Melt Circulation Pump: Provided, installed and wired under Section 23 21 23, HVAC Pumps.

J. Snow-Melt Supply (SMS) and Return (SMR) Piping (not inbedded in slab): Provided, installed under Section 23 05 03, Hydronic Piping.

K. Hydronic Specialties: Provided and installed under Section 23 05 04, Hydronic Specialties.

L. Glycol Feeder: Provided, installed and wired under Section 23 25 00, Chemical Water Treatment.

2.2 MANIFOLDS
   A. Distribution manifolds that are prepiped for between 2 and 12 separate circuits.

   B. The manifold shall consist of brass supply and return headers, each with 1 inch female threaded isolation ball valves.

   C. The distribution headers mounts shall be fastened to the rails at the rear of the distribution cabinet or directly to a support structure (wall). The distribution header shall be aligned by vertically adjusting the fastening bolts.

   D. The manifold shall consist of:
      1. Material: Brass MS 63
      2. Distribution header/collector: 1 1/4" flow distribution header and return collector.
      3. Heating Circuits: for 2 to 12 heating circuits.
      4. One combination shut-off/balance valve on each heating circuit in the return pipe.
      5. One shut-off valve in each heating circuit in the supply pipe.
      6. Air vents and drains on the supply and return header.
      7. Main isolation valves on the supply and return header.

2.3 CABINET
   A. Recessed concealed steel cabinet for mounting in-wall with push-fit (lockable) door, wall frame, bottom trim and cover trim.

END OF SECTION 22 70 00
SECTION 23 05 03
HYDRONIC PIPING AND VALVES

PART 2 - PRODUCTS

2.1 ACCESS DOORS
A. Materials shall be in accordance with Division 8.

2.2 CHILLED WATER PIPING (BELOW GRADE)
A. Pre-Insulated PVC (Bell Joint)
   1. Manufacturers (Refer to Section 20 10 00):
      a. Ricwil (PermaPipe), Chil-Gard
      b. Thermal Pipe Systems
   2. Carrier Pipe: PVC pressure pipe, ASTM D2241, class 160; pressure: 160 psi at 73 °F; fittings: integral bell and spigot joints with rubber sealing ring
   3. Insulation: Rigid closed cell polyurethane; density: 1.9 to 2.1 pounds/feet³; k factor: 0.14 Btu-in/(h·ft²·°F); thickness: 1 inch; insulation shall completely fill space between carrier pipe and conduit with minimum thickness indicated.
   4. Conduit: Type 1, grade 1, PVC with minimum thickness of 0.06 inch
   5. Couplings:
      a. To match pipe material specified
      b. System shall use o-ring seals and slip type couplings and shall incorporate thrust blocks.
      c. Field joints shall be kept to a minimum. Insulate with molded preformed or poured in place foam. Cover with jacket material to match conduits.
      d. Joints, couplings, fittings and accessories shall be designed and installed to insure a vapor tight installation.
   6. End Seals: Same material and thickness as jacket, bonded to jacket, factory applied.

B. Pre-Insulated High Density Polyethylene (Fusion Welded)
   1. Manufacturers (Refer to Section 20 10 00):
      a. Quik-Therm as manufactured by Perma-Pipe
   2. System
      a. The system shall be non-corrosive, non-metallic, structurally strong, completely waterproof, and entirely resistant to attacks by salts, water and all ground chemicals normally encountered in an underground environment. All sections shall be factory prefabricated in 40-foot lengths, with polyethylene disks provided on both ends of each piece. Factory-trained field technical assistance shall be provided for the critical period of the installation; ie., unloading, field joint instructions and testing.
   3. Service Pipe and Fittings
a. Internal piping and fittings shall be high-density polyethylene (HDPE), made from a high-density, high-molecular-weight resin, that is classified as a Type III, Grade P34, Class C, Category 5 by ASTM D-1248. The ASTM D-3350 cell classification shall be 345434C and the polyethylene shall be rated as PE3408 by the Plastics Pipe Institute. All service piping shall be manufactured to SDR 11 and shall have a pressure rating of 160 psi.

b. All fittings shall be injection molded and have the same thickness and pressure rating as the piping. Fabricated and/or mitered fittings that are not in accordance with ASTM D-3261 shall not be allowed.

4. Insulation
a. The insulation shall be rigid polyurethane foam, conforming to ASTM C-591, with a minimum density of 2 pounds per cubic foot, 90-95 percent closed-cell content and initial thermal conductivity k=.13. The insulation shall completely fill the annular space between the pipe and the jacket. Support guides shall be factory installed, to assure equal thickness of insulation around the pipe. The minimum insulation thickness shall be as indicated on the drawings.

5. Protective Jacket
a. The outer casting protective jacket shall be high-density polyethylene to the same specifications as the service piping. The jacket shall be manufactured to a minimum thickness of SDR 32.5. Jackets made from PVC, tape materials, or thin walled polyethylene shall not be allowed. Fittings shall not be insulated or jacketed. Both ends of each length of piping shall have a polyethylene disk between the service pipe and the jacket. The disk shall be recessed approximately a half-inch from the end of the pipe. End seals shall not be mastic, rubber, shrink end caps or other non-polyethylene materials.

6. Field Joints
a. All joints shall be thermal butt-fusion welded. The manufacturer shall supply all butt-fusion welding equipment and training to the installing contractor.

b. See Part 3 of this specification for installation of field joints.

2.3 HEATING WATER, CHILLED WATER, SNOW MELT HEATING WATER, HEAT RECOVERY WATER, CONDENSER WATER, EQUIPMENT DRAIN AND OVERFLOW PIPING (ABOVE GRADE)

A. Up to and including 2 inches:

1. Copper tubing: ASTM B88; type L; hard drawn; fittings: solder wrought copper fittings, ASME B16.22; ASTM B32, 95-5 tin-antimony or tin and silver solder with melting range of 430 to 535 °F, lead-free. Fittings shall be full nominal diameter inside and long radius.

2. Steel: ASTM A53; schedule 40 black; ASME B16.3 malleable iron fittings; 125 psi; threaded joints

B. Pipe over 2 inches:

1. ASTM A53; schedule 40 black; ASTM A234 forged steel welding type fittings

2. Copper pipe; ASTM B88; type L; hard drawn; soldered; ASME B16.22. Solder wrought copper fittings; ASTM B32, 95-5 tin-antimony, or tin and silver solder joints with melting range of range 430 to 535 °F, lead free.
3. Groove locked couplings: In lieu of welded flanged or soldered joints noted above, groove locked couplings as specified below may be used IN ACCESSIBLE AREAS ONLY for piping systems which do not exceed the design parameters of the respective gasket. Piping enclosed in inaccessible chases and shafts, above inaccessible ceilings or otherwise inaccessible shall have welded or soldered joints as specified above.

2.4 PIPE HANGERS AND SUPPORTS
A. Materials shall in accordance with Section 23 05 29.

2.5 UNIONS, FLANGES, AND COUPLINGS
A. Unions for Pipe 2 inches and Under: 150 psig threaded malleable for ferrous piping; bronze with soldered joints for copper pipe.
B. Flanges for Pipe Over 2 inches: 150 psig forged steel slip-on for ferrous piping; bronze for copper piping; gaskets to suit application for system temperature, pressure, and fluid type.
C. Grooved and Shouldered Pipe End Couplings (Steel):
   1. Manufacturers (Refer to Section 20 10 00):
      a. Victaulic
      b. Gruv-Lok
   2. Sealing Gasket: Grade E, EPDM, 150 psi, -30 to 230 °F
   3. Couplings:
      a. Victaulic Style 75, 77, 72, and 750 for all pipe joint connections requiring movement/expansion/contraction/deflection (including heating water system)
      b. Victaulic Style 07 "Zero Flex" rigid couplings for all pipe joint connections not requiring joint flexibility
   4. Accessories: Steel bolts, nuts, and washers
D. Grooved and Shouldered Pipe End Couplings (Copper):
   1. Manufacturers (Refer to Section 20 10 00):
      a. Victaulic
   2. Sealing Gasket: Grade E, EPDM, 150 psi, -30 to 230 °F
   3. Couplings:
      a. Couplings for copper tubing shall be Style 606 "No-Sweat" and shall consist of a cast ductile iron housing conforming to ASTM A536 with a copper alkyd enamel paint coating.
      b. Victaulic Flanged Connections shall be Style 641 "No Sweat" Vic Flange Adaptors. They shall engage directly into roll grooved copper tube and fittings and shall bolt directly to ANSI Class 125 cast iron and Class 150 steel flanged components.
      c. Victaulic Fittings shall be Victualic full flow copper fittings with grooves designed to accept Victaulic "No Sweat" grooved end couplings or flanges. Fittings for 2½ to 4 inch shall be copper per ASTM B75 and ASTM B584 for 5 to 6 inch sizes.
   4. Accessories: Steel bolts, nuts, and washers
E. Dielectric Connections: Union with galvanized or plated steel threaded end; copper solder end; water impervious isolation barrier.
2.6 GENERAL VALVES

A. Manufacturers (Refer to Section 20 10 00):

1. Bray
2. Crane
3. Grinnell
4. Hammond
5. Jenkins
6. Milwaukee
7. Nibco
8. Powell
9. Stockham
10. Walworth
11. Watts

B. Ball Valves:

1. Up to and including 2 inch: Bronze, two piece body, chrome plated ball with standard port, teflon seat, and stuffing box ring, lever handle, solder or threaded ends with union, 600 psi WG. Provide with memory stops when used as a balancing cock.
   a. Basis of Design: Milwaukee BA-100S (threaded), Milwaukee BA-150S, (solder)

C. Butterfly Valves:

1. 2 inch and smaller: Bronze body; threaded or solder ends; Viton seat; stainless steel disk and stem; lever handle operator; memory stops when used as a balancing cock; 175 psi SWP
   a. Basis of Design: Milwaukee, Butterball BB2-100, threaded. Milwaukee, Butterball BB2-350, solder

2. 2½ to 3 inch: Cast or ductile iron body; wafer or lug type; extended neck; threaded ends; resilient replaceable EPDM seat rated for -20 to 275 °F; aluminum bronze disc; stainless steel stem; gear operator with memory stop 200 psi SWP

3. 4 to 12 inch: Cast or ductile iron body; wafer or lug type; extended neck; resilient replaceable EPDM seat rated for -20 to 275 °F; aluminum bronze disc; stainless steel stem; gear operator with memory stop 200 psi SWP

2.7 HORIZONTAL SWING CHECK VALVES

A. 3 inches and smaller: Bronze body; bronze trim; teflon or bronze rotating swing disc; renewable teflon seat; 200 psi WOG; 5 degree seat angle;


2.8 SPRING LOADED CHECK VALVES

A. 3 to 10 inches: Iron body; bronze trim; split plate; hinged with stainless steel spring; wafer style; ANSI class 125. Accessories: Flanges, bolts, nuts and gaskets

1. Basis of Design: Milwaukee 1400 Series
END OF SECTION 23 05 03
PART 2 - PRODUCTS

2.1 AIR SEPARATORS

A. Manufacturers (Refer to Section 20 10 00):
   1. Spirotherm

B. Construction and design:
   1. In-line design, 150 psi working pressure
   2. ASME SEC 8-D construction
   3. Brass construction for sizes 1½ inches and smaller
   4. Steel construction for sizes 2 inches and larger
   5. Turbulence suppressive type air eliminator to separate micro bubbles and to remove stationary air pockets through absorption
   6. Copper or stainless steel coalescing medium
   7. Integral brass venting mechanism at top of unit
   8. Side valve to remove floating liquids and debris from the surface
   9. Threaded blowdown connection port at bottom
   10. Sized for maximum water velocity of 4 fps and maximum pressure drop of 1.5 feet WG.

2.2 AIR VENTS

A. Manufacturers (Refer to Section 20 10 00):
   1. Spirotherm

B. Manual Type:
   1. Basis of Design:
   2. 1/8 inch coin or screwdriver operated, brass connection

C. Automatic Type:
   1. Basis of design: Spirotop
   2. Brass or semi-steel body, copper float, stainless steel valve and valve seat; suitable for system operating temperature and pressure (150 psi at 240 °F minimum); with isolating valve
   3. Air vent shall be tapped for 1/8 inch IPS.

D. Automatic Type: High Capacity
   1. Basis of design: Spirotop
2. Non-modulating high capacity air vent design to purge free air from the system and provide positive shutoff at pressures up to 150 psig at a maximum temperature of 250 °F. The design of the high capacity air vent shall prevent air from entering the system if system pressure should drop below atmospheric pressure. The high capacity air vent shall be pilot operated for intermittent purging of free air at pressures up to 2 psig during normal system operation, and diaphragm operated for full capacity purging of free air at pressures between 2 to 150 psig.

E. Manual Type: High Capacity
   1. Short vertical sections of 2 inches diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber

2.3 AUTOMATIC COLD WATER FILL ASSEMBLY
   A. Pressure reducing valve; reduced pressure double check backflow preventer; test cocks; strainer; vacuum breaker; and valved bypass. Select pressure reducing valve for the pressures listed on the plans. Reduced pressure backflow preventer provided in Section 22 05 04.

2.4 BALANCING COCKS
   A. Balancing cocks where indicated shall be ball or butterfly valves as specified in Section 23 05 03.

2.5 COIL PIPING PACKAGES
   A. Manufacturers (Refer to Section 20 10 00):
      1. As listed under flow balancing valve sections (for manual or automatic flow balancing valves).

   B. Automatic or manual flow control valves as specified in this section; flow control valves shall be complete with ball valve, flow control, two pressure/temperature test ports.

   C. Combination strainer and ball valve shall be complete with blow-down strainer, one pressure/temperature test port and ground joint union for field exchange of internal components. Unit shall be all brass and stainless steel.

   D. Valves and strainers shall be marked externally with size, capacity and direction of flow.

   E. Hoses
      1. All hoses shall be equipped with swivel end connections at terminal unit. All end connections shall be crimped to meet stated pressure ratings. Serrated/slip fit connections are not acceptable.

      2. Flame Retardant Hoses. Hose materials shall be stainless steel braided over an EPDM liner. Hoses shall meet or exceed the ASTM-D380-83 standard and withstand working pressures of 1/2", 3/4": 300 PSI, 1"-1-1/4": 250 PSI, 1-1/2": 210 PSI, 2": 188 PSI, @ 200°F; Burst Pressure: 1/2": 1500 PSI, 3/4": 1200 PSI, 1", 900 PSI, 1-1/4": 750 PSI, 1-1/2" – 2": 500 PSI.

      3. Hoses shall meet or exceed flame retardant testing per standards UL #723, NEPA #225, ANSI 2.5, UBC 42-1, and ASTM-E84A, after ten minutes and produce less than 5% smoke as compared to Red Oak flooring (100%)
2.6 EXPANSION TANKS

A. Manufacturers: (Refer to Section 15000):

1. Amtrol
2. Armstrong
3. Bell and Gossett
4. Taco
5. Wessels

B. Construction:

1. Bladder Type: Welded steel; tested and stamped in accordance with ASME SEC 8-Div. 1; cleaned; prime coated; fitted with lifting rings and steel support saddle; tappings for installation of accessories; supplied with National Board Form U-1; 125 psi pressure rating; field-replaceable heavy duty butyl rubber bladder; air charging valve (standard tire valve); tank drain
2. Diaphragm type: Welded steel; tested and stamped in accordance with ASME SEC 8-Div. 1; cleaned; prime coated; fitted with lifting rings and steel support saddle; tappings for installation of accessories; supplied with National Board Form U-1; 125 psi pressure rating; heavy duty butyl rubber diaphragm; air charging valve (standard tire valve); tank drain.
3. Tank shall be full or partial acceptance as scheduled.

C. Accessories:

1. Manual air vent
2. Pressure relief valve: Select for pressures noted on the drawings.
3. Water pressure gauge: Install at system connection.
4. Air pressure gauge: charging valve indicated above shall be independent of gauge, and shall be accessible without removal of gauge.

2.7 FLOW BALANCING VALVES (AUTOMATIC)

A. Manufacturers (Refer to Section 20 10 00):

1. Autoflow
2. Griswold

B. Basis of Design: Autoflow Series YR

C. General: Pressure compensating; factory set to control within 5 % of selected rating at pressure differential of ten (10) times the minimum required full flow conditions. Valves shall be complete with flow control, two pressure/temperature test ports and ground joint union to allow field exchange of internal components without removing from pipeline. Unit shall be all brass and stainless steel.

D. Valves shall be marked externally with size, capacity and direction of flow.

2.8 FLOW CONTROL BALANCING VALVES (MANUAL) – “CIRCUIT SETTERS”

A. Manufacturers (Refer to Section 20 10 00):

1. Armstrong
2. Bell and Gossett
3. Nibco
4. Taco
5. Victaulic by Tour and Anderson

B. General: Precision machined orifice with memory stop; calibrated external name plate and direction arrow. Flow control balancing valves shall have tight shut-off and 2 meter taps, each with internal check valve and thread protector. Component construction and materials shall be suitable for application.

C. Valves Serving Design Flows of Greater than 30 gpm: Valve adjustment shall occur over a minimum of 720° adjustment rotation.

D. Circuit Setters shall be sized for a minimum of 2 foot water pressure drop and a maximum of 5 foot drop at design flow rate.

E. Connections:
   1. Up to 2 inches: Threaded or sweat
   2. 2½ inches and larger: Flanged

F. Meter: Portable meter with case; 3% accuracy pressure gauge with 0 to 60 feet WG pressure range; 500 psig maximum working pressure; color coded hoses for low and high pressure connections; connectors suitable for connections to read-out valves. Manufacturer shall be same as flow control balancing valve.

G. Flow control balancing valves shall be sized based on scheduled equipment flow rate according to the manufacturer’s guidelines.

2.9 REDUCING VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. Bell and Gossett
   2. Taco
   3. Armstrong

B. Brass body with integral check valve; manual fast fill feature; cleanable strainer

2.10 SAFETY RELIEF VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. Bell and Gossett
   2. Taco

B. Basis of Design:
   1. Bell and Gossett Series 790 and 1170

C. General: Maximum working pressure 125 psig, Maximum operating temperature 250 F. Capacities ASME certified and labeled. Relief setting: As indicated on drawings.

D. Construction:
1. Body: Brass
2. Diaphragm and Seat: EPDM
3. Internal Wetted Parts: Brass
4. Diaphragm assisted

E. Construction:
1. Body: Brass
2. Diaphragm and Seat: EPDM
3. Internal Wetted Parts: Brass
4. ASME labeled, diaphragm assisted
5. Maximum Working pressure 125 psig
6. Maximum operating temperature 250 F
7. Relief setting: As indicated on drawings

2.11 STRAINERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Sarco
   2. Strong, Dunham Busch
   3. Webster
   4. Watson McDaniel

B. Size 2 inch and under:
   1. Basis of Design: Sarco IT, BT
   2. Screwed brass or iron body for 250 psig working pressure Y pattern with 1/32 inch stainless steel perforated screen
   3. Accessories: ¾ inch blow-off valve and cap

C. Size 2½ inch to 8 inch:
   1. Basis of Design: Sarco CI-125
   2. Flanged iron body for 147 psig working pressure; Y pattern with 3/64 inch stainless steel perforated screen
   3. Accessories: ¾ inch blow-off valve and cap

2.12 VENTURIS

A. Manufacturers (Refer to Section 20 10 00):
   1. Barco
   2. Hyspan
   3. Armstrong
   4. HCI

B. Precision machined orifice with tag indicating size and flow ratings. Fittings shall have two meter taps, each with shut-off cock and thread protector.
2.13  PUMP SUCTION FITTINGS
  A.  Provided under Section 23 21 23.

2.14  GLYCOL FILL ASSEMBLY
  A.  Provided under Section 23 25 00.

END OF SECTION 23 05 04
PART 2 - PRODUCTS

2.1 MANUFACTURERS (REFER TO SECTION 20 10 00):
   
   A. Allis Chalmers
   B. Century
   C. Baldour
   D. Marathon
   E. General Electric
   F. Westinghouse

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

   A. Motors less than 250 Watts, for intermittent service: Equipment manufacturer’s standard and need not conform to these specifications.

   B. Motors which are to be controlled from a variable frequency drive shall be designed and constructed for full compatibility with the drive.

   C. Electrical Service:
      
      1. Unless indicated otherwise on equipment schedules, motors shall be supplied as with the following electrical characteristics:
         a. Motors ½ horsepower and smaller: 115 single phase, 60 Hz
         b. Motors larger than ½ horsepower shall be three phase and shall be rated as specified and scheduled

   D. Design for continuous operation in 104 °F environment.

   E. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

   F. Visible Nameplate: Indicating manufacturer’s name and model number, motor horsepower, RPM, frame size, voltage, phase, cycles, full load amps, insulation system class, service factor, maximum ambient temperature, temperature rise at rated horsepower, minimum efficiency.

   G. Nominal Efficiency: All motors shall be NEMA “premium efficiency” type. Exception: Motors for smoke control exhaust fans. Motors shall also meet or exceed required efficiency of the State energy code.

   H. Two-Speed Motors:
      
      1. Furnish when scheduled on drawings
      2. Two winding (1800/1200 rpm) or (1800/900 rpm) as scheduled
I. Invertor Duty Motors (For Use with Variable Frequency Drives):
   1. Provide where scheduled on the drawings
   2. Motors shall meet NEMA MG-1 Part 31 requirements. Nameplates shall state motors are “invertor duty”. Motors shall be suitable for variable torque and have a 10:1 speed ratio.
   3. Critical vibration frequencies are not within operating range of controller output.
   4. Temperature rise: Match rating for class B insulation.
   5. Insulation: Class H.

J. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

2.3 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS
   A. Starting Torque: Exceeding one fourth of full load torque
   B. Starting Current: Up to six times full load current
   C. Multiple Speed: Through tapped windings
   D. Open Drip-proof and Enclosed Air Over Enclosure: Class F insulation, rated for 311 °F maximum temperature, NEMA Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.4 SINGLE PHASE POWER - CAPACITOR START MOTORS
   A. Starting Torque: Three times full load torque
   B. Starting Current: Less than five times full load current
   C. Pull-up Torque: Up to 350 % of full load torque
   D. Breakdown Torque: Approximately 250 % of full load torque
   E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
   F. Drip-proof and Enclosed Motor Enclosures: Class F insulation, rated for 311 °F maximum temperature, NEMA Service Factor, prelubricated sleeve or ball bearings.

2.5 THREE PHASE POWER - SQUIRREL-CAGE MOTORS
   A. Starting Torque: Between 1 and 1½ times full load torque
   B. Starting Current: Six times full load current
   C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics
   D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors
E. Insulation System: NEMA Class F or better
F. NEMA Service Factor
G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
J. Sound Power Levels: To NEMA MG 1
K. Part Winding Start Where Indicated: Use of winding to reduce locked rotor starting current to approximately 60 % of full winding locked rotor current while providing approximately 50 % of full winding locked rotor torque.
L. Weatherproof Epoxy (where indicated) Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.6 ENCLOSED MOTOR CONTROLLERS (MOTOR STARTERS)
A. Enclosed Motor Controllers (starters) and switches are not under Mechanical unless specifically specified with a particular mechanical equipment item.
   1. Exception: Variable frequency drives furnished under Section 23 09 23.

END OF SECTION 23 05 13
PART 2 - PRODUCTS

2.1 PRESSURE GAUGES (WATER SERVICE)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Trerice
      2. Weiss
      3. Weksler
      4. Tel Tru
   B. Basis of Design: Trerice Series 600C
   C. Construction: ASME B40.1; 4½ inch dial; hermetically sealed; field liquid fillable; cast aluminum case; brass tube and socket; brass movement; painted aluminum dial with black graduations on white background; suitable for outdoor use; psi scale as appropriate for intended use; full scale accuracy of plus or minus 1 %.

2.2 PRESSURE GAUGES (STEAM SERVICE)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Trerice
      2. Weksler
      3. Weiss
      4. Tel Tru
   B. Basis of Design: Trerice Series 450 LFSS
   C. Construction: ASME B40.1; 4½ inch dial; hermetically sealed; field liquid fillable; fiberglass reinforced polypropylene case; solid front and blowout back type 316 stainless steel bourdon tube; painted aluminum dial with black graduations on white background; suitable for outdoor use; psi scale as appropriate for intended use; full scale accuracy of plus or minus 1 %.

2.3 PRESSURE GAUGE TAPPINGS
   A. ¼ inch NPT brass ball valve rated for 250 psig; Ray-Piston pressure snubber with ¼ inch NPT connections.
   B. For steam systems, provide ¼ inch cast iron syphon, NPT angle or straight pattern.

2.4 STEM TYPE THERMOMETERS AND SUPPORTS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Duro
      2. Trerice
      3. Weiss
4. Weksler
5. Tel Tru

B. Basis of Design: Trerice Series A401

C. Construction: Adjustable angle; red appearing mercury; lens front tube; clear acrylic window up to 300 °F and double strength above 300 °F; ¾ inch long NPT brass stem with 2½ inch insertion length; cast aluminum case with enamel or epoxy finish; cast aluminum adjustable joint with positive locking device; scale to suit application; well to suit service; full scale accuracy within 2 %; Fahrenheit scale as appropriate for intended use.

D. Supports: Brass separable sockets for thermometer stems with or without extensions as required.

2.5 TEST PLUGS AND KITS

A. Test Plug:

1. Manufacturers (Refer to Section 20 10 00):
   a. Flow Design
   b. MG Piping Products
   c. Pete’s Plugs
   d. Sisco
   e. Trerice

2. Construction: ¼ inch NPT or ½ inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 °F; nordel core for temperatures up to 350 °F; viton core for temperatures up to 400 °F; brass extension for insulated pipe.

B. Test Kit:

1. Manufacturers: Same as noted above for Test Plugs.
2. Internally padded and fitted carrying case; two (2) 3¼ inch diameter pressure gauges - scale range: 0 to 100 psi; two (2) gauge adapters with 1/8 inch type 316 stainless steel probes; two (2) 1 inch dial thermometers with 5 inch stem and external calibration - scale range: 25 to 125 °F; two (2) 1 inch dial thermometers with 5 inch stem and external calibration - scale range: 0 to 220 °F.

END OF SECTION 23 05 15
PART 2 - PRODUCTS

2.1 EXTERNALLY PRESSURIZED GUIDED EXPANSION JOINT

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan

B. Basis of Design: Up to 1-1/2” Hyspan Series 8500; 2” and larger Hyspan Series 3500.

C. Construction: Inner pipe and outer wall shroud housing - ASTM A53 standard wall pipe; laminated bellows - ASTM A240, T304, or T321 welded to pipe; tapped steel flanges; flange and rings - ASTM A36 - guide ring maintains alignment of inner pipe and housing and prevents contact of the bellows and pipe; 150 psig design pressure; 225 psig test pressure; 850 °F maximum working temperature.

D. Provide with drain port located at bottom of housing for steam applications.

2.2 PIPE ALIGNMENT GUIDES

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex

B. Basis of Design: Hyspan Series 9500.

C. Construction: Heavy gauge pressed steel construction - fusion welded; all surfaces coated with protective enamel paint.

2.3 PIPE ANCHORS

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
   3. Metraflex

B. Basis of Design: Metraflex Structural Cradle or I-Beam Anchors.

C. Construction: Painted steel; designed for bolting or welding to pipe as applicable.

2.4 PIPE EXPANSION LOOPS

A. Manufacturers (Refer to Section 20 10 00):
   1. Hyspan
   2. Mason
3. Metraflex (Basis of Design)

B. Construction: Pipe materials of construction and fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Rigid pipe and connections shall meet the requirements of the piping system in which the expansion loop is being installed; stainless steel inner hose and double-braided outer sleeve flexible pipe for steel piping systems; bronze inner hose and braided bronze outer sleeve flexible pipe for copper piping systems; 150 psig design pressure; 225 psig test pressure; 850 °F maximum working temperature.

C. Flexible loops shall impart no thrust loads to system support anchors or structure.

D. Configuration: Two flexible pipe sections connected with a 180° bend at one end and provided with a 90° elbow at the other end of each of the flexible pipe sections. Exceptions:
   1. Configuration shall be different when required by the specific installation (i.e. when installed at a 90° bend in the piping system, which would require 135° bends in lieu of 90° bends).
   2. Nested configurations may be utilized in parallel pipe runs to keep all expansion/seismic devices in one location. Nested configurations require (2) 90° bends with straight pipe in a loop fashion in lieu of the 180° bend.

E. Provide with drain/air release plug on 180° bend.

F. Factory supplied center support nut.
   1. Install in accordance with the manufacturers written instructions.
   2. Loops used for thermal expansion shall be installed with pipe guides located within 15 pipe diameters of each side of the loop. Loops anchored on one side require only one guide on the traveling side. When spanning a building seismic expansion joint, guides are not required.
   3. Install in a neutral, pre-compressed or pre-extended condition as required for the application.
   4. Provide pipe alignment guides on both sides of expansion loop, in locations as recommended by expansion loop manufacturer.

END OF SECTION 23 05 16
PART 2 - PRODUCTS

2.1 EQUIPMENT CURBS

A. Equipment curbs indicated to be under Mechanical on mechanical equipment schedules and specified herein shall be factory fabricated and shall be of the same manufacturer as the supported equipment to ensure compatibility and size coordination. Reference associated equipment specifications and schedules for equipment curb requirements.

2.2 FLASHING

A. Flexible Flashing: 47 mil galvanized steel shell and base, rigid insulation, mitered 3 inch cant, wood nailer, with variable step to match roof insulation and gravel
B. Metal Flashing: 26 gauge galvanized steel
C. Metal Counterflashing: 22 gauge thick galvanized steel
D. Lead Flashing: Waterproofing - 5 pounds/foot² sheet lead; soundproofing - 1 pounds/foot² sheet lead; flexible flashing - 47 mil thick sheet butyl; compatible with roofing
E. Caps: Steel; 22 gauge minimum; 16 gauge at fire resistant elements

2.3 INSERTS

A. Construction: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment; top slot for reinforcing rods; lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 PIPE HANGERS AND SUPPORTS

A. Manufacturers (Refer to Section 20 10 00):
   1. Grinnell/Anvil
   2. ERICO/Michigan Hanger
   3. Crane
   4. Fee and Mason
B. Hydronic Piping
   1. Conform to MSS SP58, MSS SP69, and MSS SP89.
   2. Hangers for Pipe Sizes ½ to 2 inches: Carbon steel, adjustable swivel, split ring.
   3. Hangers for Cold Pipe Sizes 2 inches and over: Carbon steel, adjustable, clevis.
   4. Hangers for Hot Pipe Sizes 2½ to 6 inches: Cast iron roll; carbon steel yoke, roll rod and hex nuts.
5. Hangers for Hot Pipe Sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and over: Steel channels with welded spacers and hanger rods, cast iron roll.

8. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.


10. Wall Support for Hot Pipe Sizes 6 inches and over. Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.


12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipes Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Steam and Steam Condensate Piping

1. Conform to ASME B31.1 ASTM F708 MSS SP58, MSS SP69, and MSS SP89.

2. Hangers for Pipe Sizes ½ to 2 inches: Carbon steel, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2½ to 6 inches: Cast iron roll, carbon steel yoke, roll rod and hex nuts.

4. Hangers for Pipe Sizes 6 inches and over: Adjustable steel yoke, cast iron roll, double hanger.

5. Multiple or Trapeze Hangers for Pipe Sizes to 4 inches: Steel channels with welded spacers and hanger rods.

6. Multiple or Trapeze Hangers for Pipe Sizes 6 inches and over: Steel channels with welded spacers ad hanger rods; cast iron roll and stand.

7. Wall Support for Pipe Sizes 3 inches: Cast iron hook.

8. Wall Support for Pipe Sizes 4 to 5 inches: Welded steel bracket and wrought steel clamp.

9. Wall Support for Pipe Sizes 6 inches and over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.


11. Floor Support for Pipe Sizes to 4 inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

12. Floor Support for Pipe Sizes 6 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
13. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

D. Refrigerant Piping

1. Conform to MSS SP58, MSS SP69, and MSS SP89.
2. Hangers for Pipe Sizes ½ to 1½ inches: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipes Sizes 2 inches and over: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

E. Pipe Riser Clamps

1. Steel and Cast Iron Pipe: Extension pipe or riser clamp; carbon steel; black or galvanized finish.
   a. Basis of design: Grinnell Fig 261.
2. Copper Pipe: Copper tubing riser clamp; carbon steel; copper finish.
   a. Basis of design: Grinnell Fig CT-121.

2.5 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.6 PIPE INSULATION SHIELDS

A. Manufacturers (Refer to Section 20 10 00):
   1. Grinnell
   2. Fee & Mason
   3. M-Co
   4. Pipe Shields, Inc
   5. Kin-Line

B. Hot Piping (insulated pipe, 2½” and larger): Protection saddle type; size to suit thickness of insulation; curved carbon steel plate; Grinnell Fig 160, 161, 162.

C. Hot Piping (up to 2”): Insulation protection shield type; carbon steel; galvanized finish; Grinnell Fig 167.

D. Cold Piping: Insulation protection shield type; carbon steel; galvanized finish; Grinnell Fig 167.

2.7 RESILIENT CLAMPS

A. Manufacturers (Refer to Section 20 10 00):
1. Hydra-Zorb
   B. Construction: Resilient cushion with clamps and anchoring channel.

2.8 SLEEVES
   A. Sleeves for Pipes through Non-fire Rated Floors: 18 gauge thick galvanized steel.
   B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gauge thick galvanized steel.
   C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed, refer to Section 07 84 00.
   D. Sleeves for Round Ductwork: Galvanized steel.
   E. Sleeves for Rectangular Ductwork: Galvanized steel.
   F. Sleeves for below grade piping passing under footings: Class 52; ductile iron.
   G. Sleeves for below grade piping passing through exterior walls - Mechanical Rubber Pipe Seals.
   H. Stuffing Insulation: Glass fiber type; non-combustible; 3 lb. density.
   I. Fire Safeing Sealant: Intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250 °F. It shall have ICBO, BOCA I approved ratings to 3 hours per ASTM E814 (UL 1479). 3M Fire Barrier Caulk, Putty, strip and sheet forms.

END OF SECTION 23 05 29
SECTION 23 05 48 TO BE INSERTED HERE
PART 2 - PRODUCTS

2.1 CEILING TACKS
   A. Description: Steel with ¾ inch diameter color coded head.
   B. Color code as follows:
      1. HVAC Equipment: Yellow
      2. Fire dampers / smoke dampers: Red
      3. Heating / Cooling valves: Blue

2.2 NAMEPLATES
   A. Description: Laminated three-layer plastic with engraved white letters on black background

2.3 PIPE MARKERS
   A. Manufacturers: (Refer to Section 20 10 00):
      1. W.H. Brady
      2. Seton
      3. Marking Services, Inc.
   B. Color and Lettering: Conform to ASME A13.1
   C. Plastic Pipe Markers: Factory fabricated; flexible; semi-rigid plastic; preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
   D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
   E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape; minimum 6 inch wide by 4 mil thick; manufactured for direct burial service.

2.4 TAGS
   A. Description: Brass or Aluminum with stamped letters; tag size minimum 1½ inch diameter with smooth edges.
      1. Provide ¼” letters for piping system abbreviation and ½” sequenced numbers. Provide 1/8” hole for fastener.

2.5 TAG CHART
   A. Description: Typewritten letter size list in aluminum frame, plastic laminated. Chart shall include valve number, service and location.
END OF SECTION 23 05 53
2.1 CELLULAR FOAM (PIPING)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Armstrong, Armaflex-AP
      2. Halstead
   B. Insulation: ASTM C534; flexible; cellular elastomeric; molded or sheet; \( k \) factor: ASTM C177, 0.27 Btu·in/(h·ft²·°F) at 75 °F; -70 °F minimum service temperature; 220 °F maximum service temperature; maximum moisture absorption: ASTM D1056, 5.0 percent (pipe) by weight; 6.0 percent (sheet) by volume; moisture vapor transmission: ASTM E96, 0.10 perm-inches.
   C. Connection: Waterproof vapor barrier contact adhesive compatible with the insulation. Armstrong 520 adhesive or approved equal.

2.2 GLASS FIBER (PIPING)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Schuller, Micro-Lok, AP-T Plus
      2. Knauf
      3. Owens Corning
   B. Insulation: ASTM C547; rigid molded; noncombustible; \( k \) factor: ASTM C177, 0.24 Btu·in/(h·ft²·°F) at 75 °F; 850 °F maximum service temperature; 0.2 percent maximum moisture absorption by volume.
   C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn; bonded to aluminized film with pressure sensitive tape lap sealing system; moisture vapor transmission: ASTM E96; 0.02 perm-inches.

2.3 HYDROUS CALCIUM SILICATE (PIPING)
   A. Manufacturers (Refer to Section 20 10 00):
      1. Schuller, Thermo-12 Gold
   B. Insulation: ASTM C533; rigid molded; asbestos free; gold color; \( k \) factor: ASTM C177 and C518 0.40 Btu·in/(h·ft²·°F) at 300 °F; 1200 °F maximum service temperature; 15 pounds/foot³ density.
   C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
   D. Insulating Cement: Compatible with insulation
   E. Finish: Re-wettable fabric glass cloth with adhesive. Claremont Diplag 95 or approved equal; 15 ounces/yard²; 0.04 inches thick.
2.4 JACKETS AND FITTING COVERS (PIPING)

A. PVC Plastic Jacket and Fitting Covers (Interior Applications):

1. Manufacturers (Refer to Section 20 10 00):
   a. Zeston 2000

2. Jackets and fitting covers: ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F; maximum service temperature: 450 °F; thickness: 20 mil.

3. Jackets and fitting covers (vapor barrier jackets): ASTM D1784; one piece molded type fitting covers and sheet material; off-white color; minimum service temperature: 0 °F; maximum service temperature: 450 °F; moisture vapor transmission - ASTM E96 - 0.002 perm-inches; thickness: 20 mil.

4. Connections: Pressure sensitive color matching vinyl tape

2.5 INSERTS AND SHIELDS

A. Inserts: Heavy density insulation which will not crush from weight of pipe. Locate between shield and pipe. Inserts are furnished in this Section 23 07 00 and installed in Section 23 05 29.

B. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insulation. Shields are furnished and installed under Section 23 05 29.

2.6 GLASS FIBER (EQUIPMENT)

A. Manufacturers (Refer to Section 20 10 00):

1. Schuller - Pipe and Tank Insulation
2. Owens Corning

B. Insulation: Semi-rigid, noncombustible; k factor: ASTM C335 0.27 Btu·in/ (h·ft²·°F) at 75 °F; maximum service temperature: 650 °F; density: 3.0 pounds/foot³.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film with pressure sensitive tape lap sealing system; moisture vapor transmission: ASTM E96; 0.02 perm-inches.

2.7 LACE-ON BLANKETS

A. Manufacturers (Refer to Section 20 10 00):

1. Insulation
   a. Kaowool Cerablanket

2. Fabric
   a. JP Stevens Glass-Tex Fabric Style 9987
   b. Alpha Maritex Style 3200-SA

B. Materials: 0.008 inch thick type 304 stainless steel knitted wire mesh inner liner 8 pounds/foot³ density insulation, ½ inch thick; oil and water resistant exterior protective fabric.
C. Construction: Blankets shall be sewn together. Lacing anchors shall be 2½ inch stainless steel secured with 12 gauge stainless steel washers. Blankets shall have stainless steel wire installed for draw cords.

2.8 GLASS FIBER, FLEXIBLE BLANKET (DUCT WRAP)

A. Manufacturers (Refer to Section 20 10 00):

1. Schuller, R-Series Microlite
2. Certainteed; Standard Ductwrap
3. Knauf; Ductwrap
4. Owens Corning; All Service Ductwrap

B. Insulation: ASTM C553; flexible, noncombustible blanket; $k$ factor: ASTM C518, 0.29 Btu·in/(h·ft²·°F) at 75 °F; maximum service temperature: 250 °F; maximum moisture absorption: 0.20 % by volume; density: 0.75 pounds/foot³; resistance to microbial growth: ASTM C665; shall not support mold, bacteria, or fungus growth.

C. Vapor Barrier Jacket: Foil Scrim Kraft (FSK); foil thickness: 0.00035 inches; moisture vapor transmission: ASTM E96; 0.02 perm; Class I vinyl; vinyl thickness: 0.0032 inches; moisture vapor transmission: ASTM E96; 1.3 perm; vapor barrier tape: same material as vapor barrier jacket as recommended by the insulation manufacturer.

2.9 GLASS FIBER, FLEXIBLE (DUCT LINER)

A. Manufacturers (Refer to Section 20 10 00):

1. Knauf - Duct Liner E-M
2. Certainteed - Toughgard
3. Schuller - Permacote Linacoustic

B. Insulation: ASTM C1071; flexible, noncombustible bonded glass fiber blanket with a black matt faced surface for damage resistance; $k$ factor: ASTM C1071, maximum 0.28 Btu·in/(h·ft²·°F) at 75 °F; maximum service temperature: 250 °F; maximum rated air velocity on coated air side: 4,000 fpm; surface coating with EPA registered anti-microbial agent that will not support growth of fungus or bacteria; anti-microbial agent shall be tested in accordance with: fungi test ASTM C665, fungi test ASTM G21, bacterial test ASTM G22. Insulation coating shall be formaldehyde free.

C. Adhesive:

1. Manufacturers (Refer to Section 20 10 00):
   a. DuroDyne; WBG
   b. Miracle; PF96
   c. Scotchgrip Insulation Adhesive; 4230

2. Waterproof, ASTM E162 fire-retardant type

D. Mechanical Fasteners:

1. Conform to SMACNA Mechanical Fastener Standard MF-1-1975
   a. Manufacturers (Refer to Section 20 10 00):
   b. DuroDyne
   c. Omark dished head “Insul-Pins”
d. Grip nails may be used if nail is installed by “Grip Nail Air Hammer” or by “Automatic Fastener Equipment” in accordance with Manufacturer’s recommendations.

2.10 GLASS FIBER, RIGID (DUCTWORK)

A. Manufacturers (Refer to Section 20 10 00):
   1. Schuller, Spin-Glas type 814

B. Insulation: ASTM C612; rigid, noncombustible blanket; $k$ factor: ASTM C518, 0.23 Btu-in/(h·ft²·°F) at 75 °F; maximum service temperature: 450 °F; maximum moisture absorption: 1 % by volume; density: 3.0 pounds/foot³.

END OF SECTION 23 07 00
PART 2 - PRODUCTS

2.1 ENERGY MANAGEMENT AND CONTROL SYSTEM (EMCS)

A. Native BACnet System Manufacturers (Refer to Section 20 10 00 and this Section ¶1.9 A).
   1. Johnson Control as installed by JCI Spokane Branch office
   2. Alterton BACTalk as installed by ATS Spokane Branch office
   3. Delta as installed by NW Air, Inc.

B. Operator's Terminal

   1. Minimum Hardware Requirements:
      a. Dual Core CPU, 2.4 minimum GHz clock speed
      b. 4 GIG RAM
      c. 500 GB SATA fixed hard drive
      d. DVD-RW drive
      e. 256 MB video card
      f. 17 inch LCD flat panel display, resolution 1280×1024 or better
      g. 1 serial port, 1 parallel port; 4 USB2 ports
      h. Multi-function keyboard
      i. Two-button wheel mouse
      j. 10/100/1000 PCI Ethernet adaptor or better
      k. 5 PCI and 1 AGP (or PCI-Express) expansion slots
      l. Printer with 250 sheet minimum capacity or tractor feed and 15 ppm or greater print speed

   2. Minimum System Software Requirements: Windows XP Professional, Service Pack 2 operating system or greater; latest version of Internet Explorer; latest version of Symantec antivirus software.

   3. Uninterruptible Power Supply (UPS): Provide a UPS as specified later in this section for the operator's terminal.

C. EMCS Software

   1. General
      a. The EMCS contractor shall provide all software required for efficient operation of the EMCS system. Software shall be modular in design to provide maximum flexibility, expansion, and future revision of the system. All functionality described herein shall be regarded as a minimum.
      b. The Owner shall be furnished with an unlimited site software license so that they may install an unlimited amount of software on their computers to run and operate the building. At the end of the one (1) year warranty, the Owner shall be provided with software upgrade to match the current version offered by the control manufacturer at no additional charge.
      c. 32-bit software application compatible with the specified operating system; multi-tasking type environment that allows the user to run several applications simultaneously.
2. Control Algorithms: The system shall have the ability to perform the following pre-tested control algorithms: Two-position control, proportional control, proportional plus integral control, proportional, integral, plus derivative control, and automatic tuning of control loops.

3. Operator Access: Different security levels shall be assignable to each operator. Each command and event shall be capable of being assigned a security level. Access to commands, acknowledgment of alarms, etc. shall be limited in accordance with the operator's security level designation.

4. Password Protection: Multiple operator-specific password access protection shall be provided to allow the user/manager to limit workstation control.

5. Event Reporting: The operator shall have the capability to define which actions get reported in which manners, both individually and globally through grouping of events (initially, a minimum of three (3) reporting groups shall be designated: urgent alarms, general alarms, and general messages). Reported events shall include a time and date stamp, site location and network address, and alpha-numeric event ID. Any one or combination of the following event reporting actions shall be assignable to each event: ASCII file, numeric pager (pages personnel by sending numeric messages to personal pagers through the use of a third-party service), printer, and operator’s terminal.

6. Trending: Any point, physical or calculated, shall be capable of trending. Collection of data shall be definable by either pre-defined time intervals or pre-defined changes of value. Trending information from anywhere in the system shall be available at the operator’s terminal without requiring intervention by an operator.

7. Scheduling: The system shall be capable of scheduling by zone, individual equipment, groups of zones or equipment, building area, and systems. Equipment or zone groups shall be definable by the operator. Weekly schedules shall incorporate seven (7) independent daily programs. System shall also incorporate one-time and annual event scheduling. The system shall automatically update for daylight savings time and leap years. Schedules shall be capable of being overridden at the operator's terminal.

8. Optimum Start/Stop: Start and stop equipment on a sliding schedule based on the individual zone temperature and the heating/cooling capacity of the equipment serving that zone. The heating/cooling capacity value shall be operator adjustable.

9. Source Temperature Optimization: Automatically perform source temperature optimization for all equipment noted to have temperature setpoints reset by system demand in the control diagrams. Capability shall include resetting of temperature setpoints in accordance with user-adjustable parameters as well as starting and stopping of primary mechanical equipment based on zone occupancy and/or zone load conditions. Temperature optimization loops shall be tuned to minimize cycling and maximize system stability.

10. Demand Limiting: The system shall be capable of measuring electrical usage from multiple meters serving one building. Each piece of equipment being controlled shall be programmable to respond to peak demand information. The demand control function shall utilize a sliding window method with the operator being able to establish the kilowatt threshold for a minimum of three (3) adjustable demand levels. The operator shall have the capability to set the individual equipment temperature setpoints for each operator defined demand level. Equipment shall not be shed if these reset setpoints are not satisfied. The system shall have failed meter protection, generating an alarm upon loss of KW signal. System shall archive demand and usage information. Information shall be retrievable by day, month-to-date and year-to-date basis.

11. Night Setback: The system shall allow the space temperature to drift down or up within an adjustable unoccupied temperature range. Heating and/or cooling shall be controlled to maintain the night setback range during the scheduled night setback periods.

12. Timed Local Override: When provided with occupant override capabilities the system shall permit the override of equipment which has been scheduled off. Override history shall be maintained for each timed local override input point.
13. Economizer: The system shall be capable of switchover from mechanical cooling to economizer cooling based on outside air temperature. Economizer operation shall be capable of being overridden by the operator.

D. Graphical User Interface

1. Floor Plan and System Selection/Penetration: The operator interface shall allow users to access the various system schematics and floor plans via both a graphical penetration scheme and menu selection.
   a. Graphical penetration scheme: Multiple floor plan displays, when required, shall all be accessible from a single initial screen. System schematics shall be directly accessible from the floor plan display for the area they serve. For zoned systems, both the zone and main system schematics shall be accessible from the floor plan display. For systems that interact with secondary systems and/or equipment (e.g. an air handling unit with a hot water coil served by a heating water system), the secondary system and/or equipment shall be accessible from the primary system schematic. It is the intent of this graphical penetration scheme that, from a single screen, any location served by the system can be accessed and, from any floor plan display, all systems and/or equipment serving that area can be accessed.
   b. Menu selection: A menu selection shall also be available to the operator, similar in nature and layout to the graphical penetration scheme described above.

2. Floor Plan Displays: Provide color graphic floor plan displays designating each temperature control zone. Each zone shall have a graphic and color-coded indication of space temperature relative to setpoint, with a minimum of five (5) different indicators (e.g. dark blue, light blue, green, yellow, red).

3. System Schematic Displays: Provide color graphic system schematics for all mechanical equipment and systems. Schematics shall be similar in nature to the control diagrams included in the drawings. Each system and/or equipment schematic shall include the following minimum information:
   a. System designation
   b. Graphic representation and labeling of all major equipment and components (all scheduled equipment as a minimum)
   c. Current status of all I/O points applicable to the system (located appropriately for ease of proper association)

4. System Setpoint and Scheduling Adjustments: All system setpoints and schedules shall be adjustable through the graphic interface. This includes all space temperature setpoints, occupied/unoccupied/warm-up schedules, and all points noted in the control diagrams as adjustable. Adjustments shall require only mouse operation and entering of new values. Changes shall be automatically transferred to the appropriate control module.

5. Windowing: The windowing environment of the operator's terminal shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

6. Programming Accessibility: Programming for sequences of operation shall be accessible through the graphical user interface.

7. Setpoint Accessibility: Each setpoint and/or item indicated in the control diagrams to be adjustable shall be accessible and capable of being modified through the graphical user interface.

8. Graphics Development Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
a. The contractor shall provide libraries of pre-engineered screens and symbols depicting standard HVAC components (e.g. fans, cooling coils, filters, dampers, etc.) and electrical symbols.

b. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
   1) Define symbols
   2) Position and size symbols
   3) Define background screens
   4) Define connecting lines and curves
   5) Locate, orient and size descriptive text, define and display colors for all elements
   6) Establish correlation between symbols or text and associated system points or other displays

c. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels, including application specific controllers used for DDC unitary or VAV terminal unit control.

E. Web Browser Interface

1. Compatibility: The system shall be capable of supporting an unlimited number of clients using Internet Explorer. Web browser software shall be compatible with the operating system and system configuration provided.
2. Consistency with GUI: Graphical screens developed for the GUI shall be the same screens used for the web browser client. Any animated graphical objects supported by the GUI shall be supported by the web browser interface. The browser shall provide the same view of the system as the graphical user interface including graphics, schedules, calendars, logs, etc. and shall provide the same interface methodology as the GUI. Systems that require different views or that require different means of interacting with objects such as schedules or logs will not be permitted.
3. Security: User identification and password security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented. Limitations of user access and control similar to that provided at the operator's terminal shall be assignable to each user.
4. Editing Capabilities: HTML editing by the operator shall be allowed, but not be required for proper operation.
5. Graphics Storage: Graphical screens shall be stored in the server. Systems that require graphics storage on the client machine are not acceptable.
7. Links: Graphical screens on the web browser client shall support hypertext links to other locations on the Internet or on Intranet sites through the Uniform Resource Locator (URL).

2.2 DAMPER AND VALVE ACTUATORS

A. Manufacturers (Refer to Section 20 10 00):

1. Belimo, for air handling unit dampers and other system control dampers.
2. As manufactured by approved EMCS manufacturer, for control valves and air terminal unit dampers. Manufacturers who do not have valves and air terminal unit dampers labeled under the Manufacturer's name shall provide Belimo actuators.
B. High resolution type with positive feedback on valve or damper position, direct coupled type.

1. Spring-return operation to fail open or closed upon loss of signal or power when indicated on the drawings as normally open (NO) or normally closed (NC), respectively; constructed to maintain last position upon power failure when not specified to be either normally open or normally closed on the drawings.

2. Built-in overload protection to prevent damage to the actuator when the actuator or damper reaches its end position.

3. Designed for a minimum life of 60,000 cycles; selected for compatibility with associated equipment.

4. Damper actuators sized for 50% safety factor with ample capacity to hold device at an intermediate position.

5. Valve actuators sized for torque required for valve close-off at maximum pump differential pressure. Valve actuators shall be factory installed on the valves with necessary hold off brackets and shields to protect the actuator from condensation and over-heating.

6. Actuator unit shall be submerged in oil and sealed in die cast case; UL listed; 3 year unlimited warranty.

2.3 AIRFLOW MEASURING STATION (THERMAL SENSING STYLE)

A. Manufacturers (Refer to Section 20 10 00):

1. Ebtron

B. Sensor shall consist of multiple probes which utilize thermal dispersion technology with a pressure drop not to exceed 0.05 inches WG at 2,000 FPM with 2% accuracy between 0 to 5,000 FPM.

C. Probes: Model GP-1. Gold anodized 6061 aluminum probe, hermetically sealed “bead in glass” thermistor sensors, glass filled polypropylene sensor housing, 304 stainless steel duct mounting brackets, plug and play cable in length to suit application.

D. Transmitter: 24 VAC, 20 V-A max power which is fused and protected on the transmitter, display CFM (with area input).

E. Network Configuration: GTX-116-P transmitter with 9600 baud RS485 serial output in BACnet Protocol, interface includes airflow or velocity.

F. See schedule on drawings for approximate duct sizes and airflows.

G. Submittals: Submit installation instructions with product data. After approval by Owner’s Representative, forward a copy to the installing contractor (Section 23 33 00).

2.4 WATER FLOW METER

A. Manufacturers (Refer to Section 20 10 00):

1. Onicon

B. Insertion type turbine flow meter designed for “hot tap” installation on systems filled with fluid or, alternately, provide with an insertion meter installation kit complete with thread-o-let nipple and full port valve for installation on systems with no fluid in the system.
1. F1100 Series Single Turbine Flow Meters for steel pipe 1 ¼” and larger and copper pipe 1” and larger for single directional flow where straight pipe run is long enough to produce a fully developed flow profile.
2. F1200 Series Dual Turbine Flow Meters for pipe sizes 2 ½” and larger for irregular flow conditions caused by inadequate straight pipe runs.
3. FB1200 Series Bi-Directional dual Turbine flow meter for pipe sizes 2 1/2” and larger for use in system when flow can occur in both directions and includes an isolated contact closure output to indicate flow direction as well as flow rate.
4. F-1300 Series Inline Turbine flow meters for pipe sizes ¾”.

C. Pipe size and flow rate as indicated on the drawings.

D. Materials-Chilled Water, Hot Water (to 280 degrees F), Condensor Water
   1. 316SS for heating water over 250 degrees F.
   2. 316 SS for non-metallic Pipe

E. Materials-Make-up Water, Domestic Water, un-treated Non-Potable/Industrial Water Systems
   1. 316SS for steel, copper and PVC or non-metallic piping systems.

F. Materials-Steam Condensate and Boiler Feed Water (to 280 degrees F)
   1. 316SS

G. Performance and Options
   1. Wetted parts shall be bright tin plated brass or Type 316 stainless steel.
   2. Sensing method shall be impedance sensing, nonmagnetic and nonphotoelectric.
   3. Accuracy ±2 % of actual reading from 0.4 to 20 FPS.
   4. 400 psi maximum operating pressure.
   5. 200 degrees F maximum continuous liquid temperature.
   6. Non-isolated analog output signals, 0 to 10 VDC and 20 mA, linear with flow. Binary (digital) dry contact output for bi-directional flow meter.
   7. 24 VDC power supply.
   8. Hot tap installation to include branch outlet tapping, close nipple, full port ball valve and hot tap adapter.
   9. Local display module to be Onicon Series D-1200 or BD-1200 direct read with LCD display and BACnet interface.
   10. Provide with temperature sensors for monitor of energy in addition to flow when indicated on control drawings.

2.5 REFRIGERATION SENSORS

A. Manufacturers (Refer to Section 20 10 00):

B. CMOS or IR sensor shall continuously measure and display the specific gas concentration and shall be capable of indicating, alarming, and shutting down equipment, and automatically activating ventilation system.

C. Features and Performance

1. Refrigerant: R-134a.
2. Refrigerant Concentration: 0 to 1000 ppm.
3. Accuracy: 100 to 1000 ppm; ±10 %.
5. Resolution: 1 ppm.
6. Operating environment: 30 to 120 degrees F, 0 to 80 % R.H.
7. Input power: 120VAC, 60 Hz.
8. Input signals: 0 to 5 VDC from remote IR sensors.
10. Alarm setpoints: Adjustable on face of panel.
11. Audible output: Sonic alert at 75 to 80 dB at 10 feet.
12. Strobe: Built-in, blue, 60 to 90 FPM, 100,000 candle power.
13. Display: 10-character, alphanumeric LCD with select and adjust pushbuttons.
14. Alarm lights with silence button.
16. Remote Alarm: Provide separate remote strobe and horn outside of equipment room when indicated on the plans.
18. Furnish with field calibration kit. Demonstrate calibration to the Owner and commissioning agent and provide spare gas for future Owner calibration.

2.6 CONTROL VALVES

A. Manufacturers (Refer to Section 20 10 00):

1. As manufactured by approved EMCS manufacturer, or approved by the Owner’s Representative.

B. 2-way or 3-way as indicated on the drawings

C. Ball or butterfly valves of suitable construction for intended application in accordance with the manufacturers recommendations

D. Throttling plugs and renewable composition seats

E. Stainless steel ball and stems

F. Suitable for close-off pressure differential equal to the total head of the respective circulating pump or system steam pressure

G. Provided with manual positioning capability to allow manual positioning of valve in absence of control power

H. Sized by the control contractor for a 4 psi maximum pressure drop

I. Pressure rating: 125 PSI minimum working pressure.
2.7 CONTROLLERS

A. Manufacturers (Refer to Section 20 10 00):
   1. As manufactured by approved EMCS manufacturer.
   2. Equipment Controllers
      a. Stand-Alone Operation: Integral processor, software, hardware, firmware, and memory sufficient to perform complete stand-alone control and operation of associated equipment.
      b. Expansion: Controllers shall accommodate multiple I/O expansion modules for the possibility of future expansion.
      c. Operator’s Terminal Interface: All point data, algorithms and application software within a controller shall be custom programmable from the operator’s terminal.
      d. Self-Diagnostics: Each controller shall include self-diagnostics, which allow the controller to automatically notify the network controller of any malfunctions or alarm conditions that exceed desired parameters.
      e. Operator’s Interface: Each controller shall contain a port for connection of a portable computer. The entire system shall be accessible from this port.

3. Unitary Controllers
   a. Stand-Alone Operation: Upon loss of communication, each unitary controller shall execute its assigned control algorithm in a stand-alone mode.
   b. Zone Temperature Sensor Compatibility: Unitary controllers shall support various types of zone temperature sensors including temperature sensor only, temperature sensor with setpoint adjustment, temperature sensor with local override switch, and temperature sensor with setpoint adjustment and local override switch.
   c. For applications that require airflow measurement, the unitary controller shall include a precision built-in differential pressure transducer. The differential pressure transducer shall have a measurement range of 0 to 4,000 FPM and measurement accuracy of ±5% at 400 to 4,000 FPM. Controller shall include provisions for manual and automatic calibration of the differential pressure transducer. Automatic calibration shall occur whenever the system mode switches from occupied to unoccupied bode or vice versa.
   d. VAV Applications: Unitary controller shall be provided with either a separate or integral direct-coupled electronic actuator. The actuator shall be of the on-off floating point control. The actuator assembly shall mount directly to the damper operating shaft. The actuator shall be electronically protected against overload.
   e. Serviceability: Controller wiring terminal bars shall be of detachable type allowing quick serviceability of the electronic controller hardware without removal of the existing wiring.

2.8 TEMPERATURE CONTROL DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Air Balance
   2. American Warming
   3. Ruskin
   4. Delta Control Products – Class I
   5. Tamco

B. Type 1-Low Leak, Aluminum, Air Foil
   1. Basis of Design: Ruskin CD-50
2. General: Low-leak, airfoil design; extruded aluminum; parallel blade for return air applications and opposed blade for outside and exhaust air applications or as indicated on the drawings.

3. Application:
   a. Ducts or systems 3000 cfm and greater and all ductwork constructed to pressure classes greater than 2”
   b. Dampers installed in walls or roofs that are not ducted to a fan.

C. Construction
   1. Extruded aluminum hat channel frame, 1/8 inch minimum thickness.
   2. Extruded aluminum airfoil blades with integral structural reinforcing entire length of blade.
   3. Extruded vinyl double edge blade seals, easily replaceable; non-corrosive molded synthetic bearings.
   4. Square or hexagonal axles for positive locking (round is not acceptable).
   5. Linkage concealed in frame.

D. Leakage: AMCA certified for leakage of equal to or less than 6 CFM/foot² at 4 inch WG.

E. Type 2-Low Leak, Galvanized, Non-Airfoil
   1. Basis: Ruskin CD-36, CDR-36.
   2. General: Low leak, steel frame and blades, parallel blade for return air applications and opposed blade for outside and exhaust air applications or as indicated on the drawings.
   3. Application:
      a. Ducts or systems less than 3000 cfm for ductwork construction to 2” pressure class (and less)
   4. Construction
      b. Galvanized steel blades.
      c. Seals: PVC coated polyester fabric mechanically locked to the blade edge.
      d. Synthetic bearings.
      e. Square or hexagonal axles for positive locking (round is not acceptable).
      f. Linkage concealed in frame.
   5. Leakage: AMCA certified for leakage of equal to or less than 7 CFM/foot² at 5” inch WG for a 12” wide damper.

2.9 UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Manufacturers (Refer to 20 10 00):
   1. Best Power Technology
   2. Liebert
   3. Necedan
   4. WI

B. Basis of Design: Best Power Technology Ferrups Series

C. Provide an UPS for the operator’s terminal and the direct digital controls system (DDC) microprocessor front-end. The UPS shall have an output to the EMCS to alarm the system of normal power loss and recovery.
1. UPS unit shall provide thirty (30) minutes of system operation in the event of 120 volt normal power loss for any reason.

2. The UPS unit shall normally provide power from the battery/inverter source while the battery is under continuous charge by the normal 60 Hz AC power. In the event of an overload on the inverter, the UPS shall automatically and instantaneously transfer from battery/inverter mode to normal 60 Hz AC power mode. When the overload is resolved, the system shall automatically and instantaneously re-synchronize and transfer from normal 60 Hz AC power mode back to battery/inverter mode. In the event of failure of the normal 60 Hz power, the transfer described above shall be initiated, even in the face of an overload. Upon restoration of the normal 60 Hz AC power, the system shall re-enable the transfer to normal 60 Hz AC power. All transfers shall occur in such a manner that they are transparent to both the user and the system except that if the normal 60 Hz AC power fails, an alarm contact closure shall be available which will reset automatically when the normal power source is restored.

3. The UPS unit shall fully recharge backup batteries within eight (8) hours after restoration of AC primary power.

4. Electrical requirements:
   a. 120 VAC input
   b. ±3 % max (10 % to 100 % load) regulation
   c. 5 % maximum distortion
   d. 1 Hz or 4 Hz per second slew
   e. 250:1 from line spike attenuation
   f. 86 % on line efficiency
   g. KVA rating, batteries, and output as required

5. Overloads: 125 % for 10 minutes on bypass (to 60 Hz AC); 110 % for 10 minutes on inverter (to normal).

2.10 VARIABLE FREQUENCY DRIVES (VFD'S)
   A. Furnished by the EMCS Contractor in Section 23 09 23 in accordance with Section 23 09 33.

2.11 GENERAL COMPONENTS
   A. Conduit: Conduit shall meet all requirements of the Latest Edition of the National Electrical Code and State Codes and Division 26.

   B. Contactors
      1. Single coil, electrically operated, mechanically held type
      2. Positive locking obtained without the use of hooks, latches or semi-permanent magnets
      3. Doubled break silver to silver type protected by arching contact where necessary
      4. Number and rating of contacts selected for the intended application
      5. Operating and release times shall be 100 milliseconds or less
      6. Equipped with coil transient suppression devices to limit transients to 150 % of rated coil voltage

   C. Electronic Transmitters: Temperature sensing elements shall be thermistor or platinum RTD type as indicated below.

   D. Enclosures: Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer’s standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures may be NEMA 1 when located in a clean dry indoor environment. Indoor enclosures shall be NEMA 12 when
installed in other than a clean dry environment. Equipment installed outdoors shall be housed in a NEMA 4 enclosure. Penetrations shall be sealed to preclude entry of water using a silicone material. All control panels shall be UL listed for code compliance.

E. Nameplates: Provide laminated plastic nameplates for all equipment and monitoring and control devices in accordance with the requirements of Section 23 05 53. Each nameplate shall identify the function, such as “mixed air controller” or “cold deck temperature sensor”. Nameplates shall be in accordance with the requirements of Section 23 05 53.

F. Power Conditioning
1. Capacity shall match the equipment served
2. Output 120 VAC, +6 to –8 % at 90 to 136 VAC input
3. Maximum 2 % total harmonic wave form distortion
4. 10 million to 1 common-mode noise attenuation (140dB minimum at 0.0)
5. 57dB normal-mode noise attenuation for 10 Hz to 1 MHZ
6. Provide for all solid state equipment unless protection meeting these requirements is an integral part of the equipment.

G. Power Monitors: Three-phase type with three-phase disconnect/shoring switch assembly; UL listed voltage transformers and UL listed split-core current transformers.

H. Relays
1. General:
   a. Rated for the intended application
   b. Minimum of 2 sets of Form C contacts
   c. Enclosed in a dust-proof enclosure
   d. Rated for a minimum life-cycle of 1,000,000 operations
   e. 20 milliseconds or less operating time
   f. 10 milliseconds or less release time
   g. Equipped with coil transient suppression devices to limit transients to 150 % of rated coil voltage
2. Enclosed Relays (Relay-in-a-Box) RIB: SPDT enclosed relays with nipple mount for panel applications with LED status pilot light.
3. DIN Socket Control Relays:
   a. Plug-in type with dust cover
   b. Contact rating, configuration, and coil voltage suitable for application
   c. UL listed
4. Time Delay Relays:
   a. Solid state plug-in type with adjustable time delay
   b. Delay shall be adjustable plus or minus 200 % from setpoint called for
   c. Contact rating, configuration, and coil voltage suitable for application
   d. NEMA 1 enclosure when not installed in local control panel

I. Sensors
1. General: Sensors and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.
2. Provide wall boxes for sensing elements for conduit rough-in with extension rings if required due to finished surfaces on the walls.
3. Duct Temperature Sensors: Resistor Temperature Detector (RTD) with platinum element and transmitter to match resistance range of RTD or thermistor type, accuracy of 0.1 % at 32 degrees F.
   a. Use averaging type on mixed air plenums and downstream from heating and cooling coils. Averaging type sensor encased in bendable copper sheath of the length required (normally 24 feet long). Serpentine element horizontally.
   b. Use direct insertion probe type on return air and supply air ducts. Use 4 inch long probe on terminal box discharge supply ducts. Use 12 inch long probe on main return air and supply air ducts.

4. Low Limit Thermostats (Freezestats): Dual signal low temperature cut-out and alarm thermostat with remote sensing element. Manual reset type selected for the application. Bulb shall be approximately 20 feet long for use in large ducts or plenums and shall be designed to stop the respective fan should the temperature drop below setpoint along any one foot length of the bulb. 15 to 55 degrees F adjustable range.
   a. Provide with two sets of contacts. One to hardware to equipment for shutdown and one for the DDC system for monitoring.

5. Outside Air Temperature Sensors: Resistor Temperature Detector (RTD) or thermistor; -20 °F to 180 °F temperature range, sun shield and weatherproof assembly for mounting to rigid conduit.
   a. Install away from exhaust/relief vents. Preference should be given to locate as near as possible to the outside air intake for the air handling equipment, but keeping it out of direct sunlight or other reflective sources that would adversely affect it’s accuracy. When possible the sensor should be located on the northwest outside building wall.

6. Room Temperature Sensors:
   a. 10K ohm at 77 degrees F thermistor, ±0.5 degrees F accuracy.
   b. Provide with integral communications jack to communicate with the zone’s unitary controller.
   c. Temperature sensor with blank tamperproof cover, no display, adjustment or override.
   d. Temperature sensor with LCD display indicating space temperature and setpoint adjustment buttons or slider.
   e. Temperature sensor with local occupancy override and indicator light (no display or setpoint adjustment).
      1) Generally sensors have blank cover with no display, adjustment or override. When over-rides or setpoint adjustments are required, these are indicated on the control diagrams.

7. Immersion Temperature Sensors:
   a. 10K ohm at 77 degrees F thermistor, ±0.5 degrees F accuracy.
   b. Range as suitable for application.
   c. Provide stainless steel or brass thermowell for threaded mounting into pipe.
   d. Thermal paste shall be used in all thermowells.
   e. 4 or 8 inch insertion length depending upon pipe size and mounting configuration available (elbow, lateral or straight).

8. Humidity Sensors:
   a. 0% to 100% RH range, ±5 % accuracy. Applies to space or duct sensors. Space sensors shall be incorporated in the same housing as the zone or room temperature sensors where available.
   b. Bulk polymer sensor.
c. 32 to 122 degrees F operating temperature range.
d. 4 to 20mA output, linear and proportional.
e. Duct mounted sensor with immersion probe.

9. Pressure Sensors:
a. Air Differential Pressure Sensors:
   1) Electronic transducer
   2) Linear variable differential transformer type sensing element with two-wire transmitter
   3) 2 % of full scale accuracy
b. Liquid Differential Pressure Sensors:
   1) Single pole, single throw switch
   2) Bellows type
   3) Adjustable range
   4) Suitable for intended application

10. Room Static Pressure Sensors:
a. Duct or room mounted microprocessor based differential pressure transducer.
b. 2-wire loop powered, 4 to 20 mA output.
c. Pressure ranges: 0 to 1 inch WG or 1 to 10 inches WG. Uni or bi-directional, selectable.
d. Accuracy: ±1 % full scale.
e. Local LCD display of duct or room static pressure.
f. Pick-up tubing and 8 inch insertion type duct static pick-up probe.
g. Basis of Design: Veris PX Series.

11. Carbon Dioxide (CO2) Sensors for demand ventilation control:
a. Non-dispersive infrared (NDIR) sensor.
b. Continuous monitoring.
c. Microprocessor based with LCD local display and setup keypad.
d. 0 to 2,200 ppm measurement range.
e. Accuracy: ±75 ppm or 7 % whichever is greater.
f. Repeatability: ±20 ppm.
g. Altitude correction adjustable.
h. Output signal: Continuous proportional analog output, 0 to 10 VDC or 4 to 20mA.
i. Factory calibrated with 5 year guarantee.
j. Calibration: Minimum recommended 3 year interval.
k. Furnish necessary calibration tools and gases for the test and balance agency to spot check the calibration and to demonstrate calibration to the Owner.
l. Room (wall) or duct mounted as indicated on control drawings. Provide duct mounting kit with aspirating box with sampling probe and/or tubing.
m. Integral temperature sensing when CO2 and temperature sensing are required in the same room.
n. No display on cover.
o. Temperature setpoint adjustment when indicated on the drawings.
p. Basis of Design: Telaire Ventostat 8000 Series.

J. Switches

1. Air Flow Switches:
a. General purpose utilizing differential air pressure.
b. SPDT snap-acting contacts.
c. Adjustable from 0.1 to 2.0 inches WG minimum or as required for the intended application.
d. Aluminum construction with neoprene diaphragm.
2. Bypass Switches:
   a. Momentary contact type push button.
   b. Installed in standard wall box with stainless steel cover.
3. Current Switches (fan and pump status):
   a. Self-powered.
   b. Solid state.
   c. Adjustable trip current; selected to match the current of the application and output
      requirements of the EMCS system.
   d. UL listed.
   e. Provide variable frequency drive rated current switches on motors with VFDs.
4. Damper End Switches:
   a. Momentary type limit switches for monitoring motion of the damper at a prescribed
      arc of rotation.
   b. Hermetically sealed mercury contacts that operate by way of a trip lever.
   c. Mounted on the exterior of the duct so that the trip lever is aligned with the damper
      vane.
   d. Mechanically adjustable in the switch case to set the proper lever action for
      tripping the mercury switch contacts.
   e. SPDT contact arrangement exceeding the load requirements for both voltage and
      current.
5. Air Differential Pressure Switches:
   a. Snap-acting
   b. Pilot duty rated (125 VA minimum)
   c. NEMA 1 enclosure
   d. Scale range and differential suitable for intended application
   e. UL listed
   f. Filter Status: Range 0.05 to 2.0 inches WG, adjustable, SPDT contacts, 15 amps
      at 277 VAC.
   g. Duct High Limit: Range 0.40 to 12.0 inches WG adjustable, SPST contacts, 15
      amps at 277 VAC, manual reset.
6. Flow Switches:
   a. Air Service:
      1) Differential pressure type switches as specified above.
   b. Water Service:
      1) Paddle type switch.
      2) Snap-acting with pilot duty rating (125 VA minimum).
      3) Adjustable sensitivity.
      4) NEMA 1 enclosure.
      5) UL listed.
      6) Alternatively, differential pressure type switches as specified herein.
7. Override Timers:
   a. Spring-wound.
   b. Line voltage.
   c. Contact rating and configuration as required for application.
   d. Suitable for flush mounting.
   e. 0 to 6 hour calibrated dial or as dictated by use.
K. Sensor Wells
1. Bronze or brass with NPT threads sized to match associated device.
L. Transformers

1. Current Transformers:
   a. Current ratio as necessary for application.
   b. Windings completely enclosed, except for terminals.
   c. 1 % of full scale accuracy.
   d. UL listed.

2. Voltage Transformers:
   a. 600 VAC rated.
   b. Complete with built-in fuse protection.
   c. Windings completely enclosed, except for terminals.
   d. Suitable for ambient temperatures of 40 to 130 degrees F.
   e. 0.5 % accuracy at 24 VAC.

M. Transmitters

1. Current Transmitters:
   a. Self-powered combination split-core current transformer type with built-in rectifier and high-gain servo amplifier.
   b. Unit range as necessary for application.
   c. Internal zero and span adjustment.
   d. 1 % of full scale accuracy.
   e. UL listed.

2. Voltage Transmitters:
   a. Self-powered single loop type.
   b. Internal zero and span adjustment.
   c. 1 % of full scale accuracy.
   d. UL listed.

N. Wiring: All wiring shall be compliant to local building codes and the NEC and Division 26 of these specifications.

END OF SECTION 23 09 23
PART 2 - PRODUCTS

2.1 CONSTRUCTION:

A. The drive shall be designed to provide ease of maintenance and shall be modularly constructed. Printed circuit boards shall have plug-in connections and be easily removed from the drive. Power components shall be readily accessible and have “fast-on” or screw terminal connections for easy removal.

1. Unless otherwise specified, the drive shall be a NEMA Type 1 enclosure.
2. The drive shall consist of the following major components:
   a. Input rectifier section to supply fixed DC bus voltage
   b. Phase-to-phase and phase-to-ground MOV protection
   c. Smoothing reactor for the DC bus
   d. DC bus capacitors
   e. Sine weighted pulse width modulated (PWM) inverter section consisting of Insulated Gate Bipolar Transistors (IGBT’s)
   f. Separate terminal blocks for control and power wiring
   g. Input line reactors
   h. Integral motor rated circuit and breaker disconnect and handle operation.
   i. 5 % input line impedance.

3. Bypass contactors:
   a. Bypass contactors shall be provided except for parallel fan applications or systems which have other backup operational capabilities if the drive should fail.
   b. Bypass contactor shall provide a means to manually switch a single motor from drive control to line power operation. Provide a full voltage, non-reversing contactor for line operation. Bypass contactor function shall electrically isolate the drive line and load connections as well as provide the bypass path.
   c. In addition to the electronic overload inherent to the drive, furnish an external overcurrent protective device (thermal magnetic type). This device would protect for overloads in the bypass, hand and auto mode.
   d. Bypass contactor/drive combination enclosure shall include: hinged front door, top or bottom conduit entry, ¼ turn door locking mechanism.
   e. Shall conform to all applicable provisions specified in Division 26 such as for overload protection and lockable disconnects. Power factor correction capacitors are not required.

4. The following devices shall be operable with the enclosure door closed:
   a. Bypass-Hand-Off-Auto selector switch
   b. Run/Stop Indication
   c. Manual speed control
   d. Digital display and keyboard
   e. Resetting of the external overcurrent protective device

5. Enclosure and components shall have a minimum short circuit interrupting rating of 14,000 amps. Short circuit and overcurrent protective devices shall be selected to coordinate with other in-line devices according to Division 26. Digital display panel and keyboard for programming, operation, and fault codes diagnostic information shall be
provided. No adjustments by potentiometers other than manual speed control is acceptable. All drive set-up operations and adjustments shall be digital and stored in a nonvolatile memory (EEPROM).

B. Operating Conditions

1. The drive shall be suitable for use in normal indoor non-hazardous environments subject to the following conditions unless otherwise indicated:
   a. Ambient temperature range of 0 to 40 °C
   b. Humidity range from 5 to 95 %, non-condensing
   c. Fan-assisted cooling shall be used where required to dissipate heat. The fan shall be installed in such a manner as not to degrade the enclosure rating.

C. Input Power

1. Unless otherwise specified, the drive shall accept 460VAC, 3-phase, 60 Hz.
2. Accept input line voltages of 400 to 500VAC ±10 % and line frequency of 48 to 63 Hz.
3. Drive shall be equipped with an automatic extended Power Loss Ride-through circuit which will utilize the inertia of the load to keep the drive powered. Minimum Power Loss Ride Through shall be one cycle based on full load and no inertia.
4. The drive input circuitry shall not generate line notches or large voltage transients on the incoming line. Provide protection through EMI/RFI filters.
5. The drive shall present a displacement power factor of 0.95 or better to the AC line at any speed or load.
6. The drive control efficiency at rated load and frequency shall be 98 % or better to the AC line at any speed or load.
7. The drive shall have input transient protection and shall not be sensitive to notching on the incoming line.
8. Shall be capable of automatic restart after overvoltage, overcurrent, undervoltage, or loss of input signal trip. Number of restart attempts and timing shall be programmable.

D. Output Power

1. The drive shall produce a (sine weighted PWM) three phase output for the load.
2. Unless otherwise specified, the standard drive output frequency shall be adjustable from 0 to 120 % of base speed.
3. Unless otherwise specified, the drive output voltage shall be adjustable from 0 to 460 VAC, reaching 460 V at 60 Hz.
4. Variable torque drives shall produce a reduced volts-per-hertz (V/Hz) ratio in the 60 Hz range and below.
5. Constant torque drives shall produce a constant volts-per-hertz (V/Hz) ratio in the 60 Hz range and below.
6. Unless otherwise specified, the drive shall supply a constant 460 V output when operating above 60 Hz.
7. The volts-per-hertz output of the drive shall not be affected or require readjustment when other drive adjustments (such as maximum speed) are changed.
8. Selectable constant V/Hz ratio or configurative V/Hz ratio. The drive shall have selectable pre-programmed V/Hz ratios and the capability of programming a custom V/Hz pattern.
9. As standard, the drive will have the ability to produce a linear or squared V/Hz curve.
10. When subject to the range of ambient conditions stated above, the drive shall be capable of maintaining 110 % of rated output current continuously.
11. When subject to the range of ambient conditions stated above, the drives shall be capable of delivering for up to one minute, the following:
   a. 110 % of rated output current for variable torque drives.
   b. 150 % of rated output current for constant torque drives.
12. The drive shall have field adjustable PWM carrier frequency to minimize audible motor noise. The carrier frequency shall be adjustable from approximately 1 KHz to at least 3 KHz.

13. The drive shall be capable of operating the output open circuited with no fault or damage.

14. The drive shall be capable of delivering 150% starting torque in starting torque application and 110% in variable torque applications.

E. Control Features:

1. Bypass-Hand-Off-Auto selector switch functions for bypass contactor/drive applications:
   a. Bypass selected: The bypass contactor starts the motor.
   b. Hand selected: the speed is controlled from the local operator control panel. The remote 0 to 10VDC signal shall be isolated and have no control in this position.
   c. Off selected: the drive cannot be started.
   d. Auto selected: the drive shall be started and stopped via a remote dry contact (24 VDC or less). The speed shall be in proportion to a remote 0 to 10 VDC control signal.

2. Unless otherwise specified, the drive shall produce an output frequency proportional to the speed reference without external feedback.

3. For all analog speed commands, the drive shall maintain set frequency to within 0.01 Hz during power line fluctuations or changes in ambient temperatures.

4. Within the drive rating, the drive shall maintain set frequency and not require readjustment due to changes in load.

5. The drive shall have a foldback current limiting circuit. During acceleration, the circuit shall automatically reduce the acceleration rate to a slower rate should the load inertia cause excessive currents.

6. The drive shall have a selectable deceleration voltage limiting circuit. The circuit shall extend the set deceleration ramp should the bus voltage approach high limits due to regeneration.

7. The drive shall have incrementally adjustable IR compensation boost. A selectable range for offsetting motor losses at low frequency operation shall be used to optimize motor torque for starting high inertia and high friction loads.

8. Drive operation shall be fully digital with microprocessor control of frequency, voltage and current.

9. The drive shall be capable of starting with the load regenerating voltage back on the drive bus.

10. The controls (including bypass-hand-off-auto) shall have the capability of being overridden by the opening of a normally closed dry contact, supplied and operated by the building fire alarm system.

F. Speed Control

1. The drive shall contain an independent parameter which will provide an adjustable minimum speed setting from 0 to 70 Hz.

2. The drive shall contain an independent parameter which will provide an adjustable maximum speed setting from 40 to 70 Hz.

3. The drive shall accept an analog input reference of 0 to 10 VDC, or from a potentiometer. The 0 to 10 VDC option shall be the standard reference unless otherwise indicated.

4. The drive shall provide a “percentage of load” analog output signal (e.g. 0 to 10 VDC) for remote monitoring. Output shall be compatible with Mechanical requirements.

5. Selectable coast or controlled ramp stop or DC braking. Selectable stopping modes of coast, ramp to stop or DC brake to stop shall be available.

6. Three adjustable skip frequencies shall be provided to minimize equipment resonances.
G. Drive Controls

1. The drive start/stop commands shall have the capability of operating from TTL, 24 VDC, 115 VAC optional interface boards. The 24 VDC option shall be the standard unless otherwise indicated.
2. The drive shall accept contact closure (2-wire control) or separate start and stop push buttons (3-wire control).
3. The drive inverter shall have capability to be enabled without the need for a start signal, after initial drive power-up.
4. The drive shall have selectable auto restart after a power loss or other pre-selected fault condition. When applied to a spinning motor, the drive shall synchronize to the motor's speed and smoothly accelerate the motor back to the setpoint speed without resetting, recycling or re-enabling the controls. Four (4) retry attempts shall not invalidate the manufacturer's warranty.
5. Internal lockout of panel controls shall be provided to prevent the changing of system parameters. Viewing capability shall not be affected.
6. Drive shall accept a normally closed dry contact signal from an external source, which, when opened will stop the drive in bypass, hand, or auto.

H. Protection

1. Protection is defined as the normal shutdown without any drive, motor or equipment damage.
2. The drive shall be capable of monitoring, annunciating and shutting down the drive for the following conditions:
   a. MOPC
      1) The drive shall have an adjustable momentary overload protection circuit (MOPC) adjustable from 50 to 115 % of drive rating for variable torque drives and from 50 to 150 % of drive rating for constant torque drives.
   b. Motor Overload Protection
      1) The drive shall provide programmable electronic motor overload protection in compliance with the NEC and tested in accordance with UL Standard 991.
      2) The overload protection shall be adjustable from 50 to 110 % of the drive full load current rating.
   c. Overvoltage/Undervoltage Protection
      1) Outside ±10 % of rated input voltage
   d. Phase Protection
      1) The drive shall have protection against (and indicate), a phase-to-phase short in the output load, or a short circuit in a phase of the output module.
   e. Heat Sink Temperature
      1) The drive shall monitor the temperature of the heat sink. If the heat sink temperature exceeds approximately 212 °F, the drive shall shut down and annunciate the condition on the digital display panel.
   f. Ground Fault Detection
   g. Bus Charged Indication
      1) When power is applied to the drive and hazardous potentials exist on the DC bus, the drive shall provide a visual indication at the front of the drive. These indications shall remain lit until power is removed from the drive and the DC bus discharges to potential of 40 VDC or less.
   h. Bus Discharge Protection
      1) The drive shall contain circuits that will discharge the DC bus to below 40 VDC within 60 seconds after input power is removed from the drive. (Note: 40 V is the current NFPA standard).
   i. Input fusing
1) The drive shall have input line fuses as a standard feature in the drive enclosures.

I. Drive Diagnostics

1. The drive shall execute, on initial power-up, a self diagnostic check. The integral programming display panel shall provide first fault indication of the drive protection functions. Fault indication shall be retained if input power is lost. Fault codes shall provide direction as to board level and input/output level to aid in trouble shooting.

J. Serial Communications

1. Provide capability to Interface with the EMCS System in Section 23 09 23 through one of the trace three protocols selected by the EMCS Contractor.
   a. The drive shall be capable of communication with the Landis & Staefa System 600 Control System utilizing the Landis & Staefa Protocol/1 Local Area Network, without use of additional circuit boards or third party interfaces.
   b. BacNet Protocol
   c. Lonworks Protocol

2. Provide with (2) programmable analog outputs, (3) programmable relay outputs.

2.2 PRODUCTS

A. Manufacturers (Refer to Section 20 10 00):

1. ABB, ACH550
2. Graham

B. Service:

1. Manufacturer shall maintain a service center or service representative within 150 miles of the job site. This center must normally provide the following services:
   a. Factory coordinated start-up service.
   b. Perform service calls and providing replacement parts within twenty-four (24) hours
   c. Provide service contracts.
   d. Training of customers in operation and basic troubleshooting.
   e. Maintaining a stock of frequently replaceable parts at a local warehouse.

END OF SECTION 23 09 33
PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATING PUMPS

A. Manufacturers (Refer to Section 20 10 00):
   1. Bell & Gossett Series 80

B. General: In-line; close-coupled; single stage; suitable for horizontal or vertical installation; capable of being serviced without disturbing piping connections.

C. Construction: Cast iron casing; cast bronze impeller keyed to shaft; alloy steel shaft; copper or bronze sleeve; mechanical seal with carbon seal ring and ceramic seat; permanently sealed, grease or oil-lubricated ball bearings; 175 psi maximum working pressure; 225 °F maximum continuous operating temperature

D. Pump casing shall have gauge tappings at the suction and discharge nozzles.
   1. Exception: Pumps that do not have gauge tappings shall be provided with gauge tappings in the connected piping on both the suction and discharge sides.

END OF SECTION 23 21 23
SECTION 23 22 13
STEAM AND STEAM CONDENSATE PIPING

PART 2 - PRODUCTS

2.1 LOW PRESSURE STEAM PIPING AND STEAM VENT PIPING
   A. Pipe up to and including 2 inch:
      1. Steel: ASTM A53; schedule 40; black; ANSI B16.4 cast iron fittings; Class 125; threaded joints
   B. Pipe over 2 inch:
      1. Steel: ASTM A53; Schedule 40; black; ASTM A234 forged steel fittings; Class 150; welding type

2.2 LOW PRESSURE STEAM CONDENSATE PIPING
   A. Pipe up to and including 2 inch:
      1. Steel: ASTM A53; schedule 80; black; ANSI B16.4 cast iron fittings; Class 125; threaded joints
   B. Pipe over 2 inch:
      1. Steel: ASTM A53; Schedule 80; black; ASTM A234 forged steel fittings; Class 150; welding type

2.3 MEDIUM PRESSURE STEAM AND STEAM CONDENSATE PIPING
   A. Pipe up to and including 2 inch:
      1. Steel: ASTM A53; schedule 80; black; ANSI B16.4 cast iron fittings; Class 300; threaded joints
   B. Pipe over 2 inch:
      1. Steel: ASTM A53; Schedule 80; black; ASTM A234 forged steel fittings; Class 300; welding type

2.4 HIGH PRESSURE STEAM AND STEAM CONDENSATE PIPING (ABOVE GRADE)
   A. Pipe up to and including 2 inch:
      1. Steel: ASTM A53; schedule 80; black; ANSI B16.4 cast iron fittings; Class 300; threaded joints
   B. Pipe over 2 inch:
      1. Steel: ASTM A53; Schedule 80; black; ASTM A234 forged steel fittings; Class 300; welding type
2.5  GASKETS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Flexitallic 
   B. Construction: Spiral wound metal gaskets suitable for joint type, system temperature and pressure

2.6  GENERAL VALVES
   A. Manufacturers (Refer to Section 20 10 00):
      1. Hammond
      2. Milwaukee
      3. Nibco
      4. Stockham
   B. General: Provide gear operators and chains for valves in mechanical rooms installed more than 8 feet above finished floor level.
   C. Gate Valves:
      1. Low and Medium Pressure Service
         a. Up to and including 2 inch: MSS-SP80; bronze body; bronze trim; rising stem; union bonnet; solid wedge disc; gland packed; malleable or ductile iron hand wheel; threaded ends; Class 125 for 80 psig and below; Class 150 for systems greater than 80 psi.
         b. Over 2 inch: MSS-SP70; iron body; bronze trim; OS and Y pattern; bolted bonnet; solid wedge disc; gland packed cast iron handwheel; flanged ends; Class 125 for 80 psig and below; Class 250 for systems greater than 80 psi.
   D. Globe Valves:
      1. Low and Medium Pressure Service
         a. Up to and including 2 inch: MSS-SP80; bronze body; bronze trim; stainless steel seat disc; union bonnet, graphite packed gland, malleable or ductile iron hand wheel; threaded ends; Class 300 lb SWP at 550 F, 600 WOG.
         b. Over 2 inch: MSS-SP70; iron body; bronze trim; OS and Y pattern; bolted bonnet; solid wedge disc; gland packed cast iron handwheel; flanged ends; Class 250 SWP, 500 WOG.
   E. Swing Check Valves:
      1. Low and Medium Pressure Service
         a. Up to and including 2 inch: MSS-SP80; bronze body; bronze trim; stainless steel pin; bronze seat and Teflon disc; threaded ends; Class 125 for 80 psig and below; Class 150 for systems greater than 80 psi.
         b. Over 2 inch: Iron body, bronze trim, stainless steel pin; renewable disc and seat; flanged ends; Class 125 for 80 psig and below; Class 250 for systems greater than 80 psi.

END OF SECTION 23 22 13
PART 2 - PRODUCTS

2.1 CONDENSATE RETURN UNITS

A. Manufacturers (Refer to Section 20 10 00):
   1. Paco Series GSD

B. General Construction: Cast iron or welded, rust resistant steel receiver with float; cast iron Y-type inlet strainer; duplex vertical pumps; integral control panel; suction isolation valves; gauge glass; discharge check valves; discharge gate valves; discharge pressure gauges; externally adjustable float switches; mechanical alternator; single-point power connection; thermometer

C. Pumps: Duplex arrangement; close-coupled; vertical; centrifugal; bronze fitted; stainless steel shaft; bronze impeller; mechanical shaft seal; open drip proof motors

D. Control Panel: NEMA 1 enclosure; provisions for padlocking of enclosure cover; UL listed; magnetic starters with overload relays and reset buttons on panel cover; disconnect with cover interlock; circuit breaker for each starter; Hand/Off/Auto switch for each pump; high level alarm horn with acknowledge button; fusible control circuit transformer; relays as required for sequence of operation indicated below; terminal strip for all required points of connection to the EMCS

E. Sequence of Operation
   1. Upon activation of first float switch, engage lead pump and operate until float switch is released. Lead pump status shall be alternated by the mechanical alternator each time a pump is engaged.
   2. Upon activation of the second float switch, engage the lag pump and operate until both the first and second float switches are released. Provide dry alarm contact for connection to the EMCS to indicate use of lag pump.
   3. Upon activation of the third float switch, engage alarm horn. Provide an additional dry alarm contact for connection to the EMCS to indicate high water level alarm.

2.2 PRESSURE REDUCING VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. Fisher, 92B

B. Construction: Cast iron body; stainless steel trim; pilot actuated, diaphragm operated type; threaded connections up to 2 inches, flanged over 2 inches; 125 psig maximum operating pressure for systems below 80 psig; maximum operating pressure of at least 15 % greater than system pressure for systems over 80 psig.

C. See drawings for required pressure operating ranges.
2.3 SAFETY RELIEF VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. Crosby
   2. Hoffman
   3. Spirax Sarco
   4. Spence

B. Construction: Bronze body; stainless steel valve spring, stem, and trim; direct pressure actuated; capacities ASME certified and labeled.

C. Drip Pan Elbow: Cast iron or steel with threaded drip; sized to match relief valve outlet.

D. Valve Rating: Relief valve shall be rated for pressure upstream of pressure reducing station using full operating capacity.

2.4 STEAM TRAPS

A. Manufacturers (Refer to Section 20 10 00):
   1. Armstrong
   2. Hoffman
   3. Spirax Sarco

B. Balanced Pressure Thermostatic Traps: Brass body for systems 80 psig and below; cast iron body for systems greater than 80 psi; bolted or screwed cover; integral ball joint union; stainless steel trim; Class 125 for systems 80 psig and below; Class 250 for systems greater than 80 psi.

C. Float and Thermostatic Traps: ASTM A126; cast iron or semi-steel body; bolted cover; stainless steel bellows type air vent; stainless steel float; stainless steel lever and valve assembly; access to internal parts without disturbing piping; bottom drain plug; 30 psig maximum operating pressure for low pressure systems; maximum operating pressure shall be at least 15 % greater than system pressure for medium and high pressure systems; maximum operating temperature shall allow for 45 °F of superheat at all operating pressures.

D. Inverted Bucket Traps: ASTM A126; cast iron or semi-steel body; bolted cover; stainless steel bucket and trim; access to internal parts without disturbing piping; Class 250 for low and medium pressure systems; Class as required for allowable operating pressure 15 % greater than the system operating pressure.

E. Thermodynamic Traps: Stainless steel body, disc and cap; integral strainer with blowdown valve and insulating cover; 600 psig maximum operating pressure; 750 °F maximum operating temperature.

2.5 STEAM VACUUM BREAKERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Armstrong
   2. Hoffman
   3. Spirax Sarco
B. Construction: Brass body, seat, stem and locknut; stainless steel spring; factory set at 2 inch vacuum, adjustable from ¼ inch to 20 inches vacuum; ¼ inch threaded shank; 150 psig maximum operating pressure; 350 °F maximum operating temperature.

2.6 AIR VENTS

A. Manufacturers (Refer to Section 20 10 00)
   1. Armstrong
   2. Hoffman
   3. Spirax Sarco

B. Construction: Balanced pressure, thermostatic air vent, cast iron body with stainless steel internals. 250 psig maximum operating pressure, ¾ inch size.

2.7 STRAINERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Armstrong
   2. Hoffman
   3. Spirax Sarco

B. Up to and including 2 inch: Screwed brass or iron body; Y pattern with stainless steel perforated screen - 60 mesh for steam and 20 mesh for condensate; ¾ inch blowdown valve with insulating cover; 250 psig maximum operating pressure

C. Over 2 inch: Flanged iron body; Y pattern with stainless steel perforated screen - 60 mesh for steam and 20 mesh for condensate; ¾ inch blowdown valve with insulating cover; 174 maximum operating pressure

2.8 FLASH TANKS

A. Manufacturers (refer to Section 20 10 00 Basic Mechanical Requirements–Equipment/Material Substitutions):
   1. Cemline
   2. Armstrong

B. Tank:
   1. Closed type, tested and stamped in accordance with ASME SEC 8 D, welded steel construction, cleaned, prime and finish coated, and supplied with steel support legs or saddles.
   3. Construct with nozzles and tappings for installation of accessories and piping connections.

2.9 CONVERTOR

A. Manufacturers (Refer to Section 20 10 00):
   1. Armstrong
2. Bell and Gossett, Type SU.
3. Taco.

B. Type: Shell and tube, U-bend tube bundle, steam in tubes, water in shell. Equipped with mounting legs.

C. Materials:
1. Shell - steel.
2. Tubes - 3/4” OD copper
3. Heads - cast iron or steel
4. Tube sheets - steel
5. Tube supports - steel

D. Construction:
1. A manufacturer’s report for pressure vessels, form No. U-1 as required under the provisions of ASME Code Rules, is to be furnished to the Owner’s Representative upon request. This form must be signed by an authorized inspector, holding National Board commission, certifying that construction conforms to the latest ASME Code for pressure vessels.
2. The ASME U symbol shall be stamped on the heat exchanger. In addition, each unit shall be registered with the National Board of Boiler and Pressure Vessel Inspectors.

E. Accessories:
1. Vacuum breaker.
2. ASME safety relief valve.

F. Support frame:
1. Provide with elevated support frame
2. Elevate frame to accommodate gravity steam line to condensate receiver above head height and field mounted pumps on concrete slab below converter. Field coordinate with existing conditions.
3. The frame shall be heavy duty channel and angle iron construction. The frame material shall be ASTM A36 structural steel. The inter-connecting piping shall be all ferrous Schedule 40 black pipe.
4. Heat exchanger shall be secured to the frame by means of a saddle. Fastening the heat exchanger with a simple welded stop will not be acceptable.

END OF SECTION 23 22 16
PART 2 - PRODUCTS

2.1 GENERAL
   A. All specialty devices shall be suitable for system operating pressures and temperatures.

2.2 FILTER DRYER
   A. Manufacturers (Refer to Section 20 10 00):
      1. Alco
      2. Asco
      3. Sporlan
      4. Virginia
   B. Filter drier shall be replaceable core type with nonferrous casing and Schraeder type valve.
   C. Size shall be full line size.

2.3 MOISTURE AND LIQUID INDICATORS
   A. Manufacturers (Refer to Section 20 10 00):
      1. Alco
      2. Asco
      3. Mueller
      4. Sporlan
   B. Combination moisture and liquid indicator with protection cap.
   C. Sight glass shall be full line size.
   D. Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.

2.4 REFRIGERANT PIPING
   A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed
      1. Fittings: ASME B16.22 wrought copper, long radius elbows
      2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy melting range 1,190 to 1,480 degrees F
      3. Traps: Standard one piece

2.5 REFRIGERANT
   A. Refrigerant: ASHRAE 34. Type as specified for each type of equipment.
2.6 CHECK VALVE

A. Manufacturers (Refer to Section 20 10 00):
   1. Superior
   2. Henry

B. Cast bronze or forged brass body, forged brass cup with neoprene seal, brass guide and disc holder and teflon seat disc

2.7 MANUAL REFRIGERANT SHUT-OFF VALVE

A. Manufacturers (Refer to Section 20 10 00):
   1. ConBraCo (Apollo)
   2. Henry
   3. Mueller
   4. Superior
   5. Virginia

B. Ball valves designed for refrigeration service and full line size.

C. Valves shall have cap seals.

D. Valves with hand wheels are not acceptable.

E. Provide service valve on each liquid and suction line at compressor.

F. If service valves come as integral part of condensing unit, additional service valves shall not be required.

2.8 SOLENOID VALVE

A. Manufacturers (Refer to Section 20 10 00):
   1. Alco
   2. Asco
   3. Sporlan

B. Electric, direct acting designed for refrigeration service

C. UL listed, 300 psi MOPD at 285 degrees F

D. Valves shall be sized to match cooling equipment capacities and power requirements.

2.9 ACCESS DOORS

A. In accordance with Section 083113.

2.10 PIPING SUPPORTS AND INSERTS

A. In accordance with Section 23 05 29.
PART 2 - PRODUCTS

2.1 MANUFACTURERS/INSTALLERS (REFER TO SECTION 20 10 00):
   A. IAT Construction Services, Inc
   B. King Soft Water

2.2 MATERIALS
   A. System Cleaner:
      1. Manufacturers (Refer to Section 20 10 00):
         a. IAT Construction Services, Inc. Product SP-125
         b. FerroQuest
      2. Alkaline Polyphosphate with surfactant and Organic dispersant in a concentration recommended in manufacturer’s published instruction sheets. Chemicals shall be non-toxic.
   B. Closed System Treatment (Heating Hot Water, Chilled Water, and Snowmelt Water):
      1. Manufacturers (Refer to Section 20 10 00):
         a. IAT Construction Services, Inc., Product CS-537
      2. Chemical properties:
         a. Nitrite solution of 1,000 to 1,200 ppm of nitrite for hot water closed system. A level of 800 to 1,200 ppm of nitrite for a cold water closed system.
         b. System shall be treated with biocides to prohibit biological growth within the closed system.
         c. Sequestering agent to reduce deposits and control PH.
   C. Steam System Treatment:
      1. Manufacturers (Refer to Section 20 10 00):
         a. IAT Construction Services, Inc., Product BT-7703
      2. Chemical properties:
         a. Sequestering agent to reduce hardness and prevent feedline congestion.
         b. Phosphate hardness supplement
         c. Alkalinity supplement
         d. Oxygen scavenger
   D. Freeze Protection
      1. Manufacturers (Refer to Section 20 10 00):
         a. DOWFROST
2. System shall be charged with an inhibited propylene glycol mixed with demineralized water.

2.3 BY-PASS (POT) FEEDER

A. Manufacturers (Refer to Section 20 10 00):
   a. IAT Construction Services, Inc
   b. A and F Machine Products
   c. JL Wingert
   d. Neptune

B. Quick opening cap for working pressure of 175 psig. Sizes as scheduled below:
   1. System volume up to 200 gallons: 1 gallon pot feeder
   2. System volume greater than 200 gallons and less than 2000 gallons: 2 gallon pot feeder
   3. System volume greater than 2000 gallons: 5 gallon pot feeder

2.4 SOLUTION METERING PUMP

A. Manufacturers (Refer to Section 20 10 00):
   1. LMI, Series A
   2. Pulsafeeder

B. Positive displacement, diaphragm pump with adjustable flow rate, thermoplastic construction, continuous-duty fully enclosed electric motor and drive, and relief valve

C. Electrical Characteristics:
   1. 120 volts, single phase, 60 Hz
   2. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.5 SOLUTION TANKS

A. Polyethylene, self-supporting, with graduated marking and molded fiberglass cover with recess for mounting pump

B. Accessories:
   1. Liquid level switch to interface with the temperature control system

2.6 GLYCOL MAKE-UP FEEDER

A. Manufacturers (Refer to Section 20 10 00):
   1. Pulsafeeder, Model GF-1
   2. JL Wingert
   3. Advantage
   4. IATCS
5. Wessels

B. The glycol system shall have the following features with all components mounted on a welded steel stand.

1. Tank (heating systems where reliefs are pumped back into the tank): 50 gallon carbon steel
2. Tank (all other systems): 50 gallon polyethylene
3. Pump: positive displacement
4. Controller: NEMA 1 enclosure
5. Electrical:
   a. 120 volts, single phase, 60 Hz
   b. Cord and Plug: Provide unit with 6 foot cord and plug for connection to electric wiring system including grounding connector.
   c. Single point electrical connection
6. Features:
   a. Pressure switch factory set: 0-100 psig (field adjustable)
   b. Pump shut-off valves
   c. Pump discharge check valve
   d. Low water pump protection
   e. Relief valve
   f. Pressure gauges
   g. Power light, pump light, alarm light
   h. Drain valve
   i. Removable tank cover
7. Accessories
   a. Dry contacts for low water level alarm to be monitored by the building temperature control system.
   b. Dual pumps to feed two separate systems from the same tank change model to Pulsafeeder GF-2.

2.7 LIQUID LEVEL SWITCH

A. Manufacturers (Refer to Section 20 10 00):
   1. LMI Model 26731 (50 gallon tank)

B. Polypropylene housing with integrally mounted PVC air trap, receptacles for connection to metering pump, and low level alarm

C. Electrical Characteristics:
   1. 120 volts, single phase, 60 Hz

2.8 WATER METER

A. Manufacturers (Refer to Section 20 10 00):
   1. Carlton, Series JSJ
   2. SeaMetrics
B. Displacement type cold water meter with sealed, tamper-proof magnetic drive, impulse contact

C. Size appropriately to water make-up line

D. Electrical Characteristics:
   1. 120 volts, single phase, 60 Hz

2.9 SOLENOID VALVES

A. Manufacturers (Refer to Section 20 10 00):
   1. ASCO (globe Style)
   2. Honeywell (ball style)

B. Outdoor applications: Forged brass body globe pattern, normally open or closed as required, general purpose with a waterproof solenoid enclosure

C. Indoor applications: Motorized ball valve of all bronze construction, normally open or closed as required, general purpose

D. Features: manual override

E. Electrical Characteristics:
   1. 120 volts, single phase, 60 Hz

2.10 TEST EQUIPMENT

A. Basic water test equipment shall be provided for determination of treatment residuals. This shall include a carrying case and reagents for use with the supplier’s products. Where specialized or supplementary equipment is required, it shall be furnished as of the offering.

B. Test equipment for glycol shall be furnished and approved by the glycol manufacturer.

END OF SECTION 23 25 00
SECTION 23 31 00
DUCTWORK

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.

B. Steel Ducts: ASTM A366.


D. Stainless Steel Ducts: ASTM A167, Type 304. 316.

E. Sealants for metal ductwork:
   1. Sealant Class A:
      a. Hardcast Inc, #IG-601, Iron Grip or approved equal.
   2. Sealant Class B:
      a. Hardcast Inc, #2001, POOKEE or approved equal.
   3. Sealant Class C:
      a. Hardcast DT-Tape and RTA-50 adhesive two part sealing system or Hardcast Inc. Aluma-Grip 701 pressure sensitive rolled sealant tape.
   4. Exterior Systems:
      a. Hardcast Inc. DT-Tape and RTA-50 adhesive two-part sealing system, or Hardcast Inc. Aluma-Grip 701 pressure sensitive rolled sealant tape.
   5. Fittings and joints which are continuously welded do not require sealant.
   6. Non-hardening, water resistant, fire resistive, compatible with mating materials.
   7. Sealant shall be compositely tested for fire and smoke hazard ratings according to recognized standard testing methods (ASTM E84) and shall have ratings not exceeding flame spread 25, fuel contributed 50 and smoke developed 50.

F. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.2 CLOTHES DRYER EXHAUST DUCTWORK

A. Commercial dryers: Galvanized steel with longitudinal seam joints and smooth interior surface.

B. Domestic dryers: Aluminum ductwork with smooth interior surface. Aluminum flex duct allowed at the dryer connection with a maximum length of 5 feet with no more than one large radius elbow.

C. Electric operated dryers shall use a minimum 26 gauge ductwork.

D. Gas operated dryers shall use a minimum 24 gauge ductwork.
E. Provide require thimbles and sleeves to achieve clearance from combustibles. Provide a backdraft damper where domestic clothes dryer vents terminate from the building.

2.3 FLEXIBLE DUCTS

A. Manufacturers (Refer to Section 20 10 00):
   1. Genflex
   2. Thermaflex
   3. Thermold
   4. Wiremold
   5. Hart and Cooley

B. Basis of Design: Thermaflex, Model G-KM

C. UL 181 Class 1 flexible air duct complying with NFPA standard 90A; factory fabricated assembly composed of an inner liner, coated wound spring steel wire, 1 inch thick fiberglass insulation (installed R-value 4.3), and a vapor barrier outer jacket; 6 inches WG positive working pressure and 1 inch WG negative working pressure for ducts up to 10 inch diameter, 4 inches WG positive working pressure and 1 inch WG negative working pressure for ducts 12 to 16 inches diameter; 4000 FPM maximum working velocity; 20 to 200 °F working temperatures.

2.4 LOW VELOCITY DUCTWORK AND FITTINGS

A. Low velocity ductwork shall be defined as all ductwork not specifically defined as medium velocity ductwork.

B. Fabricate, install, and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, the International Mechanical Code, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

C. Construct T’s, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Provide turning vanes in all rectangular elbows greater than 45 degrees (unless utilized for return duct stub-outs into return air plenums - no vanes required).

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Low velocity plenums
   1. Plenums shall be at least two (2) gauges heavier than specified ductwork of equal size.
   2. Provide access doors to service equipment. Fabricate with 16 gauge steel double wall construction with 1 inch thick fiberglass insulation in core. Openings shall be reinforced with welded angle bar frames. Doors shall be pulled airtight on neoprene gaskets.

2.5 MEDIUM VELOCITY DUCTWORK AND FITTINGS

A. Medium velocity ductwork shall be defined as all ductwork between the air handling unit and the terminal supply boxes (or exhaust).
B. Fabricate, install, and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, the International Mechanical Code, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures.

C. Round and Flat Oval Ductwork

1. Spiral lockseam construction (no standing ribs)
2. Fittings shall be all welded, or fully lapped and sealed spot welded, construction with machine formed entrances to branch fittings. All welding of fittings shall be of the continuous seam fusion type. All welded seams shall be covered with one coat of rust inhibiting paint, Rust-Oleum or approved equal, applied to both interior and exterior of duct or fittings.
3. Centerline radius of elbows shall be 1.5 times the cross section diameter unless the drawings indicate a mitered 90 degree elbow with vanes. Elbows shall be constructed with five pieces for turns greater than 60 degrees, three pieces for turns between 60 degrees and 30 degrees, and two (2) pieces for turns 30 degrees and less.

4. Manufacturers (Refer to Section 20 10 00):
   a. United McGill Corp., Model Uni-Seal (un-lined)
   b. United McGill Corp., Model K-27 (lined with insulation)
   c. Ventline
   d. Metco
   e. Apollo Inc.
   f. L&R Fabrication
   g. SMK Inc.

5. Round ducts:

<table>
<thead>
<tr>
<th>Duct Size inches</th>
<th>U.S. Duct Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 8</td>
<td>26</td>
</tr>
<tr>
<td>9 to 14</td>
<td>26</td>
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<td>15 to 26</td>
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<td>27 to 36</td>
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<tr>
<td>37 to 50</td>
<td>20</td>
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<tr>
<td>Over 51</td>
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</table>

<table>
<thead>
<tr>
<th>Fitting Size inches</th>
<th>U.S. Duct Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 26</td>
<td>22</td>
</tr>
<tr>
<td>27 to 50</td>
<td>20</td>
</tr>
<tr>
<td>52 to 60</td>
<td>18</td>
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</tbody>
</table>

6. Fittings shall be equal to United McGill Corp. as follows:
   a. Elbows: SRHE5-90, SRHE3-60, SRHE3-45, SRHE2-30
   b. Tees: SRHTC, SRHTCR, SRHTXC, SRHTXCR
   c. Laterals: SRHL, SRHLCR
   d. Concentric reducer: SRHR
   e. Eccentric reducer: SRHRE

7. Joints in ducts and fittings up to and including 36 inch in diameter shall be made with couplings (2 inch insertion depth with stophead). Larger ducts and fittings shall be joined with companion flanges. Couplings and flanges shall be supplied by the duct manufacturer.

D. Flat Oval Ducts:
<table>
<thead>
<tr>
<th>Duct Size (Major axis) inches</th>
<th>U.S. Duct Gauge</th>
</tr>
</thead>
<tbody>
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<td>Up to 24</td>
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<td>25 to 48</td>
<td>22</td>
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<tr>
<td>49 to 60</td>
<td>20</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fitting Size inches</th>
<th>U.S. Duct Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 36</td>
<td>20</td>
</tr>
<tr>
<td>37 to 60</td>
<td>18</td>
</tr>
</tbody>
</table>

1. Fittings shall be equal to United McGill Corp. as follows:
   a. Elbows: SRSEH5-90, SOSEE5-90, SOSEH3-45, SOSEE3-45
   b. Tees: SOSTC, SOSTXC
   c. Laterals: SOSLC
   d. Concentric transition: SOSR-10, SOSR-30
   e. Eccentric transition: SOSR-11, SOSR-12, SOSR-131, SOSR-132, SOSR31, SOSR32, SOSR331, SOSR332

2. Joints in ducts and fittings up to and including 41 inches wide and 26 inches high shall be made with couplings. Larger ducts and fittings shall be joined with companion flanges. Couplings and flanges shall be supplied by the duct manufacturer.

E. Lined Round and Flat Oval Ducts:

1. Machine made from round or flat oval spiral lockseam duct, galvanized steel outer wall, 1 inch thick fiberglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.
2. Previous sections on round and flat oval ducts apply here.

END OF SECTION 23 31 00
SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 2 - PRODUCTS

2.1 AIR TURNING DEVICES

A. Manufacturers (Refer to Section 20 10 00):
   1. Duro Dyne
   2. Aero/Dyne
   3. Titus
   4. Tuttle and Bailey
   5. Krueger
   6. Pottorff

B. Fabrication in accordance with SMACNA–HVAC Duct Construction Standard–Metal and Flexible suitable for duct pressure classification.

C. Multi-blade device with single vane blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

D. Vanes installed in ductwork of unequal widths or angles shall have vanes shaped to project airflow parallel to duct sides.

E. Air turns in medium velocity ductwork shall be high efficiency, double vane blades equal to H-E-P as manufactured by Aero/Dyne constructed with 2 inches long airfoil leading edge and a 3 inches long airflow trailing edge.

F. Where specifically indicated on plans, acoustical air turns shall be equal to Sonoturn.

2.2 BACKDRAFT DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Ruskin
   2. Air Control Products
   3. American Warming and Ventilation
   4. Greenheck
   5. Pottorff

B. Where specifically scheduled on the drawings to be furnished with the Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Suitable for duct pressure classification.

D. Low Pressure Duct System: multi-blade, parallel action gravity balanced backdraft dampers: extruded aluminum frame and formed aluminum blades, vinyl edge seals, synthetic bearings, linked together in rattle-free manner with 90 degree stop.

E. Medium Pressure Duct Systems: heavy duty, multi-blade, parallel action gravity balanced backdraft damper suitable for up to 4 inches static pressure: 0.07 inches extruded aluminum blades, 1/8 inch extruded aluminum frame, 1/2 inch round blade shafts, synthetic bearings, vinyl
edge seals, linked together in rattle-free manner with 90 degree stop, counterbalance to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Manufacturers (Refer to Section 20 10 00):
   1. Elmdor
   2. United McGill
   3. Duro Dyne
   4. Cesco
   5. Pottorff
   6. Ruskin

B. Fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets, quick fastening locking devices, and continuous piano hinge. For insulated ductwork, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less than 12 inches square: Secure with sash locks
   2. Up to 18 inches square: Secure with two sash locks
   3. Up to 24×48 inches: Secure with two compression latches with outside and inside handles

D. Relief type access doors
   1. Provide a United McGill relief type access door with a retaining chain immediately downstream of all combination fire/smoke dampers and smoke control dampers installed on medium pressure duct system with sealing gasket.
   2. Doors shall be insulated where ductwork is indicated to be lined.

E. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FIRE DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Ruskin
   2. Airbalance
   3. Greenheck
   4. Cesco
B. For use in fire rated partitions.

C. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

D. Ceiling Dampers: Galvanized steel frame, heat retardant non-asbestos fabric blanket as required for damper size, ceiling installation and UL listing.

E. Horizontal Dampers: Galvanized steel frame, stainless steel closure spring, heat retardant non-asbestos fabric blanket as required for damper size, ceiling type, and UL listing.

F. Vertical Curtain Type Dampers: Galvanized steel with interlocking blades. Stainless steel closure springs and latches for closure under air flow conditions. Blade configuration for blades in or out of air stream shall be as scheduled.

G. Fusible Links: UL 33, separate at 165 °F (unless noted otherwise).

2.6 COMBINATION FIRE/SMOKE DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Ruskin
   2. Air Balance
   3. Greenheck
   4. Cesco
   5. Nailor Industries, Inc
   6. Potterff

B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

C. Provide factory sleeve and collar for each damper.

D. UL leakage class I or II as scheduled on the drawings (leakage class III and IV are not acceptable).

E. Operators:
   1. UL listed and labeled spring return electric type suitable for 120 volts, single phase, 60 Hz. Actuator shall be factory installed, normally closed.
   2. Locate damper operator on exterior of duct and link to damper operating shaft.
   3. Operator shall only require cycling once a year to maintain reliability.
   4. Provide end switches to indicate damper position.
   5. Manufacturers (Refer to Section 20 10 00):
      a. Belimo

F. Normally Closed Smoke Responsive Fire Dampers:
   1. Multi-blade type, opening by gravity upon actuation of actuator or fusible link, flexible stainless steel blade edge seals to provide constant sealing pressure.
   2. Damper closure through the actuator shall be controlled to close the damper within 7 to 15 seconds through the actuator. This eliminates instantaneous closure to prevent damage to the ducts and HVAC components.
   3. Remote automatic reset when power is restored or the smoke or fire alarm system is reset.

G. Fusible Links: UL 33, separate at 165 °F
2.7 SMOKE DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Ruskin
   2. Air Balance

B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

C. UL leakage class I or II as scheduled on the drawings (leakage class III and IV are not acceptable).

D. Operators:
   1. UL listed and labeled spring return electric type suitable for 120 volts, single phase, 60 Hz. Actuator shall be factory installed, normally closed.
   2. Locate damper operator on exterior of duct and link to damper operating shaft.
   3. Operator shall only require cycling once a year to maintain reliability.
   4. Provide end switches to indicate damper position.
   5. Manufacturers (Refer to Section 20 10 00):
      a. Belimo

E. Normally Closed Smoke Responsive Smoke Dampers:
   1. Multi-blade type, opening by gravity upon actuation of actuator, flexible stainless steel blade edge seals to provide constant sealing pressure.
   2. Damper closure through the actuator shall be controlled to close the damper within 7 to 15 seconds through the actuator. This eliminates instantaneous closure to prevent damage to the ducts and HVAC components.
   3. Remote automatic reset when power is restored or the smoke or fire alarm system is reset.

2.8 VOLUME CONTROL DAMPERS

A. Manufacturers (Refer to Section 20 10 00):
   1. Ruskin
   2. Greenheck
   3. Pottorff

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers:
   1. Fabricate for duct sizes up to 12 inches high and 30 inches long. Dampers greater than 12 inches high shall be multi-blade.
   2. Blades shall have 1/8 inch clearance all around and shall operate within duct liner.
   3. Up to 18 inches long, 20 gauge galvanized steel with 3/8 inch rod pins and quadrant.
   4. 19 to 48 inches long, 16 gauge galvanized steel with ½ inch rod pins and quadrant.

D. Multi-Blade Damper:
1. Fabricate of opposed blade pattern with maximum blade length of 48 inches. Dampers with blade lengths exceeding 48 inches shall be sectioned horizontally.

2. Blades shall have 1/8 inch clearance all around and shall operate within duct liner. Provide a channel spacer the thickness of the duct liner.

3. Blades shall not exceed 9 inches high and shall be 16 gauge galvanized steel with 3/8 inch pins and quadrant.

4. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

E. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Ventlock #607, Duro Dyne or approved equal.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. Quadrant shall clearly indicate the position of the damper. Where rod lengths exceed 30 inches provide regulator at both ends.
   3. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters. Ventlock #637 for insulated ducts and Ventlock #635 for un-insulated ducts, Duro Dyne, or approved equal.

G. Dampers located above ceilings and in non-accessible locations shall be equipped with Ventlock #666 concealed regulator. Miter gears and universal joints shall be used if required.

2.9 SPIN-IN FITTINGS

A. Manufacturers (Refer to Section 20 10 00):
   1. Air Control Products
   2. Duro Dyne

B. Sheet metal conical spin-in type round branch take-off complete with manual damper with locking quadrant.

C. Air Control Products model S-SM-C for sheet metal ductwork and model S-DB-C with damper for lined ductwork.

D. Where rectangular duct sizes do not allow a conical fitting, a straight tap shall be substituted.

END OF SECTION 23 33 00
PART 2 - PRODUCTS

2.1 GENERAL

A. Motors shall be in conformance with Section 23 05 13.

B. Fans shall be statically and dynamically balanced.

C. Roof Curbs: Where roof curbs are provided for fans, the actual curb selection and height shall be coordinated with roof-insulation thickness to ensure specified or scheduled curb height is the actual height of the curb above the "finished" roof surface.

D. Consult drawings for sizes, model numbers, capacities, electrical characteristics, and accessories.

2.2 GENERAL FANS

A. Manufacturers (Refer to Section 20 10 00):

1. Acme
2. Briedert
3. Cook
4. Greenheck
5. Penn
6. 

B. Centrifugal In-Line Fans (Direct Drive)

1. Construction: Heavy gauge galvanized steel; insulated housing; square duct mounting collars on inlet and outlet; minimum of two removable panels providing adequate service access to all internal parts.

2. Wheel: Centrifugal, backward inclined, aluminum fan wheel; precision cast aluminum hub; aerodynamic aluminum inlet cone designed to provide maximum performance and efficiency.

3. Safety Screens: Galvanized mesh safety screens provided on all un-ducted inlet and discharge openings. Screens shall be easily removable for maintenance and inspection.

4. Motorized Backdraft Damper (When Scheduled): Extruded aluminum construction; brass bushings; see drawings for motor voltage; voltage shall be verified with Section 23 09 23 and Division 26 prior to ordering.

5. Vibration Isolation: Spring and neoprene isolators consisting of a steel spring in series with a neoprene isolation element; sized to match each fan; designed to support five times overload without failure and allow up to 15 degrees of hanger rod misalignment; hanging isolators for suspended fans and base isolators for floor-mounted fans

6. Disconnect Switch: NEMA 1 lockable enclosure.

C. Ceiling Exhaust Fans (Direct Drive)
1. Galvanized steel casing; insulated housing; integral aluminum backdraft damper; terminal box with cord, plug and receptacle to facilitate removal of complete fan wheel and motor assembly without disturbing the ductwork; permanently lubricated motor with built-in thermal overload protection; powder painted white steel grille; provide hanging vibration isolators when using for in-line applications; variable speed controller allowing operation from 50 to 100 % when called for on the drawings.

D. Utility Set Fan (Belt Drive)

1. Construction: Heavy gauge galvanized steel casing; lock-formed or fully-welded seams permitting no air leakage; field-rotatable housing to any of the eight (8) standard discharge positions; heavy gauge galvanized steel housing supports and members to prevent vibration and rigidly support the motor and wheel; enamel or epoxy finish unless indicated otherwise on the drawings; drain connection when called for on the drawings.; Fan shall be class I, II, or III as required for operating conditions. Motor location, fan rotation, and fan discharge shall be as indicated on the drawings.

2. Wheel: Centrifugal, backward inclined, non-overloading, aluminum fan wheel; precision cast aluminum hub; aerodynamic aluminum inlet cone designed to provide maximum performance and efficiency; aluminum blades securely welded to hub and shroud.

3. Bearings: Permanently lubricated and sealed, or regreasable heavy duty pillow block type; minimum L-50 life in excess of 200,000 hours at maximum catalogued operating speed.

4. Belts and Drives: Oil and heat resistant, non-static type belts; precision ground drive securely keyed to the wheel and motor shafts; drives shall be sized for 150 % of the installed motor horsepower; cast iron, multi-belt sheaves - adjustable for motors up to 5 hp and fixed for motors in excess of 5 hp.

5. Motor Cover/Belt Guard: Galvanized steel construction; adequate for protection of motors, drives, and personnel. Weather hoods shall be provided for fans located outside.

6. Safety Screens: Galvanized mesh safety screens provided on inlet and outlet. Screens shall be easily removable for maintenance and inspection.

7. Vibration Isolation: Base-mounted spring and neoprene isolators consisting of a steel spring in series with a neoprene isolation element; sized to match each fan.

8. Disconnect Switch: NEMA 1 lockable enclosure.

END OF SECTION 23 34 00
SECTION 23 35 00
SOUND ATTENUATORS

PART 2 - PRODUCTS

2.1 SOUND ATTENUATORS

A. Manufacturers (Refer to Section 20 10 00):
   1. Industrial Acoustics Company
   2. Dynasonics
   3. Vibro-Acoustics

B. The acoustical and aerodynamic performance of all sound attenuators shall conform to the values scheduled on the drawings.

C. Schedule: See drawings.

END OF SECTION 23 35 00
SECTION 23 36 00
AIR TERMINAL UNITS

PART 2 - PRODUCTS

2.1 GENERAL AIR TERMINAL UNITS

A. Manufacturers (Refer to Section 20 10 00):

1. Krueger
2. Nailor
3. Price
4. Titus

B. General

1. Construction: Minimum 22 gauge galvanized steel casing; round stub air inlet connections in sizes noted on the drawings; slip and drive air outlet connection; galvanized steel volume damper(s) with peripheral gasket and self-lubricating bearings; maximum allowable damper leakage 2 % of design airflow at 3 inch inlet static pressure; linkages for damper as necessary; protective metal shroud for controls components; plenum air inlet, when provided, shall have finished metal edges with no exposed insulation and frame for attachment of 1 inch throwaway filter.

2. Insulation: ½ inch, 1.5 pounds/feet³ density fibrous glass insulation meeting NFPA 90A flame and smoke requirements and UL 181 erosion requirements; black pigmented insulation coating conforming to NFPA 90A to resist erosion at velocities up to 5,000 FPM; exposed edges of liner coated with an NFPA 90A approved sealant to prevent entrainment of fibers in the airstream. Casing insulation shall be installed in a manner to preclude any raw edges or surfaces from contact with the airstream.

   a. Surface coating:
      1) Provide an EPA registered, anti-microbial agent so that the liner will not support the growth of fungus or bacteria.
      2) Anti-microbial agent shall be tested in accordance with:
         a) Fungi test ASTM C665
         b) Fungi test ASTM G21
         c) Bacterial test ASTM G22

3. Flow Sensors: Cross or annular ring configuration; located at the inlet of the terminal unit; multiple pressure sensing ports with averaging chamber; sensor shall provide amplified signal; 5 % accuracy with a 90 degree sheet metal elbow directly at the inlet of the assembly; external taps provide for calibration. An airflow (CFM) curve shall be affixed to the terminal unit expressing differential vs. CFM.

4. Hot Water Heating Coil: Copper tube mechanically expanded into aluminum plate fins; leak-tested to 300 psi; 2000 psi minimum burst pressure at ambient temperature; factory installed as an integral part of air terminal unit. Coil shall be rated in accordance with ARI standard 410 and tested in accordance with ASHRAE standard 33. All coils shall be provided with a manual air vent fitting. Valve core type vent fittings are not acceptable. Coils shall be rated for a minimum of 200 °F

5. Electric Heating Coil (UL listed): Heavy gauge galvanized steel heater frame, element support brackets and electric enclosure; mounting flange for easy field connection;
nickel/chromium resistance wire elements; NEMA 1 cover with hinged access door and door interlock to prevent opening of door when power is on; automatic reset primary over-temperature protection; secondary over-temperature protection in power circuit; magnetic contactors for each step of control; air flow switch.

6. Controllers and Actuators: Furnished by Section 23 09 23 and shipped to the terminal unit manufacturer for factory installation. Coordinate with Section 23 09 23 for actuator and controller requirements.

7. Certification: Air terminal units shall be certified under ARI standard 880-94 Certification Program and shall carry the ARI seal.

C. Fan-Powered Terminal Units

1. General: Unit shall have a single point electrical and control connection. Mount electrical components in control box with removable cover. Terminal strip in control box for field wiring of thermostat and power source.

2. Fans: Forward curved, centrifugal type; dynamically balanced fan wheel; anti-backward rotation design; permanent split capacitor type motor; thermally protected; permanently lubricated bearings; assembly mounted on rubber isolators.

3. Options: Provide manual speed controller to allow manual fan speed adjustment to specified airflow in the field. Speed controller shall have minimum voltage stop to preclude operation in install mode. Provide with control voltage transformer (24 V). Provide with 1 inch thick throwaway filter.

4. Basis of Design
   a. Parallel Configuration: Titus TQP Series
   b. Parallel Configuration - Low Profile: Titus FCL Series
   c. Series Configuration: Titus TQS Series
   d. Series Configuration - Low Profile: Titus FVL Series

D. Single Duct Terminal Units

1. Basis of design: Titus ESV Series

END OF SECTION 23 36 00
SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

A. General

1. Dampers: Provided when scheduled on the drawings. Dampers shall be opposed blade, heavy gauge steel, and shall be adjustable from the face of the inlet or outlet.
2. Frame types and mounting hardware: Coordinated with ceiling types. Architectural plans shall take precedence when referencing ceiling types, and Contractor shall reference the architectural plans for verification of ceiling type prior to ordering.
3. Finish: White unless noted otherwise on the drawings.

B. General Grilles, Registers, and Diffusers

1. Manufacturers (Refer to Section 20 10 00):
   a. Titus
   b. Tuttle & Bailey
   c. Anemostat
   d. Krueger
   e. Price
   f. Pottorff

2. See schedules on drawings.

2.2 LOUVERS

A. Manufacturers (Refer to Section 20 10 00):

1. Ruskin
2. American Warming
3. Pottorff
4. Greenheck
5. Louvers and Dampers

B. Stationary Louvers: 6 inches deep; extruded aluminum construction; 0.08 inch frame; 0.08 inch blades; drainable construction with drain gutters in each blade and downspouts in jambs and mullions; hidden blade supports as required for continuous appearance up to 120 inches; multiple louver sections as required for louvers in excess of 120 inches with mullions and supports as required; interior birdscreen; minimum 55 % free area based on 48×48 inches louver size; maximum pressure drop of 0.18 inches WG and 0.05 ounces of water per square foot during a fifteen minute period with a free area velocity of 1,100 FPM. (Tested in Accordance with AMCA 500).

1. Finish: Kynar unless noted otherwise on the drawings - color as selected by architect.
2. Basis of Design: Ruskin ELF6375DX.

END OF SECTION 23 37 00
SECTION 23 40 00
AIR CLEANING DEVICES

PART 2 - PRODUCTS

2.1 GENERAL
   A. Manufacturers (Refer to Section 20 10 00):
      1. Farr
      2. Cambridge
      3. American Air Filter

2.2 DISPOSABLE, EXTENDED AREA PANEL FILTERS (30 % EFFICIENT)-TYPE 1
   A. UL 900 Class 2 media, pleated, lofted, non-woven, reinforced cotton and synthetic fabric,
      supported and bonded to welded wire grid; rigid, heavy duty frame, high wet strength beverage
      board ASHRAE 52 rated; 25 to 30 % dust spot efficiency; 90 to 92 % weight arrestance.
   B. Basis of Design: Farr 30/30.

2.3 DISPOSABLE EXTENDED AREA PANEL FILTERS (85 % EFFICIENT) TYPE 2
   A. UL 900 Class 2 media, pleated, lofted, non-woven, reinforced cotton and synthetic fabric,
      supported and bonded to welded wire grid; rigid, heavy duty frame, high wet strength beverage
      board ASHRAE 52 rated; 80 % to 85 % dust spot efficiency. Merv 13, 4” thick.
   B. Basis of Design: Farr AP-Thirteen.

2.4 FILTER FRAMES AND HOUSINGS
   A. When installed in air handling equipment frames and housing shall be furnished with equipment.
      Refer to related Sections.
   B. Duct Filter Frame
      1. General
         a. Leakage: less than 1 % at 3 inches WG.
         b. Housing: 16 gauge galvanized steel.
         c. Flanges for connection to ductwork.
         d. Access doors: 16 gauge galvanized steel with adjustable and replaceable positive
            sealing latches and replaceable hinges with high memory neoprene peripheral
            gasket and polyurethane foam gasket at the door.
         e. Tracks shall accommodate holding frame.
         f. Holding frame shall accommodate standard size filters.

2.5 FILTER GAUGES
   A. Manufacturers: (Refer to Section 20 10 00)
B. Direct Reading Dial: 3½ inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 to 2.0 inches WG, 2 % of full scale accuracy.

C. Accessories: Static pressure tips with integral compression fittings, ¼ inch tubing, 2-way or 3-way vent valves.

END OF SECTION 23 40 00
SECTION 23 51 00
BREECHINGS, CHIMNEYS, AND STACKS

PART 2 - PRODUCTS

2.1 BREECHING


B. Fabricate breechings from following minimum gauges. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
   1. Sizes up to 12 inches: 18 gauge
   2. Sizes 13 to 24 inches: 16 gauge
   3. Sizes 25 to 36 inches: 14 gauge
   4. Sizes 37 to 60 inches: 12 gauge
   5. Sizes over 60 inches: 10 gauge

C. Provide adjustable self-actuating barometric draft dampers, where indicated, full size of breeching.

D. Provide cleanout doors of same gauge as breeching, where indicated on Drawings.

E. Weld longitudinal seams. Fabricate joints by welding, lapping and bolting, or with companion flanges. For breechings less than 24 inches diameter provide groove seam (pipe lock or flat lock) with end joints beaded and crimped.

F. Reinforce rectangular breeching with angle frames and round breeching with flanged girth joints or angle frames. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible.
   1. Sizes up to 30 inches: No reinforcing required.
   2. Sizes 31 to 36 inches: 1½×1½×3/16 inches, at 60 inch centers
   3. Sizes 37 to 60 inches: 2×2×¼ inches, at 60 inch centers
   4. Sizes over 60 inches: 3×3×½ inches, at 60 inch centers

G. Fabricate breeching fittings to match adjoining breechings. Fabricate elbows with center-line radius equal to breeching width diameter. Limit angular tapers to 20 degrees maximum.

2.2 TYPE B DOUBLE WALL GAS VENTS

A. Manufacturers (Refer to Section 20 10 00):
   1. Metalbestos
   2. Amerivent
   3. Ampco
4. Metal-Fab
5. Schebler Manufacturing

B. Fabrications: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested and listed in compliance with UL 441.

SECTION 23 63 15
VARIABLE REFRIGERANT FLOW SYSTEM

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers (Refer to Section 15000):
   1. Mitsubishi

2.2 GENERAL DESCRIPTION

A. The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRFZ (Variable Refrigerant Flow Zoning). The CITY MULTI VRFZ systems shall be the R2-Series (simultaneous cooling and heating) split system heat pump.

B. The R2-Series system shall consist of a PURY outdoor unit, BC (Branch Circuit) Controller, multiple indoor units and M-NET DDC (Direct Digital Controls). Each indoor unit or group of indoor units shall be capable of operating in any mode independently of other indoor units or groups. System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units shall be independently controlled. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of outdoor rated capacity.

C. Construction and Ratings: Rated in accordance with ARI 210/240 or ARI 365 as appropriate and constructed in accordance with UL standards. Testing shall be in accordance with ASHRAE 14.

D. Performance Ratings: Energy Efficiency Rating (EER) as scheduled (not less than prescribed by ASHRAE 90A).

2.3 OUTDOOR UNIT

A. General: The R2-Series PURY outdoor unit shall be used specifically with CITY MULTI VRFZ components. The PURY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

1. The model nomenclature and unit requirements are shown below. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor.

2. Outdoor unit shall have a sound rating no higher than 60 dB(A) individually or 64 dB(A) twinned. Units shall have a sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned while in night mode operation. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

3. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller (Single or Main) shall be insulated.
4. There shall be no more than 3 branch circuit controllers connected to any one outdoor unit.
5. Outdoor unit shall be able to connect to up to 50 indoor units depending upon model.
6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.
8. The outdoor unit shall have the ability to operate with a maximum height difference of 100 feet and have total refrigerant tubing length of 1500 feet. The greatest length is not to exceed 500 feet between outdoor unit and the indoor units without the need for line size changes or traps.
9. The outdoor unit shall be capable of operating in heating mode down to -4°F ambient temperature or cooling mode down to 23°F ambient temperature, without additional low ambient controls. If an alternate manufacturer is selected, any additional material, cost, and labor to meet low ambient operating condition and performance shall be incurred by the contractor.
10. The outdoor unit shall be capable of operating in cooling mode down to -10°F with optional manufacturer supplied low ambient kit.
11. Manufacturer supplied low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.
12. Manufacturer supplied low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
13. Manufacturer supplied low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.
14. The outdoor unit shall not cease operation in any mode based solely on outdoor ambient temperature.
15. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
16. Unit must defrost all circuits simultaneously in order to resume full heating more quickly. Partial defrost which may extend “no or reduced heating” periods shall not be allowed.

B. Unit Cabinet:
1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

C. Fan:
1. Each outdoor unit module shall be furnished with one direct drive, variable speed propeller type fan. The fan shall be factory set for operation under 0 in. WG external static pressure, but capable of normal operation under a maximum of 0.24 in. WG external static pressure via dipswitch.
2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have vertical discharge airflow.

D. Refrigerant Accessories (furnished in this Section)
1. Filter dryer replaceable core type
2. Liquid line sight glass and moisture indicator
3. Hard shut-off thermal expansion valve kit for maximum operating pressure
4. Suction and liquid line service valves and gauge ports
5. Charging valve
6. Discharge line check valve
7. Compressor discharge service valve
8. Condenser pressure relief valve
9. Compressor start assist
10. Crankcase heater
11. Cycle protector
12. Time delay relay
13. High pressure switch
14. Low pressure switch
15. For heat pump units, provide reversing valve, suction line accumulator, flow control check valve, and solid-state defrost control utilizing thermistors.

E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil fins shall have a factory applied corrosion resistant blue-fin finish.
3. The coil shall be protected with an integral metal guard.
4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
5. The outdoor coil shall include 4 circuits with two position valves for each circuit, except for the last stage.

F. Compressor:
1. Each outdoor unit module shall be equipped with one inverter driven scroll hermetic compressor.
2. A crankcase heater(s) shall be factory mounted on the compressor(s).
3. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable with a turndown of 19%-5% of rated capacity, depending upon unit size.
4. The compressor will be equipped with an internal thermal overload.
5. The compressor shall be mounted to avoid the transmission of vibration.
6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

G. Electrical:
1. See schedule on drawings.
2. The outdoor unit shall be controlled by integral microprocessors.
3. The control circuit between the indoor units, BC Controller and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 BRANCH CIRCUIT (BC) CONTROLLERS

A. General: The BC (Branch Circuit) Controllers shall be specifically used with R410A R2-Series systems. These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors, with
access and service clearance provided for each controller. The sum of connected capacity of all indoor air handlers shall range from 50% to 150% of rated capacity.

B. BC Unit Cabinet:
   1. The casing shall be fabricated of galvanized steel.
   2. Each cabinet shall house a liquid-gas separator and multiple refrigeration control valves.
   3. The unit shall house two tube-in-tube heat exchangers.

C. Refrigerant
   1. R410A refrigerant shall be required.

D. Refrigerant valves:
   1. The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and up to three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
   2. Each branch shall have multiple two-position valves to control refrigerant flow.
   3. Service shut-off valves shall be field provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation. See 15535.
   4. Linear electronic expansion valves shall be used to control the variable refrigerant flow.

E. Integral Drain Pan:
   1. An integral condensate pan and drain shall be provided. The drain pan shall have a secondary outlet that connects to a float switch by EZ-Trap Model EZT-225 that will shut off the fan coil if activated. The switch contacts shall connect to the fan coil terminal strip as designated.
   2. The drain pan shall be factory-provided with an 11 inch long insulated drain line that is available for field connection to drain piping.
   3. Provide accessory condensate pump where indicated.

F. Electrical:
   1. See schedules on drawings.
   2. The BC Controller shall be controlled by integral microprocessors.
   3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.
   4. Accessory condensate pump shall be powered by the BC controller power and shall not require a separate power source.

2.5 WALL-MOUNTED INDOOR UNIT

A. General: Mitsubishi Model PKFY with modulating linear expansion device and a flat front. The PKFY shall be used with the R2-Series outdoor unit and BC Controller. The PKFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit
   1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit
and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:
   1. All casings, regardless of model size, shall have the same white finish
   2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.
   3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:
   1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.
   2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
   3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).
   4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:
   1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:
   1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
   2. The tubing shall have inner grooves for high efficiency heat exchange.
   3. All tube joints shall be brazed with phos-copper or silver alloy.
   4. The coils shall be pressure tested at the factory.
   5. A condensate pan and drain shall be provided under the coil.
   6. Both refrigerant lines to the PKFY indoor units shall be insulated.

G. Electrical:
   1. See schedules on drawings.

H. Controls:
   1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.
   2. The unit shall have a factory built in receiver for wireless remote control.

2.6 LOW PROFILE CEILING-CONCEALED DUCTED INDOOR UNIT

A. General: The PEFY-NMSU Low Profile unit shall be a ceiling-concealed ducted indoor fan coil that mounts above the ceiling with a rear return and a fixed horizontal discharge supply and shall have a modulating linear expansion device. The PEFY-NMSU shall be used with the R2-Series outdoor unit and BC Controller. The PEFY-NMSU shall support individual control using M-NET DDC controllers. PEFY (Low Profile) models shall have an extremely compact profile (7-7/8") which requires minimal ceiling space. PEFY-NMSU models shall feature external static pressure settings up to 0.20 in. WG. Units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.
B. Indoor Unit.
   1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:
   1. The cabinet shall be space saving, low profile, ceiling-concealed ducted.
   2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

D. Fan:
   1. The indoor unit fan shall be an assembly with one Sirocco fan direct driven by a single motor.
   2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
   3. The indoor fan shall consist of three (3) speeds, High, Mid, and Low.
   4. The indoor unit shall have a ducted air outlet system and ducted return air system.

E. Filter:
   1. Return air shall be filtered by means of a MERV 13 return air filter.

F. Coil:
   1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
   2. The tubing shall have inner grooves for high efficiency heat exchange.
   3. All tube joints shall be brazed with phos-copper or silver alloy.
   4. The coils shall be pressure tested at the factory.
   5. A condensate pan and drain shall be provided under the coil.
   6. When scheduled, the unit shall be provided with an integral condensate lift mechanism able to raise drain water 21 inches above the condensate pan.
   7. Both refrigerant lines to the indoor units shall be insulated.

G. Electrical:
   1. See schedule on drawings.

H. Controls:
   1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

2.7 CONTROLS

A. General: The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet®.
B. The specification is intended to cover equipment, labor, materials and services sufficient to result in a complete control system capable of controlling and monitoring the entire variable refrigerant flow system as outlined in the drawings and in these specifications.

C. Variable refrigerant flow system manufacturer shall be responsible for all control wiring required for a complete and operable variable refrigerant flow system. All wiring shall be done in accordance with all local and national codes and Division 16. This includes all low voltage wiring between the outdoor units, BC controllers, indoor units, remote controllers, BACNet interface and centralized controllers required for control power purposes.

D. Electrical Characteristics
   1. General: The CMCN shall operate at 24VDC. Controller power and communications shall be via a common non-polar communications bus.
   2. Wiring:
      a. Control wiring shall be installed in a system daisy chain configuration from indoor unit to ME remote controller to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.
      b. Control wiring for schedule timers, system controllers, and centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to system controllers, to the power supply.
      c. Control wiring for the Deluxe MA, Simple MA, and Wireless MA remote controllers shall be from the remote controller to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.
      d. The GB-50A system controller shall be capable of being networked with other GB-50A system controllers for web based control.
   3. Wiring type:
      a. Wiring shall be 2-conductor (16 AWG), twisted shielded pair, stranded wire, as defined by the Design Tool AutoCAD output.
      b. Network wiring shall be CAT-5e with RJ-45 connection.

E. CITY MULTI Controls Network
   1. The CITY MULTI Controls Network (CMCN) consists of remote controllers, schedule timers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.
CMCN System Configuration

F. CMCN: Remote Controllers

1. Simple MA Remote Controller
   a. The Simple MA Remote Controller shall be compact in size, approximately 3” x 5” and have limited user functionality. The Simple MA supports temperature display selection of Fahrenheit or Celsius. The Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto, and fan), temperature setting, and fan speed setting. The Simple MA Remote Controller shall be able to limit the set temperature range from the Simple MA. The room temperature shall be sensed at either the Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.

   b. The Simple MA Remote Controller shall require no addressing. The Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The PAC-YT51CRB shall require cross-over wiring for grouping across indoor units.

   c. One simple MA Remote Controller shall be provided for each indoor unit. See thermostat locations on plans.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON/OFF</td>
<td>Run and stop operation for a single group</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td>Operation Mode</td>
<td>Switches between Cool/Dry/Auto/Fan/Heat. Operation modes vary depending on the air conditioner unit. Auto mode is in the R2-Series only.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
</tbody>
</table>
| Temperature Setting   | Sets the temperature for a single group. Range of temperature setting  
Cool/Dry: 67°F-87°F (57°F-87°F for PEFY/PDFY/PFFY-E)  
Heat: 63°F-83°F (63°F-83°F for PEFY/PDFY/PFFY-E)  
Auto: 67°F-83°F (63°F-83°F for PEFY/PDFY/PFFY-E) | Each Group | Each Group |
| Fan Speed Setting     | Models with 4 air flow speed settings: Hi/Mid-2/Mid-1/Low  
Models with 3 air flow speed settings: Hi/Mid/Low  
Models with 2 air flow speed settings: Hi/Low | Each Group | Each Group |
### PAC-YT51CRB (Simple MA Remote Controller)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Flow Direction Setting</td>
<td>Not Available</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Timer Operation</td>
<td>Not Available</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
| Permit / Prohibit Local Operation | Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter).  
*1: Centrally Controlled is displayed on the remote controller for prohibited functions. | N/A       | Each Group *1    |
| Display Indoor Unit Intake Temp | Not Available                                                               | N/A       | N/A              |
| Error                         | When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed | N/A       | Each Unit        |
| Test Run                      | Operates air conditioner units in test run mode.  
*2: The display for test run mode will be the same For normal start/stop (does not display “test run”). | Each Group | Each Group *2    |
| Ventilation Equipment         | Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit. LOSSNAY items that can be set are “Hi”, “Low”, and “Stop”. Ventilation mode switching is not available. | Each Group | Each Group        |
| Set Temperature Range Limit   | The range of room temperature setting can be limited by the initial setting. The lowest limit temperature can be made higher than the usual (67°F) in cool/dry mode, while the upper limit temperature lower than the usual (83°F) in heat mode.  
*Function does not work in auto mode setting | Each Group | Each Group        |
G. GB-50A Centralized Controller

1. The GB-50A Centralized Controller shall control via a PC a maximum of 50 indoor units across multiple CITY MULTI outdoor units. A PC is provided by Section 15970 for the GB-50A Centralized Controller. The GB-50A Centralized Controller shall be approximately 5”x11” in size and shall be powered from a Power Supply Unit (PAC-SC50KUA). Power supplies shall be furnished in this Section. The GB-50A Centralized Controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly/annual scheduling, monitoring of operation status, error email notification, online maintenance tool and malfunction monitoring. The GB-50A Centralized Controller shall have basic operation controls which can be applied to an individual indoor unit, a group of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic control set of operation controls for the GB-50A Centralized Controller shall include on/off, operation mode selection (cool, heat, auto, dry, and fan), temperature setting, fan speed setting, airflow direction setting, error email notification, and online maintenance. Since the GB-50A provides centralized control it shall be able to enable or disable operation of local remote controllers via the PC. In terms of scheduling, the GB-50A Centralized Controller shall allow the user to define daily, weekly, and annual schedules with operations consisting of ON/OFF, mode selection, temperature setting, and permit/prohibit of remote controllers.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON/OFF</td>
<td>Run and stop operation for a single group</td>
<td>Each Group or Collective</td>
<td>Each Group or Collective</td>
</tr>
<tr>
<td>Operation Mode</td>
<td>Switches between Cool/Dry/Auto/Fan/Heat.</td>
<td>Each Group or Collective</td>
<td>Each Group</td>
</tr>
<tr>
<td>Temperature Setting</td>
<td>Sets the temperature for a single group.</td>
<td>Each Group or Collective</td>
<td>Each Group</td>
</tr>
<tr>
<td>Fan Speed Setting</td>
<td>Models with 4 air flow speed settings: Hi/Mid-2/Mid-/Low</td>
<td>Each Group or Collective</td>
<td>Each Group</td>
</tr>
<tr>
<td></td>
<td>Models with 3 air flow speed settings: Hi/Mid/Low</td>
<td>Each Group or Collective</td>
<td>Each Group</td>
</tr>
<tr>
<td>Air Flow Direction Setting</td>
<td>Air flow direction angles 100%-80%-60%-40%, Swing, *1. Louver cannot be set. Air flow direction settings vary depending on the model.</td>
<td>*1 Each Group or Collective</td>
<td>Each Group</td>
</tr>
</tbody>
</table>
**GB-50A (Centralized Controller)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permit / Prohibit Local Operation</td>
<td>Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *2: Centrally Controlled is displayed on the remote controller for prohibited functions.</td>
<td>Each Group or Collective</td>
<td>*2 Each Group</td>
</tr>
<tr>
<td>Indoor Unit Intake Temp</td>
<td>Measures the intake temperature of the indoor unit when the indoor unit is operating.</td>
<td>N/A</td>
<td>Each Group</td>
</tr>
<tr>
<td>Error</td>
<td>When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed. *3 When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection. The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection.</td>
<td>N/A</td>
<td>*3 Each Unit or Collective</td>
</tr>
<tr>
<td>Ventilation Equipment</td>
<td>This interlocked system settings can be performed by the master system controller. When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”. When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
</tbody>
</table>

*GB-50A needs a PC (provided by 15970) connected together to monitor and operate the air conditioner system.

2. Standard software functions shall allow the building manager to securely log into each GB-50A via the PC’s web browser to support operation monitoring, scheduling, error email, and online maintenance diagnostics. Standard software functions shall not expire. Additional optional software functions shall be available of personal browser for PCs and MACs.

3. Refer to the control drawings for additional information.

H. **Web-based User Interface**

1. Licenses per function, per GB-50A shall be required and provided at no cost to the Owner.
2. PCs shall be supplied by Section 15970.
3. PC-Monitoring (SW-Mon): The CMCN shall be monitor and operate all indoor units from a networked PC’s web browser for up to 50 units per GB-50A centralized controller.
4. PC Scheduling (SW-Sch): The CMCN shall be set up with customized daily, weekly, and annual schedules from a network PC’s web browser for up to 50 units per GB-50A. Schedules shall be applied to a single indoor unit, a group of indoor units, or collectively (batch) to all indoor units controlled by the GB-50A.

5. Online Error Email (SW-Email): The CMCN shall send detailed alerts to customizable distribution lists based on user defined error types.

6. Personal Web Browser (SW-Pweb): The CMCN shall be allow up to 50 individual users to monitor and control user defined zones via a network PC or MAC’s web browser.


I. Graphical User Workstation Software

1. The Graphical User Workstation Software (TG-2000) shall require a field supplied PC. PC provided in Section 15970

2. TG-2000 Software: The TG-2000 Integrated System Software provided in this section shall enable the user to control multiple GB-50As and shall provide additional functions such as tenant billing from a single, dedicated network PC configured with the TG-2000 software. The TG-2000 configured computer shall be capable of controlling up to forty GB-50A Centralized Controllers with a maximum of 2,000 indoor units across multiple CITY MULTI outdoor units. The TG-2000 software shall be required if the user wants to simultaneously control more than 1 GB-50A Centralized Controllers from a single PC using a single software session. Licensing per function, per GB-50A Centralized Controller shall be required for the TG-2000 software. Optional software features shall be available through the TG-2000 software including tenant billing. These optional software features shall require the TG-2000 software, advance purchase from the customer, and licensing from Mitsubishi to enable feature activation. All software and fees shall be provided in this Section.

<table>
<thead>
<tr>
<th>TG-2000 (Integrated System Software)</th>
<th>AG-150A/G-50A/GB-50A License</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
<td><strong>Details</strong></td>
</tr>
<tr>
<td>ON/OFF</td>
<td>The units can turn ON and OFF for all floors or in a block, floor, or group of units.</td>
</tr>
<tr>
<td>Operation Modes</td>
<td>The operation mode can be switched between COOL, DRY, FAN, AUTO, and HEAT for all floors or in a block, floor, or group of units</td>
</tr>
<tr>
<td>Temperature Setting</td>
<td>The room temperature can be set for all floors in a block, floor, or group of units. Set temperature range Cool/Dry: 67°F-83°F Heat: 67°F-83°F Auto: 67°F-83°F * Depends on unit type</td>
</tr>
<tr>
<td>Item</td>
<td>Details</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fan Speed</td>
<td>The fan speed can be set to four stages for all floors or in a block, floor, or group of units</td>
</tr>
<tr>
<td>Air Direction</td>
<td>The air direction can be set in four vertical directions or to swing for all floors or in block, floor, or group of units. (The selectable air direction differs according to the model.)</td>
</tr>
<tr>
<td>Interlocked Unit ON/OFF LOSSNAY</td>
<td>If there is an interlocked unit (LOSSNAY), then the unit can be turned ON (strong/weak) or OFF for all floors or in a block, floor, or group of units. (Note that the ventilation mode cannot be selected for interlocked units.)</td>
</tr>
<tr>
<td>Local Operation Prohibit</td>
<td>The items for which operation with the local remote controller are to be prohibited can be selected for all floors or in a block, floor, or group of units. (The items that can be prohibited are ON/OFF, operation mode, set temperature and filter sign reset.)</td>
</tr>
<tr>
<td>Annual / Weekly Schedule</td>
<td>The annual/weekly schedule function can be used by registering the license. Two settings, such as seasonal settings for summer and winter, can be saved.</td>
</tr>
<tr>
<td>Power Rate Apportionment Charging</td>
<td>An RS-485 watt-hour meter (WHM) is connected to calculate the air conditioning charges based on the amount each tenant's air-conditioner has operated. Two charging rates can be applied per day.</td>
</tr>
<tr>
<td>History</td>
<td>Up to 3,000 items for the error history and up to 10,000 items for operation history can be saved. Each history file can be output as a daily report or monthly report in CSV format. (The operation history consists only of the operations carried out with the TG-2000 and is limited to some limited operation items.)</td>
</tr>
<tr>
<td>Operation Time Monitor</td>
<td>The cumulative operation time of each indoor unit can be viewed or output as a CSV format file. (This function is valid only when the charging function license is registered.)</td>
</tr>
<tr>
<td>Filter Sign Display Mask</td>
<td>The filter sign display at the remote controllers can be disabled.</td>
</tr>
<tr>
<td>Night Set-Back Function *1, *4</td>
<td>Heating from 55°F and higher can be set using the schedule.</td>
</tr>
<tr>
<td>Set Temperature Limit *1</td>
<td>The set temperature lower limit can be set for cooling and the upper limit for heating. (ME remote controller required)</td>
</tr>
</tbody>
</table>

*1: Compatible with TG-2000 Ver. 4.10 or later, G-50A Ver. 2.51 or later
*2: Compatible with TG-2000 Ver. 4.30 or later, G-50A Ver. 2.51 or later
*3: Compatible with TG-2000 Ver. 4.60 or later, G-50A Ver. 2.70 or later
*4: With Night Set-Back function, the CITY MULTI system can run at heating mode with target temperature set to 55°F under schedule control. This function can protect the room from dropping down to extremely low temperature in the evenings.

J. CMCN: System Integration

1. The CMCN shall be integrated to the Building Management Systems (BMS) via BACnet® interfaces. Provide all necessary hardware and labor to accomplish the interface. Map BACnet points in accordance with Section 15970 contractors requirements.

2. The Mitsubishi Electric HVAC BACnet® interface, PAC-YG31CDA (SW-BACnet), shall be compliant with BACnet®/IP (ANSI/ASHRAE 135-1995, 135a) and UDP/IP of Ethernet (ANSI/ASHRAE 135-1995, 135b). The BACnet® interface shall require a dedicated network computer and activated BACnet® software function via Mitsubishi Electric HVAC issued license. The BACnet® software license shall be on a per AG-150A/G-50A/GB-50A basis for a maximum of 50 indoor units controlled by one AG-150A/G-50A/GB-50A Centralized Controller. The BACnet® interface shall support a maximum of ten AG-150A/G-50A/GB-50A Centralized Controllers for a maximum of 500 indoor units. Operation and monitoring points include, but are not limited to, on/off, operation mode, fan speed, prohibit remote controller, filter sign reset, alarm state, error code, and error address.

K. Power Supply (PAC-SC50KUA)

1. The power supply shall supply 12VDC (TB 3) for the G-50 centralized controller and 24VDC (TB 2) voltage for the central control transmission.

END OF SECTION 23 63 15
SECTION 23 72 23

PACKAGED AIR TO AIR HEAT RECOVERY UNITS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers (refer to Section 20 10 00-General Mechanical Requirements-Equipment/Material Substitutions):

1. Venmar, Energypac series (Basis of Design)
2. Heatex
3. Heat-X-Changer by Xetex.

2.2 GENERAL DESCRIPTION

A. Configuration: Refer the drawings and details for supplemental information. Units shall be complete with fan section plus accessories, including:

1. Supply Air Stream
   a. Rear horizontal OSA motorized damper and actuator
   b. Summer Pre-filter
   c. Winter defrost coil with drain pan
   d. Energy Recovery Wheel
   e. Heating coil
   f. Winter pre-filter and final filter.
   g. Plug style supply fan
   h. Front horizontal discharge as indicated on the drawings.

2. Exhaust Air Stream
   a. Front horizontal exhaust intake
   b. Filter
   c. Energy Recovery Wheel
   d. Plug style exhaust fan
   e. Rear horizontal exhaust with motorized damper

3. Return motorized damper to allow unit to operate in recirc mode when indicated on drawings.

2.3 CONSTRUCTION

A. General: Factory-assembled, the unit consists of fan and motor assemblies (supply and exhaust), heat recovery device Flat Plate Heat Exchanger, all necessary dampers, plenums, filters, drain pans, wiring, controls and other accessories as specified.

B. Unit Cabinet:

1. Unit is to be installed by the mechanical contractor. Indoor units weatherized for outdoor use are not acceptable.
2. All unit panels are attached with zinc plated hexagonal-head type screws complete with a washer and rubber gasket for weatherproof assembly. All panel seams shall be caulked and sealed for an airtight unit.

3. When rigging, base frame deflection shall be less than 1/360 of the unit length. All major components shall be supported by the base without sagging or pulsating.

4. Unit base shall be constructed from structurally formed galvanized steel (6").

5. Unit base shall accommodate curb or concrete pad installation. Single wall and non-insulated floor construction is not acceptable.

6. Unit base shall be internally insulated with 4" fiberglass (R12.0).

7. Single wall construction with coated insulation is not acceptable. Exposed insulation edges in the airstream are not acceptable.

8. Unit floor shall be constructed from 16 gauge galvanized steel. Unit sub-floor shall be constructed of 14 gauge aluminum checker plate floor.

9. The rigid frame provides stable construction allowing for panel removal without affecting the unit integrity.

10. Roof and wall panels shall be double wall construction using 2" thick, 2.5 lb/cu.ft. mineral wool insulation (R8.6) galvanized steel painted exterior panels and galvanized steel inner liners.

   a. Exterior units shall have roof and wall panels with double wall construction using 4" thick, 2.5 lb/cu.ft. mineral wool insulation (R17.2) galvanized steel painted exterior panels and galvanized steel inner liners.

11. Internal partition shall be insulated and constructed in the same manner as the unit cabinet.

12. Double-sloped IAQ drain pans shall be made of formed sections of stainless steel. Drain pans shall be sloped at a minimum of 1.5% with a drain pipe connection of 1 1/4" MPT ending over the structural base channel. All drain pan corners shall be welded.

13. Indoor units shall have a flat roof.

C. Access Doors

1. Full size access door(s) allowing for periodic maintenance and inspections must be provided for all serviceable components. Door insulation shall be the same as unit panels. Doors shall be provided with heavy duty corrosion resistant aluminum hinges that allow doors to open at 180° with no shear effect on the full perimeter gasket on the hinge side. Exterior units shall additionally be double wall construction made of galvanized steel for both outer and inner liner for maximum rigidity and door frames shall be extruded aluminum with a built-in thermal break barrier.

2. Compression type handles operable from both sides and neoprene resilient bubble gaskets for a seal-tight enclosure shall be provided that are operable from both sides shall be provided. Exterior units shall have hold-open devices on access doors. Door openings shall be Hush with all surrounding panels. Access doors shall be equipped with a reinforced window completed with a surrounding seal-tight rubber gasket.

D. Energy Recovery Wheel

1. Wheel shall be of the enthalpy type for both sensible and latent heat recovery and be designed to insure laminar flow. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060. Ratings "in accordance with 1060" without certification are not acceptable. Desiccant shall be silica gel for maximum latent energy transfer. Wheel shall be constructed of lightweight polymer media to minimize shaft and bearing loads. Polymer media shall be mounted in a stainless steel rotor for corrosion resistance.

2. Wheel design shall consist of removable segments for ease of service and/or cleaning. Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat.
capability after cleaning. Wheels with sprayed on desiccant coatings are not acceptable. Wheels with desiccant applied after wheel formation are not acceptable. Energy recovery device shall transfer moisture entirely in the vapor phase.

3. Energy recovery drive belt material shall be high strength urethane and shall be factory installed in a pre-stretched state, eliminating the need for field belt tension adjustment. Link style belts are not acceptable.

E. Frost Control Strategies

1. Frost control shall be accomplished by varying the speed of the wheel rotation via variable frequency drive on the wheel motor.

F. Fans

1. Fans shall be factory-tested and performance ratings shall comply with AMCA 210.
2. Fans shall be statically and dynamically designed and balanced for continuous operation at the maximum rated fan speed and motor horsepower in accordance with AMCA 300.
3. Fans shall be of centrifugal type, rigidly braced and reinforced to help prevent vibration or pulsation. Wheel diameters and outlet areas shall be in accordance with the sizes adopted by AMCA.
4. Fan and motor assemblies shall be mounted inside the unit casing with 2" (90% minimum efficiency) deflection spring vibration isolators with seismic restraint and supplied with flexible neoprene connections. Fan and motor assemblies shall be mounted inside the unit casing with rubber in shear pads IRIS) for a 25% maximum vibration transmission.
5. Removable shipping restraints shall be provided to protect the fan, motor and base during shipment.
6. Fan shall be selected for stable operation, at least 20% under the first critical speed of the fan. Unit shall be equipped with non-overloading, airfoil, SWSI Plenum fan, Arrangement 3 (AMCA labeled).
7. Fan shall be solid steel, turned, ground, polished and finished off with a corrosion resistant coating. Fan wheels shall be keyed to the shaft.
8. Bearings shall be heavy duty, grease-lubricated, self-aligning ball or pillow block type, selected for a minimum average bearing life (L-SO) in excess of 200,000 hours at maximum operating speed in accordance with AFBMA 9 Standards.
9. Fan drives shall be designed for a 1.3 service factor. Drives are factory-mounted with final alignment and belt adjustment completed before unit start-up.
10. Motors and fan pulleys shall be of fixed pitch for motors greater than 10 hp and adjustable motor sheave for motors 10 hp and smaller. Fan belt guard shall have holes for tachometer. Units shall be equipped with extended lubrication lines with PVC or copper tubing mounted on the fan assembly access side.
11. Belt Guards: Constructed to completely enclose belt drive system; rigid and adequately braced; sized to allow either sheave to be increased by a minimum of two (2) sizes; removable for changing of sheave.

G. Motors

1. Provide in accordance with Section 23 0513. All motors are enclosed in the unit casing and are mounted on an adjustable base that allows for belt alignment and tensioning.
2. Fan motors shall be heavy duty, 1800 rpm, high efficiency (EPAct), open drip proof (ODP), NEMA Design B with Class F insulation and have a 1.15 service factor.
3. Fan motor torque shall efficiently accelerate the drive loads.
4. Motor shall be of minimum size as indicated in the equipment schedule. Unless indicated, motor shall not operate in the service factor range. Fan motors shall be premium efficiency and inverter duty.
5. Temperature rating shall be 122°F maximum temperature rise at 104°F ambient for continuous duty at full load (Class B Insulation).

6. Motor construction shall be to NEMA Standard MG 1. General purpose, continuous duty, Design B.
   a. Base shall be adjustable.
   b. Bearings shall be:
      1) Ball or roller type with inner and outer shaft seals.
      2) Grease lubricated.
      3) Designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motors.
   c. Energy efficient motors shall have a minimum efficiency in accordance with IEEE Standard 112-B. If efficiency is not specified, motors shall give a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112-B.

H. Dampers

1. Unit shall be equipped with all necessary dampers: outside air, exhaust air and all others required for the system, including frost control.
2. Dampers shall be designed for operating between -40°F and 212°F.
3. Air leakage through a 4S" x 4S" damper shall not exceed 10.3 cfm/sq. ft. against 4 in. w.g. differential static pressure at standard air condition. Standard air leakage data to be rated in accordance with AMCA certified rating program.
4. Outside air dampers shall be opposed blade type and exhaust air dampers of parallel blade type. For other dampers, see manufacturers recommendations.
5. Outside air dampers shall be motorized.
6. Exhaust air dampers shall be motorized.
7. Return Air dampers shall be motorized.
8. Damper actuators shall be Belimo (2 position or modulating as indicated)
9. Damper construction shall be as follows:
   a. Damper frame shall be of extruded aluminum or galvanized steel.
   b. Blades shall be of extruded aluminum.
   c. Dampers shall be of opposed blade type or parallel blades where indicated.
   d. Damper blades shall be sealed with bottom and top blade wiper seals.
   e. Frame and blades shall not be insulated.

I. Coils

1. Acceptable coils shall have ARI Standard 410 certification and bear the ARI symbol.
2. Coils shall be submerged in water and tested to a 315 psig air pressure for standard copper tube coils. Coils must display a tag with the inspector's identification as proof of testing.
3. Tubes shall have a nominal thickness of 0.020" unless otherwise specified.
4. Fins shall be made of 0.0075" thick aluminum unless otherwise specified.
5. Tubing, return bends and headers shall be made of seamless UNS 12200 copper meeting ASTM 875 and ASTM B251 Standards. Coil return headers shall be equipped with factory-installed 1.2" FPT air vent connections placed at the highest point available on the face of the header (except for evaporator coils).
6. Casings and end plates shall be made of 16 gauge galvanized steel, meeting ASTM A527 Standard unless otherwise noted.
7. Double flanged casings on the top and bottom of finned height shall be provided to allow for coil stacking.
8. Piping, control valve and valve operator shall be supplied and installed by others.

J. Hot Water Coils
1. Coils shall be designed to withstand 250 psig maximum operating pressure and a maximum steam temperature of 300°F for standard duty copper tube coils.
2. Coil tube size and wall thickness is 5/8" x 0.020".
3. Standard construction fluid MPT connections shall be made from red brass meeting ASTM B43 Standard or Schedule-40 steel pipe as a minimum.

K. Lights
   1. Unit shall have marine-type lights complete with a main switch and/or a switch per access door wired to a junction box, disconnect or transformer.

L. Filters
   1. Provide filters in this Section in accordance with the requirements of Section 23 40 00.
   2. Size for maximum 500 FPM face velocity.
   3. Provide filters with weatherproof magnahelic gage, pressure switch, and sensing tube.
   4. Outside and return air inlets shall be equipped with galvanized steel racks that permit filter slide out removal (side access) for units equal or less than 78" tall and universal holding frames with upstream access for units taller than 78".

M. Heat Recovery Unit - Controls
   1. Unit shall have a multi-power point connection (supply fan, exhaust fan, lights and low voltage terminal strip for control of damper operators).
   2. VFD's shall be provided in section 23 09 23 and field installed. Each motor with its own power supply.
   3. Heat Recovery Unit manufacturer shall provide dampers, actuators, and all the required linkage for:
      a. Exhaust damper (2 position)
      b. Outside air intake (2 position)
      c. Return air (2 position)
      d. Linkage shall be maintenance free and accessible for routine inspection.
   4. All damper actuator wiring shall land on a terminal strip provided with the unit.
   5. Flow measurement Station: Integral, continuously monitoring air flow device; capable of producing a steady non-pulsating pressure differential signal; air flow gauge mounted on unit exterior with CFM readout; demonstrated laboratory accuracy of 97%; port connections for transducer provided by Section 23 09 23. The probes for air measurement shall be produced in accordance with ASHRAE Standard 51 -1985 AMCA standard 210-85, Figure 2A for static pressure taps.

N. HEAT RECOVERY UNIT - MODEL MANUFACTURER, SIZE, CAPACITIES, CONFIGURATION, ACCESSORIES, ELECTRICAL CHARACTERISTICS (BASIS OF DESIGN)
   1. See schedule and details on drawings.

END OF SECTION 23 72 23
PART 2 - PRODUCTS

2.1 GENERAL AIR HANDLING UNIT CONSTRUCTION FEATURES:

A. Plenum Fans and Motors

1. General: Centrifugal; unhoused; plenum type; single width; single inlet; backward inclined airfoil blades.
2. Wheel: Heavy gauge aluminum construction; tapered spun wheel cone; continuously welded airfoil blades; statically and dynamically balanced; AMCA Class I, II, or III as required for the specified operating pressure.
4. Shaft: Precision turned, ground and polished solid steel; ring gauged for accuracy; keyed to fan wheel and sheaves.
5. Bearings: Heavy duty; pillow block; self-aligning; ball or roller type; grease lubricated; pressure relief fittings; high pressure lube lines extended to a common location inside the unit adjacent to the fan access door (lines shall be clear nylon material to facilitate visual confirmation of grease in the line); minim bearing life (L-10) in excess of 200,000 hours. Sleeve bearings are not acceptable.
6. Sheaves: Adjustable sheaves on fans with motor horsepower 7½ and smaller operating at fan speeds below 2,000 rpm; fixed sheaves on all fans operating above 2,000 rpm and all fans with motor horsepower 10 and larger; sheaves shall be rated for 150 % of the nameplate motor horsepower.
7. Belts: Reinforced rubber; rated for 150 % of nameplate motor horsepower; minimum of two belts per drive; factory pre-tensioned for normal operation.
8. Belt Guards: Constructed to completely enclose belt drive system; rigid and adequately braced; sized to allow either sheave to be increased by a minimum of two (2) sizes; removable for changing of sheave.
9. Motors: heavy duty; premium efficiency; open drip-proof; in accordance with Section 23 05 13. Motor shall be mounted on an adjustable motor rail slide base assembly allowing for proper adjustment of the belt tension. Provide flexible power connection to motor.
11. Vibration Isolation Springs: Free-standing, un-housed, open type springs with leveling bolts and neoprene isolation pads; minimum 2 inch deflection; selected and rated for a minimum efficiency of 98 to 99 %.
12. Seismic Restraints: Capable of containing fan in all directions with 1/2 g of force applied.
13. Fan Thrust Restraints: Provided, when applicable, to prevent the spring isolator system from grounding against the floor, walls, seismic restraints, or tearing the fan flexible connection.
14. Flow Measurement Station: Integral, continuously monitoring air flow device; capable of producing a steady non-pulsating pressure differential signal; air flow gauge mounted on unit exterior with CFM readout; demonstrated laboratory accuracy of 97 %; port connections for transducer provided by Section 23 09 23. The probes for air measurement shall be produced in accordance with ASHRAE Standard 51-1985 AMCA standard 210-85, Figure 2A for static pressure taps.
B. Water Coils

1. General: Counterflow design (except single row); fully drainable with no trapped tubes; drains and vents provided on each coil; drains extended to the exterior of the cabinet. Leak tested to 400 psi under water.

2. Casing: Minimum 16 gauge galvanized steel; pressed or extruded tube holes; reinforcing rods such that maximum unsupported length is 60 inches; formed face and stacking flanges on all sides; enclose coils with headers and return bends fully contained within casing.

3. Racks for Stacked Coils: Stacked coils shall be mounted on racks to allow individual removal of each coil; galvanized steel angle for heating coils and type 304 stainless steel angle for cooling coils.

4. Mounting: Provide access to both sides of coils. Provide removable panels in unit wall for coil removal. Provide sealing collars at connection penetrations through unit wall.

5. Tubes: 5/8 inch outside diameter seamless copper tube; brazed connections; expanded into fin collars to provide a permanent mechanical bond.

6. Fins: Corrugated aluminum


C. Steam Distribution Coils

1. General: Fully drainable with no trapped tubes; drains and vents provided on each coil; drains extended to the exterior of the cabinet.

2. Casing: Minimum 16 gauge galvanized steel; pressed or extruded tube holes; reinforcing rods such that maximum unsupported length is 60 inches; formed face and stacking flanges on all sides; enclose coils with headers and return bends fully contained within casing.

3. Racks for Stacked Coils: Stacked coils shall be mounted on racks to allow individual removal of each coil; galvanized steel angle.

4. Mounting: Provide access to both sides of coils. Provide removable panels in unit wall for coil removal. Provide sealing collars at connection penetrations through unit wall.

5. Tubes: 1 1/8 inch outside diameter seamless copper outer tube; expanded into fin collars to provide a permanent mechanical bond; 5/8 inch outside diameter seamless copper inner tube; proportionally spaced directional steam jet orifices; sloped within frame to condensate connection.

6. Fins: Corrugated aluminum

7. Headers: Cast iron with tubes expanded into header or seamless copper.

D. Double-Sloped Condensate Drain Pans

1. General: Double-sloping, IAQ design; fully drainable; in accordance with ASHRAE 62-89 for both positive draining and cleanability; entire drain pan shall be accessible for annual inspection and cleaning; provided for all cooling coils and humidifier sections.

2. Construction: Type 304 stainless steel; minimum 16 gauge; double wall; continuously welded.

3. Sloping: 1/8 inch per foot; sloped in two (2) directions: downstream from cooling coil and toward drain connection.

4. Coverage: Drain pans shall be of sufficient size for complete capture of condensate. Pan shall extend a minimum of 6 inches beyond the leaving edge of cooling coils. Stacked
coils shall be provided with intermediate drain pans, which shall be connected with stainless steel drain lines.

5. **Drain Connection:** Same material as drain pan; installed below the bottom of the pan to insure positive condensate drainage; installed below the bottom of the drain pan to insure positive condensate drainage; MPT drain connections; connections shall be on same side of unit as coil connections unless specified otherwise.

### 2.2 CUSTOM AIR HANDLING UNITS

**A. Manufacturers (Refer to Section 20 10 00):**

1. Haakon
2. Huntair

**B. Configuration:** Provide air handling units in configurations as shown on the drawings. Various accessories and sections, including fan sections, shall match for a modular installation.

**C. Side and Roof Panels:**

1. **General Requirements (Indoor Units):**
   a. **General Construction:** 2 inches thick, double wall, standing seam, acoustic/thermal panel construction; perforated inner walls for fan sections and solid inner walls for all other sections; individually removable panels for both service access and future modifications; seal all seams during assembly to provide an airtight unit; casing shall be built to exceed AMCA Class “C” plenum requirements as outlined in AMCA 99 - Standards Handbook.
   b. **Insulation:** 2 inches thick, 3 pound double density rigid insulation with foil scrim-kraft (FSK) facing. Insulation shall meet the requirements of NFPA 90A, NFPA 90B and ASTM E 84 for Flame Spread of 25 or less and Smoke Development of 50 or less. Insulation shall have thermal conductivity \( k \) factor of 0.24 Btu·in/(h·ft²·°F) at 75 degrees F (R value = 15.6).

2. **Acceptable Panel Construction Alternatives:**
   a. **Note:** Panels shall meet the requirements of one of the following alternatives in addition to the general requirements noted above.
   b. **Mechanically fastened construction:** 16 gauge galvanized steel outer wall; 22 gauge galvanized steel inner wall; insulation edges protected with metal lagging; panel seams turned inward to provide a clean flush exterior finish, angle steel stiffeners as required to maintain casing deflection criteria; 2 inch (1/8×3/8 inch) tape sealer provided between all flanged panel surfaces during assembly for an air tight seal.
   c. **Bolted panel construction:** 16 gauge galvanized steel outer wall; 16 gauge galvanized steel inner wall; 5/16 inch zinc-plated bolts on maximum 8 inch centers; stiffeners as required to maintain casing deflection criteria; continuous bead of silicone caulking applied between matching panel seams prior to assembly with a final bead following assembly on both the exterior and interior panel seams to produce an air tight seal.
   d. **Bolted panel construction:** 16 gauge galvanized steel outer wall; 16 gauge galvanized steel inner wall; reinforced roll-formed C channel stiffener/insulation retainers for structural integrity and to prevent oil canning at panel seams; ¼ inch diameter, zinc-plated bolts on maximum 10 inch centers; continuous bead of high performance polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25 and USDA approved, paintable and EPA approved for potable water.
contact, applied at each panel seam after all panel bolts have been secured for an air tight seal.

e. Screwed, two-break construction; 16 gauge galvanized steel outer wall; 22 gauge galvanized steel inner wall; wall and roof joints broken inward to provide a clean flush exterior finish; panels attached with sheet metal screws and sealed with butyl for an air tight seal.

f. Combination screwed/bolted panel construction; 16 gauge galvanized steel outer wall; 20 gauge solid galvanized steel and 22 gauge perforated galvanized steel inner wall; panels attached to tubular steel framework with zinc-plated screws, tubular steel framework provided with interior bolted standing seam with a 14 gauge galvanized steel top and bottom frame; supports as required to maintain casing deflection criteria; caulking provided at all panel seams for an air tight seal.

D. Base:

1. Structure: Structural steel channel iron around entire perimeter of the unit, with intermediate structural steel and angle iron supports as required. All channel and angle joints shall be continuously welded. Minimum channel depth shall be 8 inches unless specifically noted otherwise on the drawings.

E. Floor: 12 gauge plate floor, supported from underneath by intermediate channel as required.

1. Attachment: Continuously welded seams or screwed or bolted attachment with caulked seams.

2. Insulation: 2 inches (thick), 3 pound double density rigid insulation meeting the same requirements as side and roof panel construction. Insulation shall be covered with a galvanized steel liner.

3. Perimeter collar: A perimeter collar shall be provided around the entire unit and around each floor opening to ensure the unit is internally watertight. The entire base shall act as an auxiliary drain pan, and shall hold up to 1 inch of water.

4. Lifting lugs: A minimum of four (4) removable lifting lugs per section shall be provided, properly spaced to insure uniform loading. Rigging and lifting safety instructions shall be attached to unit.

5. Floor openings: All openings in the floor larger than 12×12 inches shall be covered with powder coated heavy gauge steel “walk-on” safety grating bolted in place, sufficient to prevent people and large objects from passing through the unit floor. Grating shall support a minimum of 300 pounds.

F. Access Doors:

1. Construction: Minimum 16 gauge galvanized steel or 0.063 inch embossed aluminum outer wall; minimum 22 gauge galvanized steel solid inner wall; one-piece frame with continuously welded corners for rigidity; same thickness as unit casing.

2. Insulation: 2 inches thick, 3 pound double density rigid insulation meeting the same requirements as side and roof panel construction. Insulation shall be encapsulated between the door panels and frame and sealed with a continuous bead of silicone caulking.

3. Window: Thermal pane; minimum 9×9 inches in size.

4. Seal: Fully gasketed with continuous hollow closed cell foam gasket. Door shall be double-gasketed, with one gasket provided on the door and one gasket placed on the frame. Gaskets shall be replaceable.
5. **Latches:** Provide two (2) latches on doors up to 48 inches tall, and 3 latches on doors taller than 48 inches. Latches shall be operable from both inside and outside of the unit.

6. **Size:** Maximum height available from manufacturer, 70 inches (minimum) or full-height of unit, whichever is less. Standard door width shall be 24 inches unless restricted by section width or access requirements require additional width. Fan compartments must have a door of minimum width to remove the motor. All doors shall be of sufficient size to allow proper maintenance and inspection access for the associated section.

7. **Safety lock-out:** All doors with access to moving parts shall be designed to require tools for opening in accordance with UL 1995 mechanical protection guidelines.

8. **Door swing:** All access doors shall swing against the air pressure - positive pressure plenum doors shall swing in, and negative pressure plenum doors shall swing out.

9. **Hinge:** Continuous piano type stainless steel or removable pin bolted type made of corrosion resistant material.

10. **Location:** Located on service side of air handling unit.

**G. Painting:**

1. Panels (wall and roof): Polyurethane primer and polyester hybrid semi-gloss top coat, or etch bond primer and alkyd enamel top coat. All panels shall be primed and top coated on both sides. Paint system shall offer excellent color retention, low fade characteristics, excellent UV resistance, very good resistance to solvents, chemical fumes, acids and alkalis, and very good abrasion resistance. Paint system shall pass a minimum of 1000 hour salt spray test per ASTM B-117. Test documentation shall be available upon request.
   a. Color: ANSI 61 Grey

2. Uncoated steel: All uncoated steel, including entire base structure, fan assembly (except wheel) and interior racks shall be painted to the same requirements of the panels.

**H. Filter Racks:**

1. **General:** Factory fabricated as an integral part of the air handling unit; 2 stage filter housing accommodating any 4 inch pre-filter and various final filters with efficiencies of 45 to 95%, ASHRAE 52, 1-92. In-line depth shall not exceed 24 inches. Filter racks shall accommodate filtration requirements for this project as specified in Section 23 40 00.

2. **Construction:** Minimum 16 gauge galvanized steel; gasketed with positive sealing fasteners.

3. **Access/Loading:** Face and rear loading for filter sections provided with 24 inches or greater access plenums; side access for all other filter sections.

4. **Differential Pressure:** Dwyer 2000 magnahelic or equal differential pressure gauges; ±2% accuracy from 0 to 2 inches WG; provide one gauge for each filter stage; gauges mounted on unit exterior; auxiliary taps for each gauge provided for use of Section 23 09 23. Coordinate with Section 23 09 23 for requirements.

5. **Leakage:** Leakage at rated airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1% at 3 inches WG differential pressure.

**I. Control Dampers:**
1. **General:** Low-leak, airfoil design; extruded aluminum; parallel blade for return air applications and opposed blade for outside and exhaust air applications or as indicated on the drawings.

2. **Construction:** Extruded aluminum hat channel frame, 0.125 inch minimum thickness; extruded aluminum, airfoil blades with integral structural reinforcing entire length of blade.; extruded vinyl double edge blade seals, easily replaceable; non-corrosive molded synthetic bearings; square or hexagonal axles for positive locking - round is not acceptable; linkage concealed in frame.

3. **Leakage:** AMCA certified for leakage of equal to or less than 3 CFM/foot² at 1 inch WG of differential pressure at 12×12 inch damper size.

4. **Basis of Design:** Ruskin CD-50

**J. Damper Linkages and Actuators:** All required damper linkages shall be factory installed by the air handling unit manufacturer. Actuators shall be furnished by Section 23 09 23 and shall be shipped to the air handling unit manufacturer for factory installation. Coordinate with Section 23 09 23 for actuator manufacturer, quantity, type and size as well as damper linkage requirements.

**K. Lights/Wiring:**

1. **General:** Compact fluorescent watt, vapor-proof, marine type fixtures; protective metal cage and sealed glass enclosure. Provide in each accessible section.

2. **Wiring:** All lights factory wired to a single switch on the exterior of the unit adjacent to supply fan door; all wiring shall be in conduit and internal to the unit. No external conduit for lighting shall be allowed. If the unit requires splitting, junction boxes shall be furnished on each section to allow final connections in the field. Wiring shall be clearly labeled to allow ease in final interconnections.

3. **Wiring Clearances:** Air handling unit manufacturer shall provide a minimum of 1.5 inch clearance above entire width of each interior bulk head (filter, coil, fan, etc.). In addition, provide a minimum of 3 knockouts for ½ inch conduit in this 1½ inch electrical clearance area. This will allow wiring 110V or 24V to be run internally and help prevent controls contractor from penetrating exterior panels multiple times with conduit.

**L. Other materials and equipment shall be as specified later in this section.**

END OF SECTION 23 73 00
SECTION 23 83 10
TERMINAL HEAT TRANSFER UNITS

PART 2 - PRODUCTS

2.1 RADIATORS

A. Manufacturer (Refer to Section 20 10 00 – Basic Mechanical Requirements:)
   1. Runtal Series - (basis of design)
   2. Panel Radiator

B. See drawings for arrangement, capacities and dimensions.

C. Radiators shall be manufactured of cold rolled low carbon steel, fully welded and consisting of header pipes at each end, connected by flat oval water tubes.

D. Minimum tube thickness shall be 0.048 inch min wall thickness.

E. Radiator header pipes shall be square 0.109 inch min wall thickness and include all necessary supply, return, and air vent connections. Internal baffling is provided as required.

F. Piping connections shall be ¾ inch NPT taper threaded sockets, located in horizontal positions. Air vent connections are 1/8 inch NPT taper threaded sockets.

G. Working pressures shall be suitable for medium pressure 85 psi max (tested at 110 psi).

H. Radiator expansion shall not exceed 0.016 inch per linear foot at 215° F. Provide with removable access panel and double sided end cap trim on both ends to conceal piping connection and dielectric unions.

I. Radiators, trip pieces, pedestal, and accessories shall be finish painted with a “custom” baked enamel finish, for a total paint thickness of 2 to 3 mils (0.002 inch – 0.003 inch) in color approved by Architect (Runtal Steel #9007). Submit paint samples with submittal.

J. Floor Supports: Provide when indicated on Drawings.
   1. System shall support from KR20 floor pedestal bracket provided with integral to radiator or wall brackets. Provide with vertical pipe trim piece to conceal piping connection through floor.
   2. Floor pedestals for radiation shall be a maximum of 36” spacing.

K. Wall Supports: Provide Wall Supports and Brackets when indicated on drawings.

L. Consult plans for pipe connection requirements (side, rear or bottom) and trim piece/end cap details.

M. See schedule.

2.2 UNIT HEATERS

A. Manufacturers (refer to Section 20 10 00–Basic Mechanical Requirements–Equipment/Material Substitutions):
1. Trane Model S (Horizontal throw)
2. Sterling

B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing. Coils tested to 375 psi under water. Supply and return connections are steel pipe. Suitable for 75 psi steam or hot water up to 200 psig or 325 deg. F.

C. Casing: Steel plates.
   1. Projection style shall have bottom plate that forms an orifice for air delivery. Air ports stamped on the plate as standard for easy removal for low final air temperatures.

D. Finish: Factory applied baked enamel of standard factory color.

E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

F. Air Outlet: Adjustable pattern diffuser on projection models and two four way louvers on horizontal throw models.

G. Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. Refer to Section 23 05 13.

H. Capacity: As scheduled.

I. Electrical Characteristics:
   1. See schedule on drawings.

2.3 FAN-COIL UNITS

A. Manufacturers (refer to Section 20 10 00–Basic Mechanical Requirements–Equipment/Material Substitutions):
   1. Trane
   2. York
   3. Carrier
   4. Williams

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 200 psi and 220 °F. Combined coil pressure drop shall not exceed 0.75”.

C. Drain Pans: IAQ style drain pan under cooling coil, easily removable for cleaning, with primary and secondary drain connection.

D. Cabinet: 0.0598 inch steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation with reinforced and matted finish.

E. Finish: Factory applied baked primer coat enamel on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven, belt or direct drive as indicated on drawings.
G. Motor: Tap wound multiple speed permanent split capacitor shaded pole with sleeve bearings, resiliently mounted.

H. Control: For direct drive units, provide multiple speed switch, factory wired, located in cabinet. For belt drive units, control is provided by section 23 09 23.

I. Filter: Provide in accordance with Section 23 40 00.

J. Capacity: As scheduled. Provide capacity of coil matched to refrigerant suction temperatures at condensing units furnished for the project. Coordinate with Section 23 63 13.

K. Electrical Characteristics: See schedules on drawings.

END OF SECTION 23 83 10
PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials used under this Contract, unless specifically noted otherwise shall be delivered to the site new, in their original unbroken packages and shall be of the best quality of their respective kind and shall conform to the latest Standard Specifications of the American Society for Testing Materials, National Electrical Manufacturers' Association, National Board of Fire Underwriters or other appropriate agency. Standard items shall bear the stamp indicating listing by Underwriter's Laboratories, Inc. when such listing is available. Custom-designed items shall be fabricated of UL approved materials.

B. Throughout these specifications various materials, equipment, apparatus, etc., are specified by manufacturer, brand name, type or catalog number. Such designations are to establish standards of desired quality and construction and shall be the basis of the bid.

C. Substitutions will be allowed only as herein provided. No substitutions will be permitted without the Architect's written acceptance. Refer to Division 01 of these specifications for additional requirements.

1. All prior acceptance submittals shall be accompanied by a transmittal letter indicating date, project name, product description/type, and deviations from contract documents if any.

2. Present complete photometric data as listed by an independent testing laboratory for all proposed luminaire substitutions. See additional requirements in Section 26 50 00.

3. Subject to the Architect's discretions certain items may be considered for substitution only after samples have been submitted for review.

D. Contractors wishing to bid on equipment other than that listed shall obtain prior acceptance of same. Unless prior acceptance (By Addendum) is issued to all bidders, the Contractor will be held to furnish all items exactly as scheduled and/or specified.

E. Unauthorized product substitution will be removed from the job site and replaced with the specified item at the Contractor's expense.

2.2 EQUIPMENT/MATERIAL SUBSTITUTIONS

A. Throughout these specifications and drawings, various materials, equipment, apparatus, etc., are specified or scheduled by manufacturer, brand name, type or catalog number. Such designation is to establish standards of desired quality and construction and shall be the basis of design and the bid.

B. Substitutions will not be permitted without written approval

C. Where two or more manufacturer designations are listed in these specifications, choice will be optional with the Contractor except that where more than one manufacturer is listed, and only one manufacturer's catalog number is specified or only one manufacturer scheduled on the drawings (basis of design) that standard of quality, dimensional characteristics, capacities, and
construction shall be maintained by materials or equipment supplied by the other manufacturer(s).

D. If the Division 26 Contractor uses manufacturers other than the basis of design, the Contractor shall be responsible for:

1. Insuring the substituted item will fit the available space while allowing proper maintenance access.
2. Any changes required by other Contractors caused by the substituted equipment.

E. In the event other than specified equipment is used and will not fit job site conditions, this Contractor assumes responsibility for replacement with items indicated as the basis of design.

F. See specifications Section(s) 01 60 00 and 01 63 00 for product prior approval requirements.

2.3 OWNER FURNISHED EQUIPMENT AND MATERIALS

A. The Contractor shall accept and become responsible for all Owner furnished equipment and materials. Inspect all equipment and materials to determine suitability for installation. Immediately notify the Owner of any defects or deficiencies. Failure to so notify the Owner shall mean that the Contractor warrants that all equipment and materials are of the proper quantity, design and are free from all defects. Properly store all equipment and materials.

2.4 SUBMITTALS FOR REVIEW

A. Shop Drawings

1. Refer to Section 01 30 00.
2. Shop drawings, catalog information and material schedules shall be submitted for approval on all materials and equipment prior to ordering. This applies to all specified material and equipment in Division 26.
3. Provide specific wiring diagrams for all equipment requiring electrical or control wiring. Upon approval, copies of these diagrams shall be forwarded to pertinent contractors.
4. Prior to construction, a facility conduit plan shall be submitted for review showing the routing of all conduits 2” and larger, (e.g. below grade, concealed, surface mounted, etc.), the locations of all junction boxes or pull boxes. Shop drawing submittal shall be the same size as the contract documents and shall show the floorplan scaled at 1/8 inch = 1 foot. Shop drawing shall be generated using a computer aided drafting program; as-built drawings and .DWG or .DXF files of the facility conduit plan shall be delivered to the Architect. CAD floorplans of the contract documents will be provided by the Owner’s representative to the Electrical Contractor in .DWG format only after completion of an “Consent for the Release of Electronic Files” (forwarded by the Owner’s representative on request).

B. Furnish complete shop drawing/catalog data for equipment and materials to be used in the work for review. Allow sufficient time for developing shop drawings, processing and review time so that the installation will not be delayed.

C. Shop drawings shall be reviewed, approved and stamped by Contractor prior to submitting to Owner’s Representative for approval. Submittals without such approval will be returned without review.
D. Submit data in accordance with Section 01 30 00 and in accordance with this section. Data shall be black and white, on 8½×11 inch or 11×17 inch, single, one-sided sheets suitable for copying. Diagrams and drawings larger than 8½×11 inch shall be accordion folded to fit in a three ring binder. Drawings and catalog data must be clean, neat copies. FAX material or other poor quality copies will not be acceptable.

E. Submittals shall be bound in a black 3-ring binder with the project name on the cover. Provide index tabs for each specification section in same order and using same name as appears in the Specifications.

F. Where choices of options and accessories are available or specified, provide written description of what is to be furnished. If necessary, list page numbers where submitted items are described.

G. Underline applicable data.

H. If material or equipment is not as specified or submittal is not complete, it will be rejected. Only complete submittal including all applicable specification sections will be reviewed.

I. Catalog data or shop drawings for equipment that are noted as being reviewed shall not supersede Contract Documents.

J. Review comments shall not relieve Contractor from responsibility for deviations from Contract Documents unless attention has been called to such deviations in writing at time of submission, nor shall they relieve this Contractor from responsibility for errors in items submitted.

K. Check work described by catalog data with Contract Documents for deviations and errors.

L. Submit four (4) copies of each shop drawing. The Engineer will retain one stamped copy, one will be provided to the Architect and a two stamped and reviewed copies will be returned to the Contractor. The Contractor shall be responsible for distribution of required number of reviewed copies to parties other than the Owner’s Representative(s).

END OF SECTION 26 01 01
SECTION 26 01 02

PROJECT FINALIZATION

PART 2 - NOT USED

END OF SECTION 26 01 02
PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Manufacturers: Conductors shall be as manufactured by:
   1. American Insulated
   2. Cerro
   3. Encore
   4. Essex
   5. Houston
   6. Southwire

B. Wire and cable shall be copper single conductor type with 600 volt insulation, unless otherwise indicated.

C. Copper conductors shall be soft drawn, minimum 98% conductivity.

D. Grounding conductors shall be copper.

E. Conductors for service entrance, feeder and branch circuits shall have XHHW insulation. Conductors installed above grade in dry locations may be THHN or THWN.

F. Outer jackets of conductors shall be color coded as follows:
   1. 120/208 volt circuits.
      a. Phase A-Black
      b. Phase B-Red
      c. Phase C-Blue
      d. Neutral-White
   2. 277/480 volt circuits
      a. Phase A-Brown
      b. Phase B-Orange
      c. Phase C-Yellow
      d. Neutral-Gray
   3. Insulated ground wires-Green.
   4. On large conductors, for which color coded jackets are not available, install bands of adhesive non-fading colored tape or slip-on bands of colored plastic tubing over the cables and wires at their terminations and in the vaults, wireways, junction boxes and outlet boxes. In vaults and wireways, install the color coding at each end of the wireway and at approximately 3 foot intervals within the vault or wireway.
   5. Materials used for identification shall be colorfast and shall withstand cleaning. Colors used shall be the same as specified for outer jackets.
2.2 METAL-CLAD CABLE

A. Manufacturers:

B. Metal-clad cable shall be Type MC pre-manufactured cable assemblies consisting of color-coded phase, neutral and ground conductors bound together with an outer covering of interlocked armor.

C. Conductors shall be stranded copper with 600 volt type THHW or THHN insulation. Insulation shall be color-coded as specified above for wire. Conductors shall be no smaller than #12 AWG.

D. Each metal-clad cable shall be provided with an insulated ground conductor together with the phase and neutral conductors.

E. Fittings for metal-clad cable shall be UL listed as suitable for the intended use.

F. Metal-clad cable shall only be permitted where specifically noted in the Drawings.

END OF SECTION 26 05 19
PART 2 - PRODUCTS

2.1 CORDS AND CAPS

A. Manufacturers: Leviton, Bryant, Hubbell, Pass & Seymour, and Arrow-Hart.

B. Attachment Plug Construction: Conform to NEMA WD 1.

C. Configuration: NEMA WD 6, UL 498, heavy duty nylon construction with external cord clamp and dead-front construction, with rating and NEMA configuration molded on the device. Match receptacle configuration at outlet provided for equipment.

D. Cord Construction: NFPA 70, Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

END OF SECTION 26 05 20
SECTION 26 05 26
GROUNDING AND BONDING

PART 2 - PRODUCTS

2.1 ROD ELECTRODES
A. Manufacturers: Erico, Harger, Thomas & Betts.
B. Material: Copper-clad steel
C. Diameter: 3/4 inch diameter
D. Length: 10 feet long

2.2 GROUND BARS
A. Manufacturers: Chatsworth
   B. MDF Ground Bars: Shall be ¼" thick by 4" high by 20" long solid copper bar with 4" insulated stand-off supports. Bar shall be factory pre-drilled to accept standard 2-hole lugs. Chatsworth #40153-020.
   C. IDF Ground Bars: Shall be ¼" thick by 2" high by 10" long solid copper bar with 4" insulated stand-off supports. Bar shall be factory pre-drilled to accept standard 2-hole lugs. Chatsworth #13622-010.

2.3 COMPRESSION CONNECTORS
A. Materials: Fasteners, splices and connectors shall be specifically selected for the materials to be joined.
   B. Irreversible compression-type, suitable for direct burial. Burndy Hyground or Thomas & Betts Color-Keyed.
   C. Manufacturers: Burndy, Harger, Thomas & Betts.

2.4 WIRE
A. Material: Stranded copper
   B. System grounding electrode conductors and bonding conductors shall be stranded single conductors, with 600 volt insulation, sized to meet NFPA 70 requirements, as manufactured by General Cable, Rome, Southwire or Triangle.
   C. Bonding conductors shall be cabled assemblies of 14 strands of 17 AWG copper wire assembled in a braided smooth twist resulting in ¼ inch diameter cable of 28,500 circular mil cross-sections with a net weight of 92 pounds per 1000 linear feet. Minimum size shall be #6 AWG. #6 AWG shall be solid, larger sizes shall be stranded.
SECTION 26 05 30
CONDUIT

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers: Allied Tube and Conduit, LTV, Triangle PWC, Western Tube and Conduit, or equal

B. Rigid Steel Conduit: ANSI C80.1

C. Rigid Aluminum Conduit: ANSI C80.5

D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Threaded galvanized or cadmium plated steel fittings. Bushings shall have nylon insulated throats

2.2 FLEXIBLE METAL CONDUIT

A. Manufacturers: AFC, Anamet, Triangle PWC, or equal

B. Description: Interlocked, galvanized steel construction

C. Fittings: ANSI/NEMA FB 1: Specifically designed for the purpose

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers: AFC, Anamet, Electriflex, Alflex, or equal

B. Description: Interlocked, galvanized steel construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1: Specifically designed for the purpose

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers: Allied Tube and Conduit, LTV, Triangle PWC, or equal

B. Description: ANSI C80.3; galvanized tubing

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, rain tight compression type with nylon insulated throats on connectors

2.5 RIGID PLASTIC CONDUIT

A. Manufacturers: Carlon, PW Pipe, Triangle PWC, or equal

B. Description: NEMA TC 2; Schedule 80 PVC

C. Fittings and Conduit Bodies: NEMA TC 3
2.6 CONDUIT WITH INNERDUCTS

A. Manufacturers: Carlon, Optic-Gard/PE, No 13109, or approved equal

B. Description: NEMA TC 2

C. Fittings and Conduit Bodies: NEMA TC 3

END OF SECTION 26 05 30
SECTION 26 05 32

BOXES

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Manufacturers: Appleton, Crouse Hinds, Killark, O Z Gedney, Raco/Bell, Steel City, or equal.

B. Boxes shall accommodate the devices to be installed and shall be sized as required by the applicable codes for number and size of conduits and conductors entering and leaving. Round or octagon boxes will not be permitted unless specifically called for. Boxes shall have galvanized finish.

C. Boxes shall be of code gauge steel and provided with plaster, tile or other appropriate device rings.

D. Outlet boxes and device boxes mounted in non-masonry walls shall be minimum 4 inches square by 1½ inches deep exclusive of rings and shall be provided with covers or device rings as specified. Boxes for wall switches and data/telephone outlets shall be minimum 2 1/8 inches deep exclusive of rings. Boxes for data/telephone outlets shall be minimum 4 11/16 inches square by 2 1/8 inches deep exclusive of rings.

E. Outlet boxes, telephone/data boxes, and device boxes mounted in masonry walls shall be double gang masonry boxes with a minimum depth of 2½ inches for 4 inch masonry walls and 3½ inches for 6 inch or 8 inch masonry walls (exclusive of rings).

F. Multi-gang boxes shall be one-piece. Do not use built-up boxes.

G. Weatherproof boxes shall be non-rusting cast metal with threaded hubs. Boxes shall have screw mounted, gasketed covers. Plugs shall be installed in all unused holes.

H. Boxes installed in masonry walls shall have tile covers.

2.2 PULL AND JUNCTION BOXES

A. Manufacturers: Circle AW, Hoffman, Rittal, or equal

B. Special oversized outlet boxes and junction boxes shall be code gauge steel and of the knockout type. Boxes shall have screw mounted covers for surface or flush mounting. Boxes shall be sized in accordance with applicable codes. Special outlet boxes shall accommodate the equipment served.

C. In damp or wet locations sheet metal pull boxes shall be hot dipped galvanized after fabrication then finish painted with two coats of rust-resistant paint. Use covers with neoprene gaskets affixed with stainless steel screws. Seal around conduit entries with silicone based sealant.

2.3 FLOOR BOXES – POWER ONLY

A. Manufacturers: Hubbell #PFB1/PFBA1A or equal
B. Floor boxes shall be non-metallic and shall be adjustable by cutting box. Boxes shall be round and approximately 5.38” in diameter. Boxes shall contain (2) ¾” and (1) 1” threaded hubs. Cover plates shall be aluminum, flush mounting with permanent ring or flange and rubber gasket equal to Hubbell #SA2925. Floor outlets in carpeted areas shall be complete with polycarbonate carpet flanges.

2.4 POKE-THRUS
A. Manufacturers: Hubbell, Walkerbox, or equal
B. Poke-thrus shall be as indicated on the drawings and include polycarbonate finish rings and shall be UL listed and classified for two (2) hours. Poke-thrus shall include flush polycarbonate finish rings, have double duplex or data ports as shown, and contain integral ¾ inch EMT conduit and junction box. Junction box shall be a minimum of 24 cubic inches capacity. Model numbers as indicated on the drawings.

2.5 COMBINATION DATA/POWER FLOOR BOXES
A. Manufacturers: Walker #RFB11 or approved equal
B. Floor boxes shall be steel type for installation in concrete floors with means of adjusting cover plate to finish floor level both before pour. Box shall contain (1) 6-gang communications compartment and (3) 1-gang power compartments. Cover plates shall be the hinged type with retractable cable exits. Provide power/data plates as required for mounting the indicated devices. Floor outlets in carpeted areas shall be complete with polycarbonate carpet flanges.

2.6 ACCESS DOORS
A. Materials shall be in accordance with Section 08 31 13.
B. Minimum size of access doors shall be 12×12 inches.
C. Access doors shall have flush, ¼ turn locks.

END OF SECTION 26 05 32
SECTION 26 05 36

CABLE TRAYS

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior surfaces shall be smooth and free of offset edges, projections or misalignment. All edges shall be smooth and de-burred.

B. Structure of trays shall be suitable to support a continuous loading of cables weighing 50 lbs. per linear foot, when supported on 6 feet centers, without any deflection exceeding 1/100 part of the span, with a safety factor of 1.70. Actual support spacing shall be as indicated below under “PART 3 INSTALLATION”.

C. Manufacturer’s factory fabricated accessories and special transitions shall be provided for all changes in direction and offsets. Use manufacturers standard fittings including bolting assemblies for all end to end connections.

D. No on-site fabricated transitions shall be accepted.

E. Unless otherwise indicated, use ladder type cable trays in telecom closets, and wire mesh type in concealed ceilings of corridors and other public spaces.

F. Each closet containing equipment racks shall be equipped with a 12 inch wide cable tray that extends completely over the equipment racks. HOMACO cable tray, part number, with the appropriate corner clamp assemblies, threaded rods, ceiling hanger brackets, and tray clips shall be used, unless another solution is approved.

2.2 LADDER-TYPE CABLE TRAY

A. Manufacturer: B-Line.

B. Description: NEMA VE 1, Class 12A ladder type tray.

C. Material: Flange-in Steel or Aluminum.

D. Finish: ASTM A 123, hot dipped galvanized after fabrication.

E. Inside Width: As indicated on drawings.

F. Inside Depth: 3-3/8 inches high (minimum) side rails.

G. Straight Section Rung Spacing: 9 inches on center.

H. Inside Radius of Fittings: 24 inches

I. Provide manufacturer’s standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

J. Covers: None.
2.3 WIRE MESH CABLE TRAY SYSTEM

A. Manufacturer: Cablofil “EZ” Series, Chatsworth OnTrac Series
B. Description: Wire-mesh with continuous, rigid, 50 mm by 100mm wire mesh.
C. Material: Carbon Steel.
D. Finish: Electrodeposited zinc plating per ASTM B 633, Type III, SC-1, applied after fabrication.
E. Inside Width: As indicated on drawings.
F. Inside Depth: As indicated on drawings. 2 inches high (minimum) side rails.
G. Inside Radius of Fittings: 12 inches.
H. Provide manufacturer’s standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
I. Covers: None.

2.4 SUPPORTS

A. Wall brackets shall be used in main corridors and all other public areas. Contractor shall attach cable tray to bracket.
B. In mechanical rooms, telecommunications closets, and other non-public spaces, channel supports may be used. Single channel supports shall be formed, steel type with finish as specified by Architect.
C. Where walls do not permit mounting of cable tray, center-hung cable tray supports shall be used.

2.5 FIRE STOP PILLOWS

A. Fire stop pillows for penetrations through fire separations shall be non-toxic intumescent type. Pillows shall be UL listed with a fire rating of three (3) hours.
B. Fire stop pillows shall be equal to Nelson PLW fire stop pillows.

END OF SECTION 26 05 36
PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT
   A. Manufacturers (refer to Section 26 01 01–Basic Electrical Requirements–Equipment/Material Substitutions):
   B. Rigid Steel Conduit: ANSI C80.1
   C. Fittings: NEMA FB 1, steel

2.2 PLASTIC CONDUIT
   A. Manufacturers (refer to Section 26 01 01–Basic Electrical Requirements–Equipment/Material Substitutions):
      1. PW Pipe
      2. Carlon

2.3 ACCESSORIES
   A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

END OF SECTION 26 05 43
PART 2 - PRODUCTS

2.1 NAMEPLATES
   A. Nameplates shall be laminated phenolic plastic, black front and back with white core, with lettering etched through the outer covering, except where other colors are a code requirement (e.g., service entrance main disconnects). White engraved letters on black background shall be 3/16 inch high at push-button stations, thermal overload switches, receptacles, wall switches and similar devices, where the nameplate is attached to the device plate. All other locations, lettering shall be ½ inch high. Nameplates shall be securely fastened to the equipment with No. 4 Phillips, round-head, cadmium-plated, steel self-tapping screws or nickel-plated brass bolts. Engraving directly on stainless steel device plates is acceptable. Nameplates shall describe the function or use of the item.

2.2 WIRE AND CABLE MARKERS
   A. Manufacturers: W. H. Brady Co, Seton, Tyton.
   B. Markers shall be cloth tape, split sleeve, or tubing type.

2.3 DUCTBANK WARNING TAPE
   A. Manufacturers: W. H. Brady Co, Seton, Tyton.
   B. Provide 5 mil red plastic tape at least 4 inches wide with black letters at least 2 inches high every 5 feet along its length indicating “CAUTION HIGH VOLTAGE” for power cables and “CAUTION COMMUNICATION CABLES” for fiber optic, low voltage, and communications cables and with a 1 mil minimum metallic foil core or backing to permit easy locating.

END OF SECTION 26 05 53
SECTION 26 05 73

POWER SYSTEM STUDY

PART 2 - PRODUCTS

2.1 STUDY REPORT

A. The results of the power system studies shall be summarized in a bound study report. Multiple copies of the final report shall be furnished and included in the O&M Manuals.

B. The report shall include the following sections:

1. Project description, purpose, basis and scope of the study.
2. Fault current calculations.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding the same.
5. Protective device time versus current coordination curves.
6. Tabulations of relay and circuit breaker trip settings, fuse selections, and commentary regarding the same.

C. A preliminary copy of the study report shall be submitted for review. The final report shall include such additions or changes as required by the reviewer.

END OF SECTION 26 05 73
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide products as scheduled from listed equipment manufacturers. Reference Section 26 01 02 relative to product substitutions.

END OF SECTION 26 06 20
SECTION 26 09 01
ELECTRICAL COMMISSIONING

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Operating equipment and systems shall be tested in presence of Commissioning Authority, at the option of the CA, to demonstrate compliance with specified requirements.

B. Testing shall be conducted under specified design operating condition as recommended or approved by Commissioning Authority.

C. All elements of systems shall be tested to demonstrate that total system satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each component or piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by any interties to other major systems.

D. Contractor shall provide all testing materials consumables, fuel, lubricants, personnel and equipment. Electrical energy for the testing may be obtained by connection to the Owner's electrical system.

2.2 DIVISION OF RESPONSIBILITY

A. The contractor or testing firm shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The contractor shall supply a copy of the short-circuit analysis and coordination study and a protective device setting sheet, and a complete set of electrical plans, specifications, and any pertinent change orders to the testing firm prior to commencement of testing.

E. The testing firm shall notify the contractor's representative prior to commencement of any testing.

F. Any system, material, or workmanship that is found defective on the basis of acceptance tests shall be reported. The electrical contractor is responsible for correcting such defects.

G. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report.

H. Safety and Precautions

1. Safety practices should include, but are not limited to, the following requirements:
   a. Occupational Safety and Health Act
   b. Accident Prevention Manual for Industrial Operations, National Safety Council
c. Applicable state and local safety operating procedures
d. Owner's safety practices
e. ANSI/NFPA 70E, Electrical Safety Requirements for Employee Workplaces
f. American National Standards for Personnel Protection: Lockout/Tagout
g. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
h. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

I. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Split-core current transformers and clamp-on or tong-type ammeters require careful consideration of the following in regard to accuracy:
   a. Position of the conductor within the core
   b. Clean, tight fit of the core pole faces
   c. Presence of external fields
   d. Accuracy of the current transformer ratio in addition to the accuracy of the secondary meter
3. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multimeters may be average or RMS sensing and may include or exclude the dc component. When the variable contains harmonics or dc offset and, in general, any deviation from a pure sine wave, average sensing, RMS scaled meters may be misleading.
4. Field test metering used to check power system meter calibration must have accuracy higher than that of the instrument being checked.
5. Accuracy of metering in test equipment shall be appropriate for the test being performed but not in excess of two % of the scale used.
6. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

J. Test Instrument Calibration

1. The testing firm shall have a calibration program that assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology. (NIST).
3. Instruments shall be calibrated in accordance with the following frequency schedule:
   a. Field instruments: Analog, 6 months maximum; Digital, 12 months maximum
   b. Laboratory instruments: 12 months
   c. Leased specialty equipment: 12 months where lessor guarantees accuracy.
4. Dated calibration labels shall be visible on all test equipment.
5. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
6. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

K. Test Report

1. The test report shall include the following:
   a. Summary of project
b. Description of equipment tested  
c. Description of test  
d. Test results  
e. Analysis and recommendations  

2. Furnish copies of the complete report to the contractor to be forwarded to the Owner as required in the acceptance contract.  

2.3 TEST PROCEDURE DEVELOPMENT AND TEST DOCUMENTATION  

A. Contractor shall prepare and submit to Commissioning Authority for review, detailed descriptions of test procedures and checklists that the Contractor proposes to perform to demonstrate conformance of completed systems to these Specifications.  

B. Decision of Commissioning Authority upon acceptability of test procedures shall be final. In the event of unresolved conflict between Commissioning Authority and Contractor, Owner’s decision shall have precedence. However, in no case shall such decision excuse the Contractor from fulfilling the requirements of commissioning as described in this Section 26 09 01 of the Specifications.  

C. Provide a digital video recording of all training sessions conducted. Furnish two DVDs to the Architect. A professional shall record the training sessions to provide a quality video the Owner can use to train future employees or refresh the operating personnel in the system operation and maintenance.  

END OF SECTION 26 09 01
SECTION 26 09 23
ENCLOSED CONTACTORS

PART 2 - PRODUCTS

2.1 GENERAL
A. Manufacturers: ASCO, Eaton Electrical, General Electric, Siemens, or Square D.
B. Description: NEMA ICS 2, AC general purpose or lighting magnetic contactor.
C. Coil operating voltage: 120 volts as indicated on the drawings, 60 Hertz.
D. Poles: As indicated on the drawings.
E. Enclosure: NEMA ICS 6, Type 1, unless otherwise indicated on the drawings.

2.2 GENERAL PURPOSE CONTACTORS
A. Coil: Be of the encapsulated type.
B. Size: 00 0 1 2 3 as indicated on the drawings.
C. Contacts: Totally enclosed, double-break silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
D. Wiring: Straight-through wiring with all terminals clearly marked.
E. Accessories:
   1. Pushbutton: On/Off
   2. Selector Switch: On/Off/Automatic
   3. Indicating Light: Green Red
   4. Auxiliary Contacts: One field convertible normally open normally closed

2.3 POWER LIGHTING CONTACTORS
A. Configuration: Mechanically held and electrically operated with encapsulated coils. Standard coil clearing contacts are to be provided so that the contactor coils shall be energized only during the instance of operation. Electrically held with continuously rated, encapsulated coils.
B. Contacts: Totally enclosed, double-break silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
C. Contact Rating: 30 60 100 200 300 400 600 800 amperes for all types of ballast and tungsten lighting, resistive heating, and motor loads.
D. Wiring: Straight-through wiring with all terminals clearly marked.
E. Disconnect Means: Contactor shall not provide the disconnecting means in the same enclosure.
2.4 MULTI-POLE LIGHTING CONTACTORS

A. Configuration: Mechanically held and electrically operated with encapsulated coils. Standard coil clearing contacts are to be provided so that the contactor coils shall be energized only during the instance of operation. Electrically held with continuously rated, encapsulated coils.

B. Contacts: Totally enclosed, double-break silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring. All contacts shall have clearly visible normally open and normally closed contact status indicators.

C. Contact Rating: 30 amperes for ballasted lighting loads and 20 amperes for all types of tungsten lighting, resistive heating, and motor loads.

D. Wiring: Straight-through wiring with all terminals clearly marked.

E. Control Module: Provide two-wire control module with each contactor, same voltage as contactor coil, except where control is indicated as a momentary contact toggle switch.

F. Accessories:

1. Selector Switch: On/Off/Automatic
2. Indicating Light: Green Red

2.5 ACCESSORIES

A. Auxiliary Contacts: NEMA ICS 2, one field convertible normally open normally closed contact in addition to seal-in contact.

B. Cover Mounted Pilot Devices: NEMA ICS 5, standard heavy duty type.

C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.

D. Pushbuttons: Unguarded Recessed Shrouded Shielded Covered Lockable type

E. Indicating Lights: Transformer, Resistor, incandescent LED neon type

F. Selector Switches: Rotary type.

G. Relays: NEMA ICS 2.

H. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.
2.6 DISCONNECTS

A. Combination Contactors: Combine contactors with thermal magnetic circuit breaker fusible switch disconnect in common enclosure.

B. Thermal Magnetic Circuit Breakers: NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

C. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class R J fuses.

END OF SECTION 26 09 23
SECTION 26 09 43
LOW VOLTAGE LIGHTING CONTROLS

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers
1. Nexlight

B. Description: Provide a fully functional low voltage lighting control system as shown on the construction documents and as specified herein.

2.2 MATERIAL AND COMPONENTS

A. Relay Panels: Panels shall be made up of the following components:
1. NEMA rated enclosure with screw cover or hinged door.
2. 16 AWG steel barrier shall separate the high voltage and low voltage compartments of the panel and separate 120v and 277v.
3. LCP input power shall be capable of accepting 120v or 277v without rewiring.
4. Control electronics in the low voltage section shall be capable of driving 2 to 48 relays, control any individual or group of relays, provide individual relay overrides, provide a master override for each panel, store all programming in non-volatile memory, after power is restored return system to current state, provide programmable blink warn timers for each relay and every zone, and be able to control Normally Open (NO) or Normally Closed (NC) relays.
5. Lighting control system shall be digital and consist of a Master LCP with up to 48 individual relays, Slave LCPs with up to 48 individual relays in each panel, a Remote LCP with up to 4 individual relays, digital switches and digital interface cards (see interfaces). Analog systems are not acceptable.
6. Lighting control system shall have the capability to output 4 independent 0v to 10v signals in a Remote LCP. Remote LCP shall control 4 independent 20a fluorescent lighting circuits. Each circuit shall have an adjustable fade rate and take inputs from a wall device, DTC system controller or a digital photocell.
   a. Standard Output relays
      1) Electrically held, electronically latched SPST relay.
      2) Relays shall be individually replaceable.
      3) Rated at 20 Amp, 277VAC Ballast, Tungsten, HID, 1 HP at 120 Vac, 2 HP at 240 Vac.
   b. Switches
      1) Any switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem.
      2) Addressable switches shall be available in 1 through 6-button version with engraveable buttons, red LED annunciation for each button and a constantly On green LED locator.
      3) Switches may be programmed to be Momentary ON, Momentary OFF, Toggle or Maintained. These functions shall be able to be changed locally (at the DTC or a PC) or remotely, via modem.
4) Contractor to verify all switch types and quantities per plans and specifications.
5) Accessories available to include digital key switch, digital key enable switch, and digital rocker switch.

c. **DTC - Digital Electronic Time Clock**
   1) A Digital Time Clock (DTC) shall control and program the entire lighting control system and supply all time functions and accept interface inputs.
   2) The DTC shall be run from non-volatile memory so that all system programming and real time clock functions are maintained for a minimum of 5 years with loss of power.
   3) Pre-Installed modem that allows for remote programming from any location using a PC. Modem to include all necessary software for local or remote control.

d. Interfaces: For future expansion capability, system to have available all of the following interfaces. Verify and install only those interfaces indicated on the plans.
   1) A dry contact input interface card that provides 10 programmable dry contact closure inputs.
   2) Software pre-installed to run programming and management software.

### 2.3 MODES OF OPERATIONS

**A.** DTC – Digital Electronic Time Clock: DTC shall control any relay or group of relays.

**B.** Switches: All system switches shall be digital. Any switch button shall be able to control any relay or group of relays anywhere on the system. Any switch function shall be able to changed locally (at the DTC or a PC) or remotely, via modem.

### 2.4 INTERFACE CARDS

**A.** The lighting control system shall be supplied with the following interfaces and capabilities:

1. **Modem:** Interface card to link multiple panels and to allow remote access and control for troubleshooting and programming via campus Network. The factory shall provide the Owner with free remote factory programming for the lifetime of the lighting control system.
2. **Multiple Input Photocell Card**
3. **Dry-contact closure interface card.**
4. **Link to BACNET Interface Card.**

**END OF SECTION 26 09 43**
SECTION 26 12 19
PAD MOUNTED DISTRIBUTION TRANSFORMERS

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Square D
   2. General Electric
   3. Eaton/ABB
   4. Cooper/RTE

2.2 LIQUID-FILLED TRANSFORMERS

A. Liquid-filled Transformers: ANSI C57.12.26, three phase, pad mounted, self-cooled transformer unit.
B. Cooling and Temperature Rise; ANSI C57.12.00; Class OA. (65 °C), self-cooled.
C. Insulating Liquid: Liquid shall be equal to RTE R-Temp Fluid.

2.3 SERVICE CONDITIONS

A. Meet requirements for usual service conditions described in ANSI C57.12.00 IEEE C57.12.01.

2.4 RATINGS

A. Capacity: As indicated in the drawings.
B. Primary Voltage: 13.2 kV
C. Taps: Standard primary taps with the following:
   1. (2) 2.5% full-current above normal voltage taps.
   2. (2) 2.5% full-current below normal voltage taps.
D. Secondary Voltage: 480 volts, wye connected
E. Impedance: 5.75 % nominal
F. Secondary Basic Impulse Level: 30 kV

2.5 ACCESSORIES

A. Accessories: ANSI C57.12.00, IEEE C57.12.01, standard accessories and magnetic liquid level gage and dial type thermometer.
B. Tap Changer: Externally-operated type.
C. Primary Terminations: Bushing wells to IEEE 386; provide three for radial feed. Include bushings for insulated loadbreak connectors. 200-ampere rating for bushings.

D. Primary Switching: Internal liquid-immersed gang-operated load break switch.

E. Primary Overcurrent Protection: Internally-mounted, externally removable Bayonet-type current-limiting fuses. Bayonet fusing to be in series with partial-range, liquid-immersed fuses. Bayonet fuses shall be accessible from the primary section without opening the transformer tank.

F. Secondary Terminations: Spades drilled for bolted lugs.

G. Other Accessories:
   1. Ground connection lugs
   2. Oil fill plug with filter
   3. Drain valve with sampling device
   4. Temperature gauge
   5. Liquid level gauge
   6. Pressure/vacuum gauge
   7. Self-sealing pressure relief valve.

2.6 FABRICATION

   A. Conform to the requirements of ANSI C57.12.28.

2.7 FACTORY FINISHING

   A. Clean surfaces before applying paint.
   B. Apply corrosion-resisting primer to all surfaces.
   C. Apply finish coat of baked enamel paint to 2 mils 4 mils thick.
   D. Finish Color: Manufacturer’s standard Olive green.

2.8 SOURCE QUALITY CONTROL

   A. Provide testing and analysis of under provisions of Section 01 40 00.
   B. Provide factory tests to ANSI C57.12.90 IEEE C57.12.91. Include routine tests as defined in ANSI C57.12.00 IEEE C57.12.01 and the following other tests:
      1. Impedance voltage and load loss
      2. Dielectric tests
      3. Audible sound level
      4. Zero-phase-sequence impedance voltage
      5. Temperature rise
   C. Test insulating liquid samples in accordance with IEEE C57.106, IEEE C57.111, IEEE C57.121.

END OF SECTION 26 12 19
PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers (refer to Section 26 01 01–Basic Electrical Requirements–Equipment/Material Substitutions):
   B. To Be Determined

2.2 AIR INTERRUPTER SWITCHES
   A. Description: Vault mounted vacuum switch.
   B. System Voltage: 13.2 kV, three phase, 60 Hz.
   C. Maximum Design Voltage: 15 kV.
   D. Basic Impulse Level: ___ kV.
   E. Main Bus Ampacity: __________ amperes, continuous.
   F. Short Circuit Rating: __________ rms symmetrical amperes; __________ rms symmetrical MVA at rated nominal voltage.

2.3 COMPONENTS
   A. Interrupter Switch: Non-fused two position load interrupter switch.
   B. Voltage and Short Circuit Ratings: Match ratings specified for integrated assembly.
   C. Continuous Rating: __________ amperes.
   D. Momentary Rating: __________ amperes.
   E. Fault Closing: __________ amperes, two time duty cycle.

2.4 ACCESSORIES
   A. Incoming Cable Terminations: Load Break Elbows.
   B. Operating Handle: ____________.

2.5 FABRICATION
   A. Construction: ________________
   B. Main Bus: Copper.
2.6 FACTORY FINISHES
   A. Finish Color: Manufacturer’s standard.

2.7 MEDIUM VOLTAGE FUSES
   A. Manufacturers (refer to Section 26 01 01–Basic Electrical Requirements–Equipment/Material Substitutions):
      1. __________________ Model __________________.
   B. Description: Enclosed current limiting, Expulsion type suitable for use outdoors in enclosure.
   C. Fuse Rating: E fuse, size as indicated.
   D. Voltage: 15 kV.

2.8 SOURCE QUALITY CONTROL
   A. Section 01 40 00 – Quality Assurance: Manufacturer quality control.
   B. Provide factory inspection and testing in accordance with IEEE C37.20.3.
   C. Make completed switch assemblies available for inspection at manufacturer’s factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.
   D. Allow witnessing of factory inspections and tests at manufacturer’s test facility. Notify Owner at least 7 days before inspections and tests are scheduled.

END OF SECTION 26 13 16
PART 2 - PRODUCTS

2.1 MEDIUM VOLTAGE CABLE

A. Manufacturers:

1. Okonite
2. Etna
3. Southwire
4. Substitutions: Refer to Section 01 60 00 - Material and Equipment Not permitted

B. Cable Size: As indicated on drawings.

C. Description: MV-105, NEMA WC8, ethylene propylene rubber insulated cable.

D. Voltage: 15 kV, grounded

E. Conductor: Copper, Compact Class B stranded.

F. Construction: Single conductor with an extruded strand shield over the conductor, an insulation layer of EPR and an insulation shield consisting of corrugated copper drain wires embedded in a chlorinated polyethylene jacket.

G. Cable shield shall be covered by 220 mil thick homogeneous layer of EPR insulation. Minimum thickness at any point in the cable shall be 200 mils.

2.2 SEPERABLE CONNECTORS – LOAD BREAK ELbows

A. Manufacturers:

1. RTE/Cooper Power Systems
2. Substitutions: Refer to Section 01 60 00 - Material and Equipment Not permitted

B. Description: IEEE 386, fully-shielded and insulated plug-in termination with voltage test ports.

C. Voltage: 15 kV

D. Rating: 200A, Fully Rated

2.3 FIREPROOFING TAPE

A. Manufacturers:

1. 3M suitable for 15 kV installation.
2. Substitutions: Refer to Section 01 60 00 - Material and Equipment Not permitted

END OF SECTION 26 15 13
SECTION 26 22 13
DRY TYPE TRANSFORMERS

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Eaton, General Electric, Eaton/ABB or Cooper/RTE.

B. Type: Transformers shall be of the two-winding insulating type. Units shall be enclosed except for ventilating openings. Transformers shall be air-cooled by natural convection and not rely upon fans for airflow. Mounting method shall be as indicated. Where indicated, provide transformers with close-to-wall mounting kits.

C. Core and Core Assemblies: Transformer core shall be constructed of high-grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10 % above the highest tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of copper or electrical-grade aluminum, with continuous wound construction.

1. On units rated 15 kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. Taps shall be provided in the primary winding, with two (2) steps below nominal voltage in 5 % increments.

2. On units rated above 15 kVA the core and coil assembly shall be impregnated with non-seal out moisture. The assembly shall be installed on vibration-absorbing pads. Taps shall be provided in the primary winding, with two (2) steps above and four (4) steps below nominal voltage in 2.5 % increments.

D. Insulation: Insulation materials shall be flame-retardant and shall not support combustion.

E. Bonding: The core of the transformer shall be visibly bonded to the enclosure by means of a flexible grounding conductor sized in accordance with code.

F. Vibration Isolation: The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for the flexible ground strap.

G. Enclosures: Transformer enclosures shall be made of heavy-gauge steel. Transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure at full load shall not exceed 122 degrees F rise above a 104 degrees F ambient.

1. On units with encapsulated core and coil, the enclosure shall be NEMA Type 3R, totally enclosed, non-ventilated.

2. On ventilated units, the enclosure construction shall be NEMA Type 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.

H. Finish: the entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer
2.2 RATINGS

A. Dry-type transformers shall have kVA capacity, phase, primary voltage, secondary voltage, voltage ratios and winding configuration indicated on the drawings and/or the associated schedules.

B. Dry-type transformers shall have Aluminum windings.

C. Transformers shall be designed for continuous duty at rated kVA, for operation twenty-four (24) hours a day, 365 days a year.

D. Basic Impulse Level: 10 kV, minimum.

E. Transformer sound levels shall not exceed the following:

1. Up to 9 kVA: 40 dB
2. 10 to 50 kVA: 45 dB
3. 51 to 150 kVA: 50 dB
4. 151 to 300 kVA: 55 dB
5. 301 to 500 kVA: 60 dB
6. 501 to 700 kVA: 62 dB
7. 701 to 1000 kVA: 64 dB

2.3 GENERAL PURPOSE TRANSFORMERS

A. General purpose transformers shall be insulated as follows:

1. 15 kVA and above: 365 degrees F, insulation system, based upon 239 degrees F, rise.

2.4 K-RATED TRANSFORMERS

A. Where K-factor ratings are indicated on the drawings and/or the associated schedules, transformers shall be specifically designed to supply loads with a non-linear harmonic profile equal to or less than the indicated K-factor without exceeding 239 degrees F, temperature rise.

B. K-factor rated transformers shall have an impedance in the range of 3 % to 5 %, and shall have a minimum reactance of 2 %, in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

C. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies.

D. Size secondary neutral conductor at twice the secondary phase conductor ampacity.

E. K-rated transformers shall be insulated as follows:

1. 2 kVA and below: 302 degrees F insulation system, based upon 176 degrees F rise.
2. 3 to 15 kVA: 365 degrees F insulation system, based upon 239 degrees F rise.
3. Above 15 kVA: 429 degrees F insulation system, based upon 302 degrees F rise.

2.5 SHIELDED ISOLATION TRANSFORMERS

A. Where shielded transformers are indicated on the drawings and/or the associated schedules, an electrostatic shield consisting of a single turn of aluminum shall be placed between the primary and secondary winding and bonded to the transformer core.

B. Electrostatic shield shall result in an effective coupling capacitance between primary and secondary no greater than 33 picofarads, maximum.

C. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
   
   1. Common Mode:
      a. 0 to 1.5kHz - 120 dB
      b. 1.5kHz to 10kHz - 90 dB
      c. 10kHz to 100kHz - 65 dB
      d. 100kHz to 1MHz - 40 dB

   2. Transverse Mode:
      a. 1.5kHz to 10kHz - 52 dB
      b. 10kHz to 100kHz - 30 dB
      c. 100kHz to 1MHz - 30 dB

D. Shielded transformers shall be insulated as follows:
   
   1. 3 to 15 kVA: 365 degrees F insulation system, based upon 239 degrees F temperature rise.
   2. Above 15 kVA: 429 degrees F insulation system, based upon 239 degrees F temperature rise.

2.6 BUCK-AND-BOOST TRANSFORMERS

A. Buck-and-boost transformers shall be insulated for maximum voltage in indicated buck-and-boost configuration as follows:

   1. Up to 2 kVA: 365 degrees F insulation system, based upon 176 degrees F rise.
   2. Above 2 kVA: 429 degrees F insulation system based upon 302 degrees F rise.

B. Lugs shall be suitable for terminating conductors sized for full load ampacity of transformer unit when operating in indicated buck-and-boost configuration.

2.7 ACCESSORIES

A. Provide mounting brackets for wall-mounted units. Provide additional trapeze supports from ceiling structure where walls are not suitable for full weight of transformer.
B. On ventilated outdoor units, provide suitable weathershields over ventilation openings.

END OF SECTION 26 22 13
PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Square D or Cutler Hammer

B. Construction: Each switchboard shall consist of the required number of vertical sections bolted together to form a rigid, free-standing, totally enclosed assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Enclosures shall be equipped with adequate means for ventilation within the enclosure.

1. All sections of each switchboard shall be rear-aligned. Devices shall be front-removable. Bus connections and conductor terminations shall be front-accessible, enabling the switchboard to be mounted against a wall.
2. The assembly shall be provided with adequate lifting means.
3. Switchboards used as service-entrance equipment shall be UL listed and labeled as suitable for such use.

C. Enclosures: Switchboard enclosures shall be NEMA Type 1 general purpose enclosures, unless otherwise indicated. Enclosures shall be made from heavy gauge galvanized steel.

D. Finish: External surfaces shall be finished with one coat of zinc chromate and one coat of gray baked enamel. Coat internal surfaces with minimum one (1) coat corrosion-resisting paint, or plate with cadmium or zinc.

E. Busing: Switchboard buses shall be solid and full-capacity rated, with all hardware in place for present and indicated future devices.

1. Bus bars shall be copper or tin-plated aluminum. Bus sizing shall limit temperature rise at rated current on any current-carrying port to a maximum of 65 degrees C over an ambient of 40 degrees C.
2. Provide a full-capacity neutral bus for each switchboard indicated with neutral.
3. A copper ground bus shall be provided in each switchboard. The ground bus shall be firmly secured to each vertical section structure and shall extend the entire length of the switchboard. Ground bus shall be sized as indicated on the drawings, but not less than 1/3 the size of the switchboard main bus. Minimum ground bus size shall be 1/4×2 inches.
4. All hardware used on bus bars shall be high tensile strength and zinc plated. All bus joints shall be provided with conical spring-type Belleville washers.
5. Bus bars shall include provisions for extension to future switchboard sections.

F. Devices: Main and distribution section overcurrent protective devices shall be as indicated on the drawings.

1. Adjustments shall be accessible without removing covers, unless such removal does not require use of tools.
2. The trip rating of each unit shall be clearly indicated and visible or identified on a permanently affixed nameplate.
3. Devices shall be mounted in switchboards such that the operating handles are no more than 78 inches above the floor when in their highest position, taking into account the height of the housekeeping pad under the switchboard.

4. Switchboards located outdoors shall not contain circuit breakers with electronic trip units.


2.2 MAIN SERVICE SWITCHBOARD

A. Metering: Provide Square D meter and network gateway with internal web server. Meter to be mounted in enclosure separate from switchboard and provided with (1) telecommunications outlet.

B. Main and Tie Devices: Each device shall be load-break, service-rated insulated-case circuit breaker or bolted pressure switch as indicated on the drawings. Devices shall be individually mounted and compartmented.

C. Distribution Section Devices: Each device shall be a quick-make, quick-break molded-case circuit breaker or fusible switch assembly as indicated on the drawings. Devices over 200 amperes shall be individually mounted; devices 200 amperes and under shall be twin mounted, unless otherwise indicated on the drawings.

2.3 SECONDARY DISTRIBUTION SWITCHBOARDS

A. Main Lugs: Suitable lugs shall be provided for connection of the incoming feeder.

B. Main Devices: Each device shall be load-break, insulated-case circuit breaker or bolted pressure switch as indicated on the drawings. Devices shall be individually mounted and compartmented.

C. Distribution Section Devices: Each device shall be a quick-make, quick-break molded-case circuit breaker or fusible switch assembly as indicated on the drawings. Devices shall be group mounted, unless otherwise indicated on the drawings.

2.4 SHORT CIRCUIT RATINGS

A. Each switchboard shall be labeled with a UL integrated equipment short circuit rating. All overcurrent protective devices shall have the interrupting capacity rating as indicated without relying upon series-connected ratings, except as otherwise specifically indicated on the drawings.

B. Switchboards shall have short circuit ratings as shown on the drawings, but not less than 50,000 amperes RMS symmetrical at rated voltage.

2.5 SWITCHBOARD INSTRUMENTATION

A. Compartment: Switchboard instrumentation compartment shall have adequate space for switchboard instruments, potential transformers (if needed), and current transformers. Compartment shall be front-accessible with hinged cover.
B. Current Transformers: One (1) transformer shall be provided for each phase. Transformers shall be 5 ampere secondary, bar or window type, with secondary shorting device. Primary/secondary ratio shall be such that secondary current when switchboard is loaded to full capacity is 5 amperes. Burden and accuracy shall be consistent with connected metering.

C. Potential Transformers: One (1) potential transformer shall be provided for each phase, sized for connected switchboard instruments and relays plus 50 % minimum spare capacity. Transformers shall be 120 volt secondary, disconnecting type with integral fuse mountings.

D. Switchboard Instruments: All instruments shall be arranged for semi-flush mounting.

1. Electronic circuit monitors shall provide true rms metered values. Information provided by each meter shall include frequency, temperature, current, demand current, voltage, real power, reactive power, apparent power, demand power, predicted demand power, power factor, accumulated energy, accumulated reactive energy, total harmonic distortion (THD) of each current and voltage, and K-factor of each current. The meter shall be accurate to 0.15 % of reading plus 0.05 % of full scale for voltage and current metering, and 0.3 % for all power and energy functions. The meter shall accept inputs from industry standard instrument transformers (120 VAC secondary PTs and 5 A secondary CTs). Connection to 480Y/277 VAC circuits shall be possible without use of PTs.
   a. The meter shall be rated for an operating temperature range of -25° C to 70° C and have an overcurrent withstand rating of 500 amps for 1 second.
   b. All setup parameters required by the meter shall be stored in nonvolatile memory and retained in the event of a control power interruption. Any battery or other device used to provide non-volatile memory shall be serviceable from the front of the meter and servicing shall not require removing the meter from the gear in which it is mounted.
   c. The meter shall maintain in nonvolatile memory maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.
   d. The following metered values as well as the minimum and maximum instantaneous readings since last reset shall be communicated by the meter:
      1) Frequency
      2) Temperature
      3) Current, per phase rms and neutral (if applicable)
      4) Current, 3-phase average rms
      5) Current, apparent rms
      6) Voltage, phase-to-phase and phase-to-neutral
      7) Voltage unbalance, phase-to-phase and phase-to-neutral
      8) Power factor, per phase
      9) Power factor, 3-phase total
     10) Real power, per phase and 3-phase total
     11) Reactive power, per phase and 3-phase total
     12) Apparent power, per phase and 3-phase total
     13) Demand current, per phase and three-phase average
     14) Demand real power, three-phase average
     15) Demand apparent power, three-phase average
     16) Accumulated energy, (MWh, MVAH, and MVARh)
     17) Total Harmonic Distortion (THD), voltage and current, per phase
     18) K-factor, per phase
   e. The meter shall be Square D, Model as specified by Owner.

2. Ammeters: Ammeters shall be direct-reading, full-range type, with 4 1/2 inch square recessed case and 250 degree scale. Dial shall be white with black figures and pointer,
with scale matched to current transformer. Movement shall be 5 ampere, 60 Hertz, with ± percent accuracy.

3. Ammeter Selector Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, and four positions including OFF. Switch shall be arranged so ammeter measures current on each phase.

4. Voltmeter: Voltmeters shall be direct-reading, full range type with 4 1/2 inch square recessed case and 250 degree scale. Dial shall be white with black figures and pointer, with rated line-to-neutral voltage at center scale. Movement shall be 240 volt, 60 Hertz, with ± 1 percent accuracy.

5. Voltmeter Selector Switch: Rotary multistage snap-action type with 600 volt AC-DC silver plated contacts, engraved escutcheon plate, and seven positions including OFF. Switch shall be arranged so voltmeter measures voltage from phase-to-phase and from phase-to-neutral on each phase.

6. Watt-hour Meters: Watt-hour meters shall be three phase induction type with three stators, each with current and potential coil, rated 5 amperes and 120 volts at 60 Hertz. Meter shall be suitable for connection to 4-wire circuits. Meter shall be equipped with an integral demand register with a 15-minute interval and a resettable needle. Include potential indicating lamps, contact devices to operate remote impulse-totalizing demand meter and ratchets to prevent reverse rotation.

2.6 INSULATED-CASE CIRCUIT BREAKERS

A. Main or tie protective devices indicated as circuit breakers shall be draw-out stationary insulated case type, UL listed for application at 100 % of the continuous ampere rating indicated on the drawings, in their intended enclosures.

B. Insulated-case breakers shall be manually operated (MO), except where electrically operated (EO) is specifically indicated on the drawings. Manual operated circuit breakers shall be convertible to motor operation by insertion of an internally mounted motor operator without voiding UL label.

C. The circuit breaker control face plate shall include color coded visual indicators to indicate contact open and closed positions as well as mechanism charged and discharged positions. Manual control pushbuttons shall be provided for opening and closing the breaker.

D. Insulated-case circuit breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of five-cycle closing. All the energy required for closing the breaker shall be completely stored and held in readiness pending a release to close action. As a safety feature, provisions shall be available to manually discharge the stored energy without closing the breaker.

E. Insulated-case circuit breakers shall have high endurance characteristics. The circuit breakers shall be capable of no-load and full-load interruptions at rated current equal to, or exceeding, the UL endurance ratings for encased circuit breakers.

F. Each breaker shall be equipped with a tripping system consisting of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall provide adjustable time-current protection functions. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. The trip unit shall include adjustments for:

1. Long-time pick-up and delay
2. Short-time pick-up and delay with I2t curve-shaping option
3. Instantaneous pick-up
4. Ground-fault pick-up and delay, with I2t curve-shaping option (switchboards with line-to-ground voltage above 150 volts only).

2.7 MOLDED-CASE CIRCUIT BREAKERS

A. Feeder protective devices indicated as circuit breakers shall be molded-case type, with inverse time and instantaneous tripping characteristics. Ground fault protection shall be provided where indicated.

B. Each circuit breaker shall be operated by a single toggle-type handle and shall have a quick-make, quick-break, over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, with arc extinction chutes. Multiple-pole circuit breakers shall be common trip.

C. Where indicated, circuit breakers shall be current-limiting type. Such circuit breakers shall have automatically resetting current limiting elements in each pole, coordinated with the thermal and instantaneous trip elements. Let-through current and energy level shall be less than permitted for same size Class RK-5 fuse.

D. Circuit breakers in the main service switchboard shall be equipped with a tripping system consisting of:

1. Three (3) current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall provide adjustable time-current protection functions. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. The trip unit shall include adjustments for:
   a. Long-time pick-up and delay
   b. Short-time pick-up and delay, with I2t curve-shaping option
   c. Instantaneous pick-up
   d. Ground-fault pick-up and delay, with I2t curve-shaping option (switchboards with line-to-ground voltage above 150 volts only).

E. Circuit breakers located in non-air conditioned spaces or outside the building shall be ambient compensated type.

F. Circuit breakers for air conditioning equipment shall be UL labeled “HACR”.

2.8 GROUND FAULT PROTECTION

A. Ground fault protection shall be provided at the main service switchboard where the service voltage is greater than 150 volts to ground. The ground fault protection system shall be modified zero sequence sensing type, and shall comply with the following requirements:

1. System shall require no external power to trip circuit breakers.
2. System shall be suitable for use on grounded systems, whether the system neutral is carried through the system or not.
3. Pickup current setting and time delay shall be field adjustable.
4. System shall include a means of testing the ground fault system, complying with on-site testing requirements.
5. System shall include local visual ground fault trip indication.
6. System shall include I2t curve-shaping option.
7. System shall include zone-selective interlocking communication capabilities compatible with other ground fault protection on upstream and downstream devices, equipped with ground fault protection. Compatibility shall include thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing, and external ground fault sensing systems.

8. System shall not affect interrupting rating of the companion devices.

B. Each device shall be equipped with a current sensor, ground fault relay and a ground fault trip mechanism. Ground fault protection integral with the overcurrent protective devices is acceptable, provided it complies with requirements specified herein.

C. Current sensors shall be of sufficient size to encircle all phase and neutral conductors.

D. Ground fault relays shall be solid state with adjustable pickup current and delay settings. Adjustment dial shall be calibrated to permit field adjustment.

E. Ground fault trip mechanisms shall be stored-energy devices designed to open the respective protective devices when tripped by the ground fault protection system and shall be capable of operating satisfactorily at 55% of rated voltage.

F. Provide a test winding and external test push button to simulate the flow of ground fault current through the current sensor in order to test the operation of the protection system including the sensor pickup, relay, and circuit protective device operation.

G. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

2.9 WIRING AND TERMINATIONS

A. Suitable terminals shall be provided for all line and load terminations, sized for conductors as indicated on the drawings.

B. Lugs shall be provided for connection of all neutral conductors in incoming and outgoing feeders and circuits.

C. Lugs shall be provided for connection of all grounding conductors, including grounding electrode conductors, equipment grounding conductors, and bonding conductors.

D. Control wiring, fuse blocks and terminal blocks within the switchboard shall be provided as necessary. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, and switches, shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

E. Control wire within the switchboard shall be Type SIS, bundled and secured with nylon ties. Control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

F. Switchboard instrument current transformer secondary leads shall first be connected to conveniently accessible short circuit terminal blocks before connecting to any other device. Accuracy shall be consistent with connected metering. Provide primary and secondary fuses.
2.10 ACCESSORIES

A. Device Accessories: Provide kirk-key interlocks, shunt-trip units and auxiliary switches as indicated on the drawings.

B. Auxiliary Contacts: Field convertible contacts, in addition to seal-in contact and pilot light contacts.

C. Indicators: Light-emitting diode (LED) lamps, liquid-crystal display (LCD) read-outs or dial gauges.

D. Relays: 120 volt, unless otherwise indicated.

E. Control Power Transformers: 120 volt secondary, sized for control burden plus 50 %, 100 VA minimum. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

END OF SECTION 26 24 13
PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Square D or Cutler Hammer.

B. Types: Panelboards shall be dead-front design. Panelboards shall be circuit breaker type, except where fused switch assemblies are specifically indicated.

C. Interiors: Panelboard interiors shall be completely factory assembled with bolt-on devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

1. Main bus bars shall be copper or tin-plated aluminum, sized to limit temperature rise on any current carrying part to a maximum of 150 °F above an ambient of 104 °F outside the enclosure.

2. Full-size insulated neutral bars shall be included for panelboards indicated with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have suitable lugs for the incoming feeder and each outgoing feeder or branch circuit requiring a neutral connection.

3. A copper ground bus capable of being isolated shall be included in each panelboard. The ground bus shall be bonded to panelboard enclosure, except where isolated ground bus is indicated. Ground busing shall have suitable lugs for the equipment grounding conductors associated with the incoming feeder and each outgoing feeder or branch circuit, and for any bonding conductors.

D. Finish: In finished areas, finish all panels with one (1) coat of zinc chromate and one coat of primer sealer. In all other locations, finish panels with one (1) coat of zinc chromate and one coat of gray baked enamel.

E. Door locks shall be flush cylinder type. All panelboard locks shall be keyed alike.

F. Enclosures: Panelboard enclosures shall be NEMA Type 1 general purpose enclosures. Enclosures shall be made from galvanized steel. Provide adequate gutter space for wire bending and termination. Where feeder conductors supplying the mains of a panel board are carried through its enclosure to supply other electrical equipment, the enclosure shall be sized to include the additional required wiring space. At least four (4) interior mounting studs with adjustable nuts shall be provided.

1. Panelboards shall be surface-mounted or flush-mounted as indicated. Surface trims shall be same height and width as box. Flush trims shall overlap the box by ¾ inch on all sides.

2. When panelboards are located adjacent to each other, cabinets and doors shall be of the same size.

3. Where barriered top, side or bottom compartments are indicated, each compartment shall have its own hinged, lockable door. Maintain at least 2 inches of solid trim between
doors. Contactors or relays mounted in panelboard compartments shall have vibration isolators.

4. Where skirts are indicated, provide removable sheet-metal skirts to the floor and to the ceiling to conceal conduits.

G. Service Equipment: Panelboards used as service-entrance equipment shall be UL listed and labeled as suitable for such use.

2.2 DISTRIBUTION PANELBOARDS

A. Enclosures: Enclosures for distribution panelboards shall be at least 11 inches deep, and 36 inches wide.

1. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

B. Bolt-On Alternative: In lieu of bolt-on circuit breakers, circuit breakers equipped with line terminal jaws, equal to Square D I-Line type, are acceptable, provided that in the event of a short circuit condition, the increased magnetic flux causes the jaws to grip the bus more firmly. Circuit breaker jaws shall be protected by an impact resistant molded shroud. Circuit breakers of this type shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners.

2.3 BRANCH CIRCUIT PANELBOARDS

A. Enclosures: Enclosures for lighting and appliance branch circuit panelboards shall be at least 5.5 inches deep and 20 inches wide.

1. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles.

2. Doors shall be flush with panelboard trim and shall not uncover any live parts. Doors shall have a flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners.

3. All panelboard locks shall be keyed alike.

B. Panel Index: A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

2.4 SHORT CIRCUIT RATINGS

A. Each panelboard shall be labeled with a UL integrated equipment short circuit rating. All overcurrent protective devices shall have the interrupting capacity rating as indicated without relying upon series-connected ratings, except as otherwise specifically indicated on the drawings and/or associated schedules.

B. Panelboards applied at 240 volts or less shall have short circuit ratings as indicated on the drawings and/or associated schedules, but not less than 10,000 amperes RMS symmetrical at 240 volts.

C. Panelboards applied at 480 volts shall have short circuit ratings as indicated on the drawings and/or associated schedules, but not less than 14,000 amperes RMS symmetrical at 480 volts.
2.5 CIRCUIT BREAKERS

A. Circuit breakers shall be molded-cast type, with inverse time and instantaneous tripping characteristics.

B. Each circuit breaker shall be operated by a single toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding with arc extinction chutes. Multiple-pole circuit breakers shall be common trip.

C. Where indicated, circuit breakers shall be current-limiting type. Such circuit breakers shall have automatically resetting current limiting elements in each pole, coordinated with the thermal and instantaneous trip elements. Let-through current and energy level shall be less than permitted for same size Class RK5 fuse.

D. The trip rating of each circuit breaker shall be imprinted in the handle.

E. Ground fault interrupting circuit breakers shall have “Test” button and pigtail for neutral connection.

F. Circuit breakers located in non-air conditioned spaces or outside the building shall be ambient compensated type.

G. Circuit breakers used for switching lighting circuits shall be UL labeled “SWD”.

H. Circuit breakers used for air conditioning equipment shall be UL labeled “HACR”.

I. Circuit breakers shall have mechanical screw type removable connector lugs, AL/CU rated.

J. Circuit Breaker Accessories: Provide shunt-trip units and auxiliary switches as indicated on the drawings or panel schedules.

2.6 FUSIBLE SWITCH ASSEMBLIES

A. Fusible switches shall be quick-make, quick-break, load interrupter enclosed knife switches with externally operable handles. Provide interlock with defeat mechanism to prevent opening front cover with switch in ON position. Handle shall be lockable in OFF position.

B. Fusible switches shall be equipped with rejection-type fuse clips designed to accommodate Class R current-limiting fuses only, except as otherwise indicated.

END OF SECTION 26 24 16
PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Eaton Electrical, General Electric, Siemens, or Square D.

B. Configuration: Motor control centers shall conform to NEMA Class 1, Type B requirements.

C. Enclosures: Each motor control center shall consist of one or more vertical sections bolted together to form a rigid, free-standing, totally enclosed assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front panels shall be formed. Enclosures shall be equipped with adequate means for ventilation within the enclosure.

1. All sections of each motor control center shall be rear-aligned. Devices shall be front-removable. Bus connections and conductor terminations shall be front-accessible, enabling the motor control center to be mounted against a wall.

2. The assembly shall be provided with adequate lifting means.

3. Motor control centers enclosures shall be NEMA Type 1A general purpose enclosures, with fully gasketed doors, unless otherwise indicated. Enclosures shall be made of heavy gauge galvanized steel.

4. Motor control centers shall contain a horizontal wireway at the top and bottom, isolated from the horizontal bus and readily accessible through a hinged cover. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.

5. A vertical wireway with minimum of 35 square inches of cross sectional area shall be contained within each vertical unit adjacent to compartments for mounting control units. The wireway shall be covered by a hinged door and shall contain cable supports.

6. Magnetic starter control units through NEMA size 5 shall be of the draw out type. Draw out provisions shall include a positive guide rail system and stab shrouds to ensure alignment of stabs with the vertical bus. Draw out units shall have a tin-plated stab assembly for connection to the vertical bus. Wiring to these stabs shall not extend into the bus compartment. Units shall be equipped with control wiring terminal blocks, adequate to accept #14 AWG conductors. Each unit compartment shall be provided with an individual front door.

7. Finish: External surfaces shall be finished with one coat of zinc chromate and one coat of gray baked enamel. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

D. Busing: Busing shall be solid and full capacity rated, with all hardware in place for present and indicated future devices.

1. Horizontal bus bars shall be copper or tin-plated aluminum. Vertical busses feeding unit compartments shall be copper and shall be securely bolted to the horizontal main bus. Bus sizing shall limit temperature rise at rated current on any current-carrying part to 122 degrees F over an ambient of 104 degrees F.

2. The vertical bus shall be isolated and insulated by means of a full-height insulating barrier. The barrier shall include shutters or snap-in covers to complete isolation of the vertical bus when a unit is removed.
3. Provide a full-capacity neutral bus for each motor control center indicated with neutral.
4. A copper ground bus shall be provided in each motor control center. The ground bus shall be firmly secured to each vertical section structure and shall extend the entire length of the motor control center. Ground bus shall be sized as indicated on the drawings, but not less than 1/3 the size of the motor control center main bus. Minimum ground bus size shall be \( \frac{1}{4} \times 2 \) inches.

5. All hardware used on busbars shall be high tensile strength and zinc plated. All bus joints shall be provided with conical spring-type Belleville washers.
6. Busbars shall include provisions for extension to future motor control center sections.

E. Devices: Overcurrent devices and motor control units shall be as indicated on the drawings or motor control center schedule(s). Devices shall be mounted in motor control centers such that the operating handles are no more than 78 inches above the floor when in their highest position, taking into account the height of the housekeeping pad under the motor control center.

F. Future Provisions: Fully equip remaining space in each section with busing and bus connections, suitably insulated and braced for short circuit currents. Space shall be suitable for addition of future devices.

G. Motor control centers used as service-entrance equipment shall be UL listed and labeled as suitable for such use.

2.2 MOTOR CONTROL CENTER ADDITIONS

A. Devices: Overcurrent devices and motor control units to be added in existing motor control centers shall be as indicated on the drawings or motor control center schedule(s). Provide all busing, hardware and deadfront panels as required to install the units in the existing motor control center.

B. Added Sections: Sections to be added to existing motor control centers shall be provided with all required mounting hardware to enable them to be connected to the existing motor control center. Bus connections shall be same material as buses in the existing motor control center.

2.3 SHORT CIRCUIT RATINGS

A. Each motor control center shall be labeled with a UL integrated equipment short circuit rating. All overcurrent protective devices shall have the interrupting capacity rating as indicated without relying upon series-connected ratings, except as otherwise specifically indicated on motor control center schedule(s).

B. Motor control centers shall have short circuit ratings as shown on the drawings or motor control center schedule(s), but not less than 42,000 amperes RMS symmetrical at rated voltage.

2.4 MOTOR CONTROLLER UNITS

A. Motor controller units shall be combination motor circuit protector or fused switch disconnects and motor starters as indicated on motor control center schedule(s). Motor disconnects and motor starters as indicated on motor control center schedule(s). Motor circuit protectors shall be equipped with integral current limiters and pin inserts to stop magnetic adjustment at the percentage of motor full-load current dictated by code requirements. Fused switches shall be
quick-make, quick-break type, equipped with rejection-type fuseholders and current-limiting fuses.

B. Motor starters shall be sized for the application. Provide control station and pilot lights in cover as indicated on motor control center schedule(s). Each motor starter shall include the following features:

1. Overload protection in each ungrounded conductor, with a common reset button.
2. A 120 volt control voltage transformer with primary and secondary fuses
3. An adjustable 0 to 30 second time-delay relay
4. Pilot lights operated by dedicated auxiliary contacts, quantity as indicated.
5. Auxiliary contacts as required for interlocks and control sequences indicated.
6. Additional spare normally-open and normally-closed auxiliary contacts as indicated, but not less than one (1) of each per starter.

C. Full-voltage starters shall be as specified under Section 26 29 13.
D. Two-speed starters shall be as specified under Section 26 29 13.
E. Reduced-voltage starters shall be as specified under Section 26 29 13.
F. Variable frequency controllers shall be as specified under Section 26 29 23.
G. Circuit breakers shall be as specified under Section 26 28 17.
H. Motor circuit protectors shall be as specified under Section 26 29 13.
I. Fusible switch assemblies shall be as specified under Section 26 28 16.

2.5 WIRING AND TERMINATIONS

A. Mechanical type terminals shall be provided for all line and load terminations, suitable for copper or aluminum conductors rated for 168 degrees F of the size indicated on the drawings.

B. Lugs shall be provided for connection of all neutral conductors in incoming and outgoing feeders and circuits.

C. Lugs shall be provided for connection of all grounding conductors, including equipment grounding conductors and bonding conductors.

D. Control wiring, fuse blocks and terminal blocks within the motor control center shall be provided as necessary. Control components mounted within the assembly, such as fuse blocks, relays, control stations, pushbuttons, switches and pilot lights shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

E. Control wiring within the motor control center shall be Type SiS, bundled and secured with nylon ties. Control wires leaving the motor control center shall be provided with terminal blocks with suitable numbering strips. Provide two (2) additional spare terminal points in each motor controller for future external wiring terminations. Provide wire markers at each end of all control wiring.

2.6 ACCESSORIES

A. Pilot Lights: Heavy duty oil tight type, mounted in cover.
B. Pilot Light Contacts: Form Z
C. Auxiliary Contacts: Field convertible contacts, in addition to seal-in contact and pilot light contacts.
D. Detector Switches: Rotary type, mounted in cover.
E. Pushbuttons: Unguarded type, mounted in cover.
F. Indicators: Light-emitting diode (LED) lamps, liquid-crystal display (LCD) read-outs or dial gauges.
G. Relays: 120 volt, unless otherwise indicated.
H. Control Power Transformers: 120 volt secondary, sized for control burden plus 50 %, 100 VA minimum. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

END OF SECTION 26 24 19
SECTION 26 27 16
CABINETS AND ENCLOSURES

PART 2 - PRODUCTS

2.1 CABINETS AND HINGED COVER ENCLOSURES

A. Manufacturers:
   1. Circle AW
   2. Hoffman
   3. Rittal
   4. Or approved equal

B. Construction: NEMA 250, Type 1 steel enclosure, unless otherwise indicated.

C. Size: As indicated on the drawings. If not so indicated, sized to accommodate all devices within.

D. Covers: Continuous hinge, and flush lock keyed to match branch circuit panelboard.

E. Interior Panels: Provide 14 gauge, white enamel, and removable panels for mounting of equipment or terminal blocks.

F. Knockouts: Manufacturer’s standard knockouts.

G. Enclosure Finish: Manufacturer’s standard gray baked enamel.

H. Provide metal barriers to form separate compartments wiring of different systems and voltages.

I. Provide accessory feet for free-standing equipment.

2.2 TERMINAL BLOCKS

A. Terminal Blocks: NEMA ICS 4

B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

D. Provide ground bus terminal block, with each connector bonded to enclosure.

2.3 FABRICATION

A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide conduit hubs in exterior and wet locations and knockouts in interior dry locations.
C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

END OF SECTION 26 27 16
PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. Wiring devices shall be of the same manufacturer insofar as possible. Devices shall be specification grade, switches shall be rated 20 amperes, and receptacles shall be grounding type.

B. Devices shall be side wired only.

C. Except as otherwise specified on the drawings, wiring devices shall be Hubbell, Pass & Seymour, Cooper, or Leviton and shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>Device</th>
<th>Hubbell Catalog #</th>
<th>Pass &amp; Seymour Catalog #</th>
<th>Cooper Catalog #</th>
<th>Leviton Catalog #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Pole Switch</td>
<td>1221</td>
<td>20AC1</td>
<td>1221</td>
<td>1221-2</td>
</tr>
<tr>
<td>Single Pole Switch w/pilot light (120V)</td>
<td>1221-PLC</td>
<td>20AC1-PLC</td>
<td>1221ILC</td>
<td>1221-PLC</td>
</tr>
<tr>
<td>2-pole Switch</td>
<td>1222</td>
<td>20AC2</td>
<td>1222</td>
<td>1222-2</td>
</tr>
<tr>
<td>3-way Switch</td>
<td>1223</td>
<td>20AC3</td>
<td>1223</td>
<td>1223-2</td>
</tr>
<tr>
<td>4-way Switch</td>
<td>1224</td>
<td>20AC4</td>
<td>1234</td>
<td>1224-2</td>
</tr>
<tr>
<td>Duplex Receptacle, Standard</td>
<td>5252</td>
<td>5262</td>
<td>5252</td>
<td>5252</td>
</tr>
<tr>
<td>Duplex Receptacle, Hospital Grade</td>
<td>8200</td>
<td>9200-HG</td>
<td>8200</td>
<td>8200</td>
</tr>
<tr>
<td>Duplex Receptacle, GFI</td>
<td>GF-5262</td>
<td>1591F</td>
<td>GF5292</td>
<td>6598</td>
</tr>
<tr>
<td>Duplex Receptacle, Isolated Ground</td>
<td>IG5252</td>
<td>IG6200</td>
<td>IG5262</td>
<td>5262-IG</td>
</tr>
<tr>
<td>Duplex Receptacle, Surge-Protected</td>
<td>IG5252-IS</td>
<td>G6262-ISP</td>
<td>IG5262S</td>
<td>N/A</td>
</tr>
<tr>
<td>Single Receptacle (15A, 125V)</td>
<td>5251</td>
<td>5261</td>
<td>5251</td>
<td>5251</td>
</tr>
<tr>
<td>Duplex Receptacle (20A, 125V)</td>
<td>5352</td>
<td>5362</td>
<td>5352</td>
<td>5352</td>
</tr>
<tr>
<td>Single Receptacle (20A, 125V)</td>
<td>5351</td>
<td>5361</td>
<td>5351</td>
<td>5351</td>
</tr>
<tr>
<td>Single Receptacle (30A, 125V)</td>
<td>9308</td>
<td>5920</td>
<td>5716N</td>
<td>5371</td>
</tr>
<tr>
<td>Single Receptacle (30A, 250V)</td>
<td>9330</td>
<td>5930</td>
<td>5700N</td>
<td>5372</td>
</tr>
<tr>
<td>Single Receptacle (30A, 125/250V)</td>
<td>9430</td>
<td>5744</td>
<td>9344N</td>
<td>278</td>
</tr>
<tr>
<td>Single Receptacle (50A, 250V)</td>
<td>9367</td>
<td>5950</td>
<td>5709N</td>
<td>5374</td>
</tr>
<tr>
<td>Single Receptacle (50A, 125/250V)</td>
<td>9450</td>
<td>5754</td>
<td>7985N</td>
<td>279</td>
</tr>
</tbody>
</table>

D. Wiring device colors shall be as selected by the Architect.
E. Where only one receptacle, single or duplex, is supplied by a branch circuit (dedicated circuit), the receptacle shall have the same ampere rating as the overcurrent protective device ahead of the circuit.

F. Where receptacles are provided for equipment not having grounding-type cords and cord caps, the Contractor shall furnish and install new cords and cord caps on equipment to match new receptacles.

G. Key operated switches shall be same as above except with lock type mechanism. All switches shall use the same key.

H. Weatherproof devices shall be the same as standard devices except with diecast lockable weatherproof plate equal to Intermatic #WP1010HMC.

I. Switch and receptacle combinations shall be devices as above in a 2-gang box.

J. Flush floor power outlets shall be grounded duplex outlets with cast box and brass coverplate equal to Hubbell #B2537 with #S3725. Pedestal type floor fittings shall include duplex or double duplex outlets as indicated with satin chromium finish and cover plates.

K. Flush floor telephone outlet covers shall be brass with two concentric openings with screw type plugs. Model numbers shall be as indicated on the drawings.

L. Ground fault interrupting receptacles shall be duplex type with “Test” and “Reset” buttons. Receptacle shall have feed-through provisions for protection of down stream receptacles. Unit shall be complete with cover plate. Receptacles located on the building exterior, in toilet rooms, and elsewhere as shown on the drawings shall be GFI type. Provide cast weatherproof cover plates with hinge on top for receptacles on the building exterior.

M. Clock hanger outlets shall have stainless steel plate with support hook and wire well. Receptacle shall be equal to Leviton #5261-CH.

N. Outlets for CCTV cameras or VSS cameras shall be equal to Hubbell #5261I with stainless steel plate.

O. Dropcords shall have Kellem's K022-16-005 or K073-04-1279 cable grips with Kellem's K203-02-001 springs supporting 600V, type SO cable and twistlock connector body. Dropcords shall be in conformance with the following schedule:

<table>
<thead>
<tr>
<th>Connector Body</th>
<th>Type SO Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>120V, 15 Amp</td>
<td>Hubbell #2323 3/C-#12</td>
</tr>
<tr>
<td>120V, 20 Amp</td>
<td>Hubbell #2313 3/C-#12</td>
</tr>
<tr>
<td>120V, 30 Amp</td>
<td>Hubbell #2613 3/C-#10</td>
</tr>
<tr>
<td>120V, 50 Amp</td>
<td>Hubbell #3762 3/C-#6</td>
</tr>
</tbody>
</table>

2.2 DIMMER SWITCHES

A. Dimmer switches have a preset slide control with an on/off switch. Dimmer switches shall be solid state with radio frequency interference suppression.

B. Dimmers shall be as follows:

1. Up to 600 watts - Pass & Seymour #90680-I or #90683-I (three-way)
2. Up to 1000 watts - Pass & Seymour #91180-I or #91183-I (three-way)
3. Up to 1500 watts - Pass & Seymour #91580-I or #91583-I (three-way)
4. Up to 2000 watts - Pass & Seymour #92080-I
C. Dimmers shall be suitable for use on common neutral circuits without interference between dimmers. Provide dimmers rated for fluorescent loads where required.
D. Dimmers shall be furnished with decorative cover plates. Color shall be selected from available finishes by Architect.

2.3 INCANDESCENT DIMMER SWITCHES
A. Dimmer switches shall be incandescent, push on, push off, rotary knob type. Dimmer switches shall be solid state with radio frequency interference suppression.
B. Dimmers shall be as follows:
   1. Up to 450 watts - Prescolite #DS6A or DS6-3P (three-way)
   2. 450 to 800 watts - Prescolite #DS10A or DS10-3P (three-way)
   3. 800 to 1200 watts - Prescolite #DS15A
   4. 1200 to 1600 watts - Prescolite #DS20A
C. Dimmers shall be suitable for use on common neutral circuits without interference between dimmers.
D. Three-way dimmers shall utilize Prescolite #DSS-3 companion switches where installed adjacent to each other.
E. Dimmers shall be furnished with decorative cover plates. Color shall be selected from available finishes by Architect.

2.4 FLUORESCENT DIMMER SWITCHES
A. Dimmer switches for fluorescent lights shall be thin profile, linear slide control type, with off position. Dimmer switches shall be solid state with radio frequency interference suppression.
B. Dimmers shall be suitable for use with the fluorescent dimming ballasts utilized. The ballasts and dimmers shall operate as a coordinated system to produce square law dimming of T-12 fluorescent lamps down to 1% of lumen output.
C. Dimmer switches shall be equal to Lutron Nova Model #NF-10-277.
D. Dimmers shall be furnished with decorative cover plates. Color shall be selected from available finishes by Architect.

2.5 OCCUPANCY SENSORS
A. Manufacturer: Watt Stopper, or approved equal.
B. Operating voltage shall be 24 volts D.C. Include power pack relay module with self-contained transformer and relay for derivation of operating voltage and line voltage switching. Relay contacts shall be rated for 20 amps ballast load at either 120 volts or 277 volts or 13 amps incandescent load at 120 volts.
C. Where more than one circuit is to be switched, provide an additional slave relay module, with contacts rated the same as the power pack relay module.

D. Occupancy sensors shall be as follows:
   1. Dual technology (ultrasonic and PIR), wall mount occupancy sensors shall be Watt Stopper #DT-300 with isolated relay.
   2. IR wall switch occupancy sensors shall be Watt Stopper #DW Series.
   3. Power pack relay module shall be Watt Stopper, compatible with Sensor model and line voltage.

2.6 DEVICE PLATES

A. Device boxes and blanked outlets shall have stainless steel plates equal to Sierra S-Line. Blank outlet plates shall be factory marked to identify the system to which it is connected. Stainless steel plates shall be 0.04 inch thick with #302 satin finish.

B. All device plates located in inmate areas shall be equal to Hubbell #SWP series with Torx® head center pin reject screws and UL listed to UL514A or UL514D. Device plates shall have safety ground tab or equivalent redundant ground feature.

2.7 CORD REELS

A. Provide drop cord reels with 4-roller cable guides, Daniel Woodhead #9385 or equal, with a 20-foot 3-conductor #12 AWG Type SO cord and NEMA 5-20 connector assembly.

B. Provide stainless steel escutcheon ring around assembly to conceal edge at ceiling opening.

END OF SECTION 26 27 26
SECTION 26 27 27
SUPPORTING DEVICES

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Materials and Finishes: Corrosion resistant.

B. Select materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit, including weight of wire in conduit.

C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use precast inserts, expansion anchors and preset inserts.
   2. Steel Structural Elements: Use beam clamps, spring steel clips, and welded fasteners.
   3. Concrete Surfaces: Use self drilling anchors and expansion anchors.
   5. Solid Masonry Walls: Use expansion anchors and preset inserts.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
   1. B-Line or equal

B. Description: Galvanized steel or zinc plated.

END OF SECTION 26 27 27
PART 2 - PRODUCTS

2.1 FUSES

A. Manufacturers: Bussman, Shawmut, and Littlefuse.

B. Fuses shall be provided as indicated on the drawings and shall be current-limiting type.

C. Fuses in switchboards shall be Class L or Class J type, unless otherwise indicated on the drawings and/or associated schedules.

D. Fuses in safety switches, busway plug-in units, and panelboards shall be Class RK1, unless otherwise indicated on the drawings and/or associated schedules.

E. Fuses in combination motor starters and fuses protecting motors or transformers shall be Class RK5 dual-element time-delay type.

F. Interrupting Capacity: 200,000 amperes RMS symmetrical.

G. Provide one (1) complete set (3 per size) of spare fuses in a metal cabinet.

2.2 SPARE FUSE CABINET

A. Description: Surface-mounted galvanized steel sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified. Trim shall be same height and width as box.

B. Doors: Trim shall be supplied with a hinged door. Door shall be flush with trim. Door shall have a flush cylinder lock and catch assembly.

C. Lock: Door lock shall be flush cylinder type, keyed same as panelboard locks.

D. Finish: Finish cabinet with one coat of zinc chromate and one coat of gray baked enamel.

END OF SECTION 26 28 13
SECTION 26 28 16
ENCLOSED SWITCHES

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Eaton Electrical, General Electric, Siemens, or Square D.

B. Type: Safety switches shall be enclosed heavy-duty type, with externally operable handle and enclosed load-interrupter knife switch.

C. Construction: Switch mechanism shall be quick-make quick-break type, such that the operation of the contacts shall not capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

1. The handle shall travel at least 90 degrees between ON and OFF positions so the handle position is easily recognizable. Facilities shall be provided for padlocking handle in OFF position.
2. Switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the ON position.
3. Switches shall have line terminal shields.
4. Current carrying parts shall be plated to resist corrosion.
5. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

D. Neutral Bus: A full-size insulated neutral bus shall be included in safety switches indicated with neutral. Neutral busing shall have suitable lugs for each incoming and outgoing circuit requiring a neutral connection.

E. Ground Bus: A copper ground bus capable of being isolated shall be included in each safety switch. The ground bus shall be bonded to the switch enclosure, except where isolated ground bus is indicated. Ground busing shall have suitable lugs for the equipment grounding conductors associated with the incoming and outgoing circuits and for any bonding conductors.

F. Enclosures: Rated to suit the installation location. Indoor switches shall have NEMA Type 1 general purpose enclosures, except as otherwise indicated on the drawings. Unless otherwise indicated, switches installed outdoors shall have NEMA Type 3R raintight enclosures.

1. Enclosures shall be made from galvanized steel.
2. Provide adequate gutter space for wire bending and termination. Where conductors supplying a safety switch are carried through its enclosure to supply other electrical equipment, the enclosure shall be sized to include the additional required wiring space.

2.2 FUSIBLE SWITCHES

A. Fuse Clips: Fusible switches shall be equipped with rejection-type fuse clips designed to accommodate Class R current-limiting fuses only, except as otherwise indicated.

B. Service Equipment: Fusible switches used as service-entrance equipment shall be UL listed and labeled as suitable for such use.
END OF SECTION 26 28 16
PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. Manufacturers: Eaton Electrical, General Electric, Siemens, or Square D.

B. Type: Enclosed circuit breakers shall be provided with dead-front enclosures. The circuit breaker handle or operating mechanism shall be accessible through the front cover.

C. Neutral Bus: A full-size insulated neutral bar shall be included in each enclosed circuit breaker indicated with neutral. Neutral busing shall have suitable lugs for all incoming and outgoing circuits requiring a neutral connection.

D. Ground Bus: A copper ground bus capable of being isolated shall be included in each enclosed circuit breaker. The ground bus shall be bonded to the enclosure, except where ground bus is indicated to be isolated. Ground busing shall have suitable lugs for the equipment grounding conductors associated with all incoming and outgoing circuits and for any bonding conductors.

E. Enclosures: Enclosures shall be suitable for locations as indicated on the drawings. Except as otherwise indicated, enclosures located indoors shall be NEMA Type 1 general purpose enclosures, and enclosures located outdoors shall be NEMA Type 3R rain-tight enclosures.
   1. Enclosed circuit breakers shall be surface-mounted or flush-mounted as indicated. Surface trims shall be same height and width as box. Flush trims shall overlap the box by ¾ inch on all sides.
   2. Enclosures shall be made from galvanized steel. Provide adequate gutter space for wire bending and termination. Where conductors supplying the enclosed circuit breaker are carried through its box to supply other electrical equipment, the enclosure shall be sized to include the additional required wiring space.

F. Finish: In finished areas, finish enclosed circuit breakers with one coat of zinc chromate and one coat of primer sealer. In all other locations, finish enclosed circuit breakers with one coat of zinc chromate and one coat of gray baked enamel.

G. Service Equipment: Enclosed circuit breakers used as service-entrance equipment shall be UL listed and labeled as suitable for such use.

2.2 SHORT CIRCUIT RATINGS

A. Each enclosed circuit breaker shall be labeled with a UL integrated equipment short circuit rating. All circuit breakers shall have the interrupting capacity rating as indicated without relying upon series-connected ratings, except as otherwise specifically indicated on the drawings and/or associated schedules.

B. Enclosed circuit breakers applied at 240 volts or less shall have short circuit ratings as indicated on the drawings and/or associated schedules, but not less than 10,000 amperes RMS symmetrical.
C. Enclosed circuit breakers applied at 480 volts or less shall have short circuit ratings as indicated on the drawings and/or associated schedules, but not less than 14,000 amperes RMS symmetrical.

D. When series ratings are indicated on the drawings and/or associated schedules, a UL series-rating label shall be provided. The label shall state the conditions of the UL series rating, including:
   1. Size and type of required upstream device
   2. UL series short circuit rating

2.3 CIRCUIT BREAKERS

A. Circuit breakers shall be molded-case type, with inverse time and instantaneous tripping characteristics.

B. Each circuit breaker shall be operated by a single toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle positions. Contacts shall be non-welding silver alloy type with arc extinction chutes. Multiple-pole circuit breakers shall be common trip.

C. Where indicated, circuit breakers shall be current-limiting type. Such circuit breakers shall have automatically-resetting current limiting elements in each pole, coordinated with the thermal and instantaneous trip elements. Let-through current and energy level shall be less than permitted for same size Class RK-5 fuse.

D. The trip rating of each unit shall be clearly indicated and visible or identified on a permanently affixed nameplate. Adjustments shall be accessible without removing covers, unless such removal does not require use of tools.

E. Where indicated, circuit breakers shall be equipped with a tripping system consisting of three (3) current sensors, a trip unit, and a flux-transfer shunt trip. The trip unit shall provide adjustable time-current protection functions. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. The trip unit shall include adjustments for:
   1. Long-time pick-up and delay
   2. Short-time pick-up and delay, with I2t curve-shaping option
   3. Instantaneous pick-up

F. The trip rating of the circuit breakers shall be imprinted in the handle.

G. Ground fault interrupting circuit breakers shall have “Test” button and pigtail for neutral connection.

H. Circuit breakers located in non-air conditioned spaces or outside the building shall be ambient compensated type.

I. Circuit breakers used for switching lighting circuits shall be UL labeled “SWD”.

J. Circuit breakers used for air conditioning equipment shall be UL labeled “HACR”.

K. Circuit breakers shall have mechanical screw type removable connector lugs, AL/CU rated.
2.4 ACCESSORIES

A. Handle Lock: Enclosed circuit breakers shall include provisions for padlocking.

B. Provide kirk-key interlocks, shunt trips, and auxiliary switches as indicated on the drawings.

END OF SECTION 26 28 17
SECTION 26 29 13
ENCLOSED MOTOR CONTROLLERS

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers: Eaton Electrical, General Electric, Siemens, or Square D.

2.2 MANUAL MOTOR STARTERS

A. Description: Manual motor starters shall be enclosed, general-purpose, Class A, manually operated, full-voltage controllers with toggle handles. Each manual motor starter shall include properly sized overload elements and a green neon pilot run light.

B. Enclosures: Enclosures shall be NEMA rated to suit the installation location. Manual motor starters that are wall-mounted in finished spaces shall be equipped with flush faceplates suitable for mounting the device recessed in a standard outlet box. In mechanical rooms, above ceilings and in other unfinished locations, manual master starters shall be equipped with surface mounting enclosures.

2.3 AUTOMATIC MOTOR CONTROLLERS

A. Description: Automatic motor controllers shall be enclosed general-purpose Class A motor starters, sized for the application. Provide control station and pilot lights in cover as indicated in separate motor controller schedule(s). Automatic controllers shall include the following features:

1. Overload protection in each ungrounded conductor with a common reset button. Protection shall consist of adjustable, solid state overload relays which shall protect the motor from overload, phase loss and ground faults.
2. A fused 120 volt control voltage transformer with primary and secondary fuses.
3. An adjustable 0 to 30 second time delay relay.
4. Pilot lights operated by dedicated auxiliary contacts, quantity as indicated.
5. Buttons: On/Off or Start/Stop flush pushbuttons.
6. Auxiliary contacts as required for interlocks and control sequences indicated.
7. Additional spare normally-open and normally-closed auxiliary contacts as indicated, but not less than two (2) per starter (one of each type).

B. Full-Voltage Controllers: Full-Voltage Controllers shall be magnetic motor starters. Contactors shall be electrically-operated and electrically held, with arc extinguishing characteristics and silver-to-silver renewable contacts.

C. Two-Speed Controllers: Reduced-voltage controllers shall be provided for two-speed motors. Two-speed controllers shall be magnetic starters as specified for full-voltage starters, except they shall have two contactors. Two-speed controllers shall be two winding type to control separate windings of reconnectible squirrel-cage induction motors, so as to operate motor at different speeds. Six (6) overload units shall be provided for each starter, sized for the actual full-load current of the motor at the relevant speeds.
D. Reduced-voltage controllers shall be provided for certain motors as indicated on separate motor controller schedule(s). Each reduced-voltage non-reversing (RVNR) controller shall be a solid-state reduced voltage starter, equipped with a magnetic contactor which shall automatically bypass the solid-state controls and remove them from the circuit once the motor reaches rated voltage and speed. The solid-state controls shall utilize a six (6) silicon controlled rectifier (SCR) full-wave rectifier design and shall provide for adjustable voltage or current ramp to control starting torque. Controllers shall conform to the following requirements:

1. The solid-state controls shall consist of three (3) sets of back-to-back phase-controlled power semi-conductors mounted on an electrically-isolated heat sink, together with associated logic circuitry.
2. Power semi-conductors shall be rated with peak inverse voltage at least 2.5 times rated line-to-line voltage.
3. Suitably rated snubbers for voltage suppression shall be included to prevent false SCR firing due to dv/dt characteristics of the electrical system.
4. Logic circuitry shall include:
   a. Three-phase current sensing via current transformers for closed loop control to insure motor stability.
   b. Dual inline package (DIP) switches for current limit calibration range for various motor ampere ratings.
   c. Voltage ramp-up time adjustment: 1 to 45 seconds
   d. Current limit adjustment: 250 to 500 %
   e. Initial torque adjustment: 20 to 80 % of rated voltage or 100 to 200 % of rated current
   f. Smooth stop time adjustment: 3 to 30 seconds, with an interlock to release starter seal-in lock upon completion of stop cycle.
   g. Automatic reset upon removal of line power and re-application of incoming power. Tripped functions shall be designed to be cleared by removing control power from logic circuitry.
   h. A stall/SCR protective circuit with inverse time characteristic and thermal memory.
   i. Short circuit electronic trip overcurrent protection: time not to exceed ½ cycle.
   j. Electronic running overload protection, based on inverse time-current algorithm.
   k. Phase loss/unbalance protection: to shut down unit upon 35 % current differential between any two phases.
   l. Gate firing circuit lockout protection on trip
   m. Fault relay lockout protection
   n. Minimum and maximum voltage adjustments
   o. Voltage stability adjustment

5. The paralleling bypass contactor shall be fully rated for across-the-line starting duty. The contactor shall utilize an energy balanced contact closure to limit contact bounce.
6. Enclosed units shall include a thermal magnetic circuit breaker for short circuit protection and quick disconnect means. Starters and breakers are to be tested in series and be rating for UL withstand rating of 35,000 amperes RMS symmetrical, minimum.
7. A normally open (NO) contact shall annunciate fault conditions.

E. Enclosures: Enclosures shall be NEMA rated to suit the installation location. Unless otherwise indicated, units located indoors shall be provided with NEMA Type 1A general purpose enclosures with fully gasketed doors. Enclosures shall be constructed of sheet steel, not less than 16-gauge thick.

F. Finish: Enclosure surfaces shall be thoroughly cleaned and phosphatized prior to painting. They shall be primed with a corrosion-resistant coating, and finished with gray baked enamel.
2.4 DISCONNECTS

A. Combination Controllers: Where combination controllers are indicated, combine motor controllers with fusible switch disconnect or motor circuit protector in common enclosure.

B. Fusible Switches: Fusible switches shall be quick-make quick-break, load-interrupter knife switches with externally operable handles.
   1. Provide interlock with defeat mechanism to prevent opening front cover with switch in ON position.
   2. Handle shall be lockable in OFF position.
   3. Fuse clips shall be rejection-type designed to accommodate Class R current-limiting fuses only.
   4. Reference Section 26 28 16 for additional information.

C. Motor circuit protectors shall be molded-case circuit breakers, as specified in Section 26 28 17, except that the tripping characteristic shall be magnetic-only instantaneous trip without thermal inverse-time trip.
   1. Instantaneous trip setting shall be adjustable.
   2. The operating handle shall have a positive, non-teasing operating mechanism mounted on the front cover, arranged for ON/OFF action. The operating handle shall have means for padlocking in the OFF position.
   3. Provide current limiters in each phase, circuited in with the motor circuit protector. The current limiters shall be specifically designed for motor circuits. Current limiters shall be coordinated with the motor circuit protector to allow the motor circuit protector to clear low-level faults, and prevent single-phasing should the current limiter operate. Each phase of the current limiter shall have a built-in trip indicator.
   4. A manual push-to-trip button shall be provided to exercise trip unit.

2.5 ACCESSORIES

A. Pilot Lights: Heavy duty oil tight type, mounted in cover.

B. Pilot Light Contacts: Form Z

C. Auxiliary Contacts: Field convertible contacts, in addition to seal-in contact and pilot light contacts.

D. Selector Switches: Rotary type, mounted in cover.

E. Pushbuttons: Unguarded, mounted in cover.

F. Indicators: Light-emitting diode (LED) lamps, liquid-crystal display (LCD) read-outs or dial gauges.

G. Relays: 120 volt, unless otherwise indicated.

H. Control Power Transformers: 120 volt secondary, sized for control burden plus 50 %, 100 VA minimum. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

END OF SECTION 26 29 13
SECTION 26 29 33
ELEVATOR POWER MODULE PANEL

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer: Bussmann, Farraz – Shaw Mutt, or Littel fuse.

B. Description: The panel shall be main lug only with copper bus, rating as indicated in the Drawings. Provide individual horsepower rated fusible feeder switches with individual shunt trip capabilities. Feeder switches shall have ampere ratings as indicated on the drawings based upon elevator manufacturer requirements and utilize Class J fuses provided separately.

C. Ratings: 277/480V, 3 phase, 4 wire.

D. Withstand Current Rating: 200,000 rms symmetrical amperes, when used with Bussmann Low-peak Class J fuses.

E. Panel Accessories: The following accessories shall be provided:

1. Control power transformer: Rated 100VA with primary and secondary fuses, secondary shall be 120 volt.
2. Isolation relay: Contacts shall be 3PDT, 10 amp, 120 volt AC. The coil shall be 120 volt AC or 24 volt DC.
3. Test Switch: Key to test switch.
4. Pilot Lights: On Pilot Light (Green, Red, or White)
5. Auxiliary Contacts: 1P or 2P normally closed mechanical interlock for hydraulic elevator automatic recall.
6. Isolated Neutral Lugs: Isolated neutral shall be full capacity.

F. Feeder Switch Accessories: The following accessories shall be provided:

1. All switches shall have shunt trip capabilities at 120V AC from remote fire safety signal. Branch feeders shall be selectively coordinated and fed with an upstream supply overcurrent protective device at a minimum of 2:1 size ratio utilizing Class J fuses.

END OF SECTION 26 29 33
SECTION 26 32 13

PACKAGED ENGINE GENERATOR SYSTEMS

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers:
   1. Onan
   2. Kohler
   3. Caterpillar

B. All materials, equipment, and parts comprising the unit specified herein shall be new and unused, of current manufacture, and of highest grade and assembled in a workmanlike manner.

C. The generator set, the automatic transfer switch and all accessories shall be furnished as a complete system to insure single source responsibility.

D. The generator set shall receive the manufacturer’s standard factory load testing. Prior to acceptance of the installation, equipment shall be tested to show it is free of any defects, will start automatically, and will operate properly when subjected to tests specified herein.

E. Engine generator system shall be provided in a weatherproof enclosure for operation outdoors.

2.2 PACKAGE ENGINE GENERATOR SYSTEM

A. Description: NFPA 110, engine generator system to provide source of power for Level 1 and 2 applications, and conforming to NFPA 99.

B. Provide a fully assembled diesel fueled engine-driven generator unit as indicated, rated for continuous standby operation, at 2500 feet altitude, at 105 degrees F. Provide unit-mounted radiator, blower fan, water pump, thermostat, and radiator capable of cooling engine with up to 0.5 inches water static pressure on fan. Connect engine drive directly to generator through semi-flexible steel disk coupling. Provide fuel intake with solenoid valve powered from starting battery. Equip set with associated control equipment to automatically start engine and stop engine. Equip generator with exciter and voltage regulator to maintain voltage. Equip generator with a circuit breaker capable of being locked in the open position.

C. The combined engine-generator set shall have the following capabilities:
   1. Frequency regulation: isochronous from no load to full load
   2. Voltage regulation: ±2 %
   3. Steady state operation: ±0.25 % frequency variation from no load to full load; ±1 % voltage variation from no load to full load
   4. Recovery: after assuming a single step load of rated KW and KVA the engine-generator set shall recover to 90 % of rated voltage and 90 % of rated frequency within 30 cycles (½ second)
   5. Provide specified capabilities at elevation installed
   6. The combined mechanical and electrical efficiency of the engine generator set shall not be less than 80 %.
7. Engine shall start and reach synchronous speed and generator shall be completely ready to accept load before the transfer switch operates and within 10 seconds of normal power source failure.

8. Minimum continuous standby KVA: As indicated in the drawings

9. Minimum continuous standby KW: As indicated in the drawings

D. As measured by an oscilloscope, the engine/generator shall be capable of starting the connected loads with a voltage dip of no greater than 25% when the load is applied in steps, each spaced 1 second apart, as follows:

1. Step 1: Emergency Transfer Switch ATS-E
2. Step 2: Legally Required Optional Standby Transfer Switch ATS-SE
3. Step 3: Optional Standby Transfer Switch ATS-S

E. The engine-generator set shall comply with NFPA 37, 99 and 110.

2.3 ENGINE

A. Type: Water-cooled Air-cooled in-line or V-type, four-stroke cycle, spark ignition gaseous internal combustion engine. The engine brake horsepower shall not be less than that required to produce the starting and running KW and KVA values specified at 80 % overall efficiency.

B. Rating: Sufficient to operate under 10 % overload for one hour in an ambient of 90 degrees F at an elevation of 2500 feet.

C. Fuel System: Propane (liquid withdrawal with vaporizer at engine). Provide a relief valve between the propane tank and liquid vaporizer in accordance with American Gas Association.

D. Engine speed: 1800 rpm.

E. Governor: Isochronous type to maintain engine speed within 0.5 %, steady state, and 5 %, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Governor shall be electronic. Equip governor with means for manual operation and adjustment.

F. Alarm and Safety Devices: The engine shall be equipped with the following:

1. A sensor device plus visual warning device to indicate a water jacket temperature below 70 degrees F.
2. Two sensor devices for each of the following alarm conditions, set at a different operating points, plus visual pre-alarm warning device for each condition to indicate:
   a. High engine temperature (above manufacturer’s recommended safe operating temperature range)
   b. Low lubricating oil pressure (below manufacturer’s recommended safe operating range)
3. An automatic engine shutdown device plus visual device to indicate that a shutdown took place for:
   a. Overcrank (failed to start)
   b. Overspeed
   c. Low lubricating oil pressure
   d. Excessive engine temperature
4. A common audible alarm device and an auxiliary common alarm contact to warn that any one (or more) of the pre-alarm or alarm conditions exist
G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer’s instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 208 volts AC. Engine jacket heater rated 4 KW. Heater shall be pre-set at the factory for the manufacturer’s recommended temperature.

I. Radiator: Radiator using 50 % ethylene glycol coolant, with blower type fan, sized to maintain safe engine temperature in a maximum ambient temperature of 110 degrees F. maximum. The radiator shall be equipped with a duct adapter flange. Radiator air flow restriction 0.5 inches of water. Louvers shall be powered by the engine starting batteries.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, fuel vaporize and gear-driven water pump. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base. Vibration isolators shall be steel spring type capable of isolating 95 % of all generator set vibrations. Isolators shall be complete with anchor bolts for installation in new concrete base.

2.4 GENERATOR

A. Generator: NEMA MG1, three phase, twelve or ten-lead, Y-connected, re-connectable brushless synchronous generator with brushless exciter. A direct drive blower shall be provided for generator cooling. The generator shall include a resettable thermal protector for exciter/regulator protection against extended low power factor loads. Combination mechanical and electrical efficiency shall be 80 % minimum.

B. Rating: kW and kVA ratings at 0.8 power factor as indicated in ¶2.2C, 480Y/277 208Y/120 volts, 60 Hz at 1800 rpm.

C. Insulation Class: F.

D. Temperature Rise: 105 °C continuous.

E. Enclosure: NEMA MG1, open drip proof.

F. Voltage Regulation: Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation ±1 % from no load to full load. Include manual controls to adjust voltage droop, voltage level ±5 % and voltage gain.

2.5 FUEL SYSTEM

A. The fuel system will consist of a liquid withdraw tank with underground fuel piping and a minimum 250-gallon propane fuel storage tank. Fuel propane storage tank shall be sized for a minimum run time of 90-minutes.

B. Provide all required tank items including but not limited to a tank angle valve #755OP with a check-lock adapter.
C. Provide a low fuel level switch for remote detection of low fuel. The switch shall close at 20% of remaining fuel. Provide a fuel level gauge.

D. Provide fuel piping from the fuel tank to the generator set. Provide all fittings, relief valves, flexible hose line, shut-off valves, etc. as required. Fuel pipe shall be ½ inch, schedule 80 black iron. Coat all underground fuel line with asphaltic emulsion and wrap with 3M protective tape.

E. The fuel line shall be buried a minimum of 12 inches between tank and generator. Provide fuel to 80% level for initial testing and demonstration.

2.6 ACCESSORIES

A. An engine mounted engine coolant driven propane expansion system for propane liquid input.

B. An engine mounted fuel filter, fuel solenoid valve, shutoff and pressure regulator.

C. Exhaust Silencer: Provide a critical grade silencer, including flexible exhaust fitting, properly sized and installed according to the manufacturer’s recommendation. The silencer shall be mounted so that the engine does not support its weight. The exhaust pipe shall be of sufficient size to ensure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer.

1. When engine/generator is provided in a weatherproof enclosure, silencer shall be mounted above the weatherproof enclosure. Provide rain cap at the outlet.

D. A DC electric starting system with positive engagement drive shall be furnished. The motor voltage shall be 24 VDC.

1. Fully automatic generator set start-stop controls in the generator control panel shall be provided. Controls shall provide shutdown for low oil pressure, high water temperature, overspeed, overcrank, and shall include one auxiliary contact. Controls shall include a 30 second, single-cranking cycle limit with lockout.

2. A lead/acid storage battery set of the heavy-duty diesel starting type shall be provided. Battery voltage shall be 24 VDC. The battery set shall be of sufficient capacity for 1 1/2 minutes total cranking time without recharging with sufficient reserve capacity to maintain the total load of the annunciator and generator control panels for a period of 2 hours, without the voltage applied to the load falling below 90% of normal. A battery rack and necessary cables and clamps shall be provided. The batteries shall be mounted in the steel sub-base.

3. Batteries shall be compatible with the charger used and shall be designed to meet the requirements of emergency service. Battery jars shall be transparent or translucent in order to visibly indicate when batteries require water additions. Automotive type batteries are not acceptable.

4. Provide each battery with a heater similar to KIM KB7515, 120 volts AC, 800W, rated for operation at a design temperature of 20° F below zero.

E. Batteries: Heavy duty, starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Include necessary cables and clamps.

F. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

G. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. The battery charge power shall be supplied from the normal source; Contractor shall provide circuits as required. The charger shall float at 2.17 volts per cell and equalize at 2.33
volts per cell. It shall include over-load protection, silicon diode full wave rectifiers, voltage surge suppressors, DC voltmeter, ammeter, and fused AC input. AC input voltage shall be 120 VAC. Charger shall have an automatic 24 hour equalizer timer. Amperage output shall be no less than 5 amperes. The battery charger shall be capable of fully charging the starting battery during running conditions. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall mounted enclosure to meet NEMA 250, Type 1 requirements.

H. Line Circuit Breaker: NEMA AB 1, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70. Include battery-voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.

I. Engine-Generator Control Panel: NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
   1. Frequency Meter: 45-65 Hz. range, 3.5 inch dial.
   2. AC Output Voltmeter: 3½ inch dial, 2 % accuracy, with phase selector switch.
   3. AC Output Ammeter: 3½ inch dial, 2 % accuracy, with phase selector switch.
   4. Voltage level adjustment rheostat.
   5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
   6. Four-position function switch marked “Auto”, “Manual”, “Off/Reset” and “Stop”.
   7. Automatic starting controls.
   8. Engine running time meter.
   9. Oil pressure gage.
   10. Water temperature gage.
   11. Speed control potentiometer.
   12. Battery voltage meter.
   13. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals pre-wired to terminal strip.
   14. Additional visual indicators and alarms as required by NFPA 110.
   15. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote alarm functions as specified, as required by NFPA 110.

J. Remote Annunciator Panel: Flush mounted panel with brushed stainless steel. The remote annunciator shall provide the following functions:
   1. Individual visual signals shall indicate:
      a. When the emergency or auxiliary power source is operating to supply power to load.
      b. When the battery charger is malfunctioning.
      c. When the control switch is not in the auto position.
   2. Individual visual signals plus a common audible signal (with silence switch) to warn of an engine-generator alarm condition shall indicate:
      a. Water temperature below 50 °F
      b. Excessive water temperature. (alarm and pre-alarm)
      c. Low lubricating oil pressure. (alarm and pre-alarm)
      d. Low fuel—when the main fuel storage tank contains less than 20% capacity
      e. Overcrank (failure to start)
f. Overspeed

3. Remote annunciator shall be located as shown on the drawings. The annunciator circuits shall be powered by the starting batteries.
4. A slave annunciator exactly duplicating the above shall be located within the generator control panel.
5. An audible and visual derangement signal, with silence switch, shall be provided which will activate when any of the warning signals indicated on the remote annunciator are activated. The derangement signal shall be located as shown on the drawings. Provide a nameplate reading, “GENERATOR MALFUNCTION - NOTIFY MAINTENANCE PERSONNEL IMMEDIATELY”.

K. Third Party Systems Interface: Provide additional auxiliary contacts to perform the following:

1. Provide auxiliary relays for each of the functions listed above in the paragraph titled ‘Remote Annunciator Panels’. Provide connection to the Div. 23 DDC system for engine/generator status annunciation. Reference the mechanical temperature control drawings for additional information.
2. Provide auxiliary contacts for annunciation of the engine/generator runtime to the Div. 23 DDC system. Reference the mechanical temperature control drawings for additional information.
3. Provide auxiliary contacts for automatically starting and exercising the engine/generator thru the Div. 23 DDC system. Reference the mechanical temperature control drawings for additional information.
4. Provide starting module to open intake and exhaust dampers prior to starting engine/generator set. Upon damper end switch operation, the engine/generator shall be capable of starting. Provide conduit and wiring connection to the damper TCU for the proper damper operation. Reference the mechanical temperature control drawings for additional information.

L. Sound Attenuated Weather-protective Enclosure: Reinforced steel housing allowing access to control panel and service points, with locking doors and panels. Include all accessory items recommended by the manufacturer for satisfactory operation of the equipment at a design temperature of 20 °F below zero. Maximum door width shall be 36 inches. Include fixed louvers, battery rack, and silencer. Where indicated, provide an auxiliary power panel within the enclosure for connection of lighting, battery charger, water jacket heater, fuel line heat tape, etc.

1. Engine noise shall not exceed 80 dBA as measured at 23 feet from the exhaust outlet.

PART 3 - END OF SECTION 26 32 13
SECTION 26 36 23

ENCLOSED TRANSFER SWITCH

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Onan, ASCO, Russelectric, or approved equal.

2.2 AUTOMATIC TRANSFER SWITCH
A. Description: NEMA ICS 10, automatic transfer switch suitable for use as service equipment.
B. Configuration: Electrically operated, mechanically held transfer switch over-center type with switched neutral. Contacts shall break before making. Voltage and current rating shall be as indicated on the drawings.
C. Interrupting Capacity: 600 % of continuous rating
D. Withstand Current Rating: 42,000 rms symmetrical amperes, when used with molded case circuit breaker. Class J K1 L current limiting fuse.

2.3 AUTOMATIC TRANSFER AND BYPASS/ISOLATION SWITCH
A. Description: NEMA ICS 10, automatic transfer switch with manual bypass switch.
B. Configuration: Draw-out type electrically-operated, mechanically-held transfer switch over-center type with switched neutral with manually-operated CONNECTED, TEST, AND DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY POSITIONS. Contacts shall break before making. Voltage and current rating shall be as indicated on the drawings.
C. Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.
D. Interrupting Capacity: 600 % of continuous rating
E. Withstand Current Rating: 42,000 rms symmetrical amperes, when used with molded case circuit breaker. Class J K1 L current limiting fuse.

2.4 MANUAL TRANSFER SWITCH
A. Description: NEMA ICS 10, manual transfer switch suitable for use as service equipment.
B. Configuration: Electrically operated, mechanically held transfer switch over-center type with solid neutral. Contacts shall break before making. Voltage and current rating shall be as indicated on the drawings.
C. Sequence of Operation: Switch position is selected by control switch mounted in switch cover. Remotely.
D. Withstand Current Rating: 42,000 rms symmetrical amperes, when used with molded case circuit breaker. Class J K1 L current limiting fuse.

2.5 PRODUCT OPTIONS AND FEATURES

A. Normal Source Monitor: Provide solid state under-voltage sensor for each phase of normal source and emergency source.
   1. Voltage sensors shall be temperature compensated type, for maximum deviation over the temperature range of -25 °F to 175 °F voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of normal or emergency source, even where motor feedback voltages exist.
   2. Under frequency relay on the emergency source shall initiate transfer when the frequency varies more than 3 % from rated nominal value.
   3. Solid-state under-voltage sensors shall simultaneously monitor all phases of the normal source. Pick-up settings shall be adjustable from minimum of 805 to maximum of 98 % of nominal voltage, factory set at 85 %. Dropout settings shall be adjustable from minimum of 70 % to maximum of 98 % of pick-up settings with fixed dropout time delay of 0.5 seconds.
   4. Solid-state under-voltage sensors shall simultaneously monitor all phases of the emergency source. Pick-up settings shall be adjustable from minimum of 80 % to maximum of 98 % of nominal voltage, factory set at 90 %. Dropout settings shall be adjustable from minimum of 70 % to maximum of 98 % of pick-up settings with fixed dropout time delay of 0.5 seconds.

B. Programmed transition to allow the transfer switch to pause with neither normal nor emergency power connected to the load while residual voltage decays. (Adjustable from 0.5 to 5.0 seconds.)

C. Close differential voltage sensors: To monitor normal generator power for both under-voltage and over-voltage conditions.

D. Normal/Test switch: Test position starts the generator set for test and/or maintenance; normal position returns the generator to automatic control.

E. With/Without Load switch: To determine whether the load transfers during the test/exercise.

F. Push To Retransfer-Manual/Auto pushbutton/switch: Auto position allows automatic retransfer when power returns. In the manual position, the “Push to Retransfer” button must be used to retransfer.

G. Time Delay Start/Stop: Start delay is to eliminate nuisance starts due to momentary power loss or dip. (Adjustable from 0.5 to 10.0 seconds.) Stop delay is to allow the generator to fun unloaded for gradual cool-down. (Stop delay adjustable from 0.5 to 8.0 minutes.)

H. Time Delay Transfer/Retransfer: To allow the power to stabilize before connections to the load. (Transfer relay adjustable from 0.5 to 10.0 seconds, retransfer from 1.0 seconds to 30.0 minutes.)

I. In-Phase Monitor

J. Engine starting contacts
K. Auxiliary dry contacts in both normal and emergency positions. Provide a minimum of one (1) normally open and one (1) normally closed contact for each position (contacts are reserved for future use). Provide additional contacts as required to provide the functions detailed below:

1. Provide auxiliary contacts for automatically starting and exercising the engine/generator through the Building Management System. Reference the mechanical temperature control drawings for additional information.

L. Controls shall provide built-in “control mode status indicators”, consisting of LED’s to indicate a sequence of function. These indicators shall be visible with the cabinet doors and covers closed. As a minimum, the following control modes shall have LED indication:

1. Normal Source Available
2. Alternate Source Available
3. Switch Position
4. Normal Bypass
5. Alternate Source Bypass

2.6 AUTOMATIC SEQUENCE OF OPERATION

A. Transfer Load to Emergency Source:

1. Controls shall signal the emergency power system to start upon signal from normal source voltage sensors.
2. Switch shall transfer the load to the emergency power system after the generator set reaches proper voltage and frequency but not later than ten (10) seconds after normal source power failure.
3. The transfer switch shall control the generator set to allow generator set to start and otherwise be ready to accept the load in the time specified. It shall be the responsibility of the supplier to assure that this requirement is met.

B. Retransfer Load to Normal Source:

1. Switch shall retransfer the load to the normal source after normal power restoration.
2. Controls shall signal the engine-generator set to stop after load retransfer to normal source.

C. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency source to normal source if emergency source fails when normal source is available.

D. Engine Exerciser: Bypass exerciser control if normal source fails during exercising period. Exerciser Clock to set the day, time, and the duration of the exercise period.

2.7 ENCLOSURE

A. Enclosure: NEMA Type 1

B. Finish: Manufacturer’s standard finish

END OF SECTION 26 36 23
PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers:
   1. Transtector, Inc
   2. Square D/Advanced Protection Technologies
   3. Or approved equal

B. Description: Provide one (1) TVSS at the facility service entrance equipment and provide additional branch panel units as shown on the drawings.

C. All TVSS components shall be rated for operation from 30 to 120 °F and from 0 to 85 % humidity, non-condensing.

D. Maximum continuous operating voltages of any system component shall not be less than 115 % of the nominal system voltage on the service protection panel and 120 % on branch protection panels.

2.2 SERVICE PROTECTION PANEL

A. Description: NEMA 4 enclosure, factory primed and painted.

B. Configuration: Modular TVSS units shall consist of silicon avalanche suppression diodes (SASD) and shall be capable of being removed from service for maintenance without interruption to building power. The unit shall utilize hybrid designs or use any degrading technologies (MOV or selenium). Modular TVSS units shall consist of user replaceable MOV based modules (one per phase) with integral 200kAIC fuses and shall be capable of being removed from service for maintenance without interruption to building power. Provide LED indication on the cover of the TVSS unit to indicate operational status of the TVSS.

C. The clamping voltage shall be provided for a 10 × 1000 microsecond wave form per ANSI/IEEE C62.41-1991 for B3 location categories using ANSI/IEEE C62.45-1987 testing techniques (power applied). The clamping voltage shall not exceed the surge voltage ratings indicated below:

<table>
<thead>
<tr>
<th>Voltage Configuration</th>
<th>Surge Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>SASD based:</td>
<td></td>
</tr>
<tr>
<td>120V, Single Phase</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>240V/120V, Single Phase</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>208/120V, Three Phase Wye</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>240V, Single Phase</td>
<td>600 Vpk (L-L)</td>
</tr>
<tr>
<td>240V, Three Phase Delta</td>
<td>600 Vpk (L-L)</td>
</tr>
<tr>
<td>380/220V, Three Phase Wye</td>
<td>600 Vpk (L-N)</td>
</tr>
<tr>
<td>480/277V, Three Phase Wye</td>
<td>800 Vpk (L-N)</td>
</tr>
<tr>
<td>480V, Three Phase Delta</td>
<td>1000 Vpk (L-L)</td>
</tr>
<tr>
<td>MOV based:</td>
<td></td>
</tr>
</tbody>
</table>
### Voltage Configuration

<table>
<thead>
<tr>
<th>Voltage Configuration</th>
<th>Surge Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>SASD based:</td>
<td></td>
</tr>
<tr>
<td>208/120V, Three Phase Wye</td>
<td>470 Vpk (L-N), 470 Vpk (L-G)</td>
</tr>
<tr>
<td>480/277V, Three Phase Wye</td>
<td>920 Vpk (L-N), 920 Vpk (L-G)</td>
</tr>
</tbody>
</table>

D. The TVSS shall have a minimum surge current capacity of 360kA/phase.

E. The TVSS shall have a minimum operational life of ten (10) years without degradation in performance.

F. The TVSS capability shall be equal bi-directionally and treat both the positive and negative impulses with separate suppressor modules per phase.

1. The effective response time shall be 5 nanoseconds or less.
2. Suppression shall be line to neutral (line to line on delta systems).

G. Provide an optional remote status indicator consisting of a normally closed dry contact to provide an on-line status of the TVSS unit.

H. The TVSS shall be Transtector ACP3900-xxxW Square D XTE/XLHP/CX.

#### 2.3 BRANCH PROTECTION PANEL

A. Description: NEMA 4 enclosure, factory primed and painted.

B. Configuration: Modular TVSS units shall consist of silicon avalanche suppression diodes (SASD) and shall be capable of being removed from service for maintenance without interruption to building power. The unit shall not utilize hybrid designs or use any degrading technologies (MOV or selenium). Modular TVSS units shall consist of user replacement MOV based modules (one per phase) with integral 200kAIC fuses and shall be capable of being removed from service for maintenance without interruption to building power. Provide LED indication on the cover of the TVSS unit to indicate operational status of each TVSS module.

C. TVSS performance shall meet the minimum requirements of UL 1449 for permanently connected systems. The clamping voltage shall not exceed the surge voltage ratings indicated below:

<table>
<thead>
<tr>
<th>Voltage Configuration</th>
<th>Surge Voltage Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>SASD based:</td>
<td></td>
</tr>
<tr>
<td>120V, Single Phase</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>240V/120V, Single Phase</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>208/120V, Three Phase Wye</td>
<td>330 Vpk (L-N)</td>
</tr>
<tr>
<td>240V, Single Phase</td>
<td>600 Vpk (L-L)</td>
</tr>
<tr>
<td>240V, Three Phase Delta</td>
<td>600 Vpk (L-L)</td>
</tr>
<tr>
<td>380/220V, Three Phase Wye</td>
<td>600 Vpk (L-N)</td>
</tr>
<tr>
<td>480/277V, Three Phase Wye</td>
<td>600 Vpk (L-N)</td>
</tr>
<tr>
<td>480V, Three Phase Delta</td>
<td>1000 Vpk (L-L)</td>
</tr>
<tr>
<td>MOV based:</td>
<td></td>
</tr>
<tr>
<td>208/120V, Three Phase Wye</td>
<td>470 Vpk (L-N), 470 Vpk (L-G)</td>
</tr>
<tr>
<td>480/277V, Three Phase Wye</td>
<td>920 Vpk (L-N), 920 Vpk (L-G)</td>
</tr>
</tbody>
</table>

D. The TVSS shall have a minimum surge current capacity of 120kA/phase.
E. The TVSS shall have a minimum operational life of 10 years without degradation in performance.

F. The TVSS capability shall be equal bi-directionally and treat both the positive and negative impulses with separate suppressor modules per phase.
   1. The effective response time shall be 5 nanoseconds or less.
   2. Suppression shall be line to neutral (line to line on delta systems).

G. Provide an optional remote status indicator consisting of a normally closed dry contact to provide an on-line status of the TVSS unit.

H. The TVSS shall be Transtector ACP3900-xxxW Square D XTE/XG.

END OF SECTION 26 43 02
PART 2 - PRODUCTS

2.1 LUMINAIREs

A. Furnish Products as scheduled on the Light Fixture Schedule on the drawings. Refer to Section 26 01 02 for substitutions and product options.

B. Provide luminaires complete with lamps, tubes, ballasts, brackets, hardware, poles, bases, etc. as required for a complete and operable lighting system.

C. Only island type “insert and twist” lamp sockets shall be used for fluorescent lamps (except for “U” lamps.)

D. Luminaires shall have manufacturer’s standard finish unless otherwise noted. Luminaires installed on exterior of building shall be weather-resistant design and display a “Damp” or “Wet” location label as required per applicable codes. Fixtures installed on low density tile shall be designed for direct surface mounting.

E. Fluorescent luminaires installed on the exterior of the building and/or in unheated spaces shall have cold weather ballasts.

F. All lenses in fluorescent luminaires shall be 100% virgin acrylic. Overall lens thickness shall be 0.125 inches with 0.080 inches maximum penetration.

G. Recessed or semi-recessed luminaires shall be provided to be compatible with ceilings as installed. Furnish and install frames where required for proper installation. Recessed incandescent luminaires shall be thermally protected. Integrally ballasted luminaires shall have thermally protected ballasts.

H. Luminaires requiring caps, mounting spacers, hold-down clips or other accessory items shall be furnished complete with same, whether the catalog numbers shown include such items or not.

I. Unless otherwise noted, fluorescent 3 or 4 lamp luminaires shall contain two (2) ballasts for two (2) level control of the fixture. Inside and outside lamps shall be on different switchlegs.

J. Luminaires shall be designed or gasketed to eliminate any light leaks.

K. Luminaires shall be designed such that ballast case temperature does not exceed 195 °F under the following conditions:

1. Line voltage: nominal rating ±5 %
2. Room ambient temperature: 77 °F ±5 %
3. Plenum ambient (where applicable): 130 °F ±5 %
4. Ceiling material R factor of 20 or less: ±5 %
5. Luminaire manufacturer shall supply thermal test data to show compliance with the above requirements.
2.2 EMERGENCY LIGHTING UNITS

A. Emergency lighting units shall be fully automatic AC/DC assemblies with sealed pure lead batteries and solid state chargers. Emergency lighting units shall have lamps as indicated. AC operating voltage shall be 120 or 277 volts as required to match area lighting. Lamps shall be extended life type.

2.3 EXIT SIGNS

A. Exit lights shall be self-contained, fully automatic AC/DC units with sealed pure lead battery and solid state charger. Exit lights shall have green letters on white. AC operating voltage shall be 120 or 277 volts as required to match area lighting. Lamps shall be LED type unless otherwise indicated on the drawings. Where lamps are the extended life type, luminaries shall include down-light feature.

2.4 FLUORESCENT BALLASTS

A. Fluorescent non-dimming ballasts:

1. Manufacturers: Motorola, or approved equal.
2. Description: Ballast shall be totally solid state, CBM certified by ETL with the following specifications:
   a. Power Factor, 0.95
   b. Total Harmonic Distortion, less than 10 %
   c. Total Third Harmonic Distortion, less than 6 %
   d. Transient Protection meeting ANSI C62.41, Cat. A and B (formerly IEEE 587)
   e. EMI meeting FCC Part 18, Subpart C
   f. Sound Rating, A
   g. Guarantee, five (5) years including replacement labor
   h. Lamp flicker, less than 2 %
   i. Lamp crest factor, less than 1.5
   j. Lamp current frequency, greater than 25 kHz
   k. UL listed, Class P.

3. Voltage: Match luminaire voltage.

B. Fluorescent non-dimming ballasts for T-4(twin, hex and quad tube compact fluorescent) lamps:

2. Description: Ballast shall be totally solid state, CBM certified by ETL, internally fused, and shall automatically turn off when the lamp is approaching end of life, with the following specifications:
   a. Power Factor greater than 0.98
   b. Total Harmonic Distortion, less than 10 %
   c. EMI meeting FCC Part 18, Subpart C
   d. Transient Protection meeting ANSI C62.41, Cat. A and B (formerly IEEE 587)
   e. Sound Rating, A
   f. Guarantee, three (3) years including replacement labor
   g. Lamp flicker, less than 3 %
   h. Lamp crest factor, less than 1.55
   i. Lamp current frequency, greater than 20 kHz
   j. UL listed, Class P
2.5 FLUORESCENT DIMMING BALLASTS

A. Fluorescent dimming ballasts for T-5, T-8, and T-12 lamps:

1. Manufacturers: Lutron FDB series or approved equal.
2. Description: Ballast shall be totally solid state, CBM certified by ETL with the following specifications:
   a. Power Factor greater than 0.95 and a ballast factor equal to 0.93
   b. Total Harmonic Distortion, less than 10 %
   c. EMI meeting FCC Part 18, Subpart C
   d. Transient Protection meeting ANSI C62.41, Cat. A (formerly IEEE 587)
   e. Sound Rating, A
   f. Guarantee, three (3) years including replacement labor
   g. Lamp flicker, less than 2 %
   h. Lamp crest factor, less than 1.6
   i. Lamp current frequency, greater than 25 kHz
   j. UL listed, Class P
   k. Dimming shall be smooth, continuous, and without flicker down to 1 % light level for T-12 and T-8 lamps (5 % for T-5 lamps).
   l. Ballasts shall be inaudible in a 27dB ambient throughout the dimming range.

3. Voltage: Match luminaire voltage.

B. Fluorescent dimming ballasts for T-4 (twin, hex and quad tube compact fluorescent) lamps:

2. Description: Ballast shall be totally solid state, CBM certified by ETL, internally fused, and shall automatically turn off when the lamp is approaching end of life, with the following specifications:
   a. Power Factor greater than 0.90
   b. Total Harmonic Distortion, less than 20 %
   c. EMI meeting FCC Part 18, Subpart C
   d. Transient Protection meeting ANSI C62.41, Cat. A (formerly IEEE 587)
   e. Sound Rating, A
   f. Guarantee, three (3) years including replacement labor
   g. Lamp flicker, less than 2 %
   h. Lamp crest factor, less than 1.6
   i. Lamp current frequency, greater than 25 kHz
   j. Light Stability vs. line voltage variation: 2 % variation over ±10 % line variation.
   k. UL listed, Class P
   l. Dimming shall be smooth, continuous, and without flicker down to 5 % light level.
   m. Ballasts shall be inaudible in a 27 dB ambient throughout the dimming range.

3. Voltage: Match luminaire voltage.

2.6 HIGH INTENSITY DISCHARGE (HID) BALLASTS

A. HID ballasts shall be as manufactured by Universal or Advance. Ballasts installed indoors shall be enclosed and potted. Ballasts installed outdoors may be core and coil type if installed in a weatherproof compartment of the luminaire. All ballasts shall have Bussmann HLR-GLR fusing. All ballasts shall have a minimum starting temperature of -20 °F and shall be capable of
maintaining lamp output with momentary voltage dips of 20%. Luminaire manufacturer shall supply test data to show compliance with all requirements. Fuse size shall be per manufacturer’s recommendations. Ballasts for recessed luminaires shall be thermally protected.

B. Metal halide ballasts shall be of the constant wattage auto-transformer type with minimum power factor of 90%. Maximum lamp current crest factor shall be 1.7.

C. High pressure sodium ballasts shall be of the constant wattage auto-transformer type with minimum power factor of 90%. Maximum lamp current crest factor shall be 1.5.

D. Ballasts and lamps shall be specifically selected for complementary operation.

E. Voltage: Match luminaire voltage.

2.7 PULSE START METAL HALIDE SYSTEM

A. Pulse start metal halide ballasts shall be specifically designed to operate the lamp specified. Pulse start ballasts shall be 277V linear reactor ballasts as manufactured by Advance. Ballasts installed indoors shall be encased and potted. All ballasts shall have Bussmann HLR-GLR fusing; fuse size shall be per manufacturer’s recommendations. Ballasts shall have a minimum power factor of 90% and a maximum lamp current crest factor of 1.46. Ballasts shall have a minimum starting temperature of -20 °F and shall be capable of maintaining lamp output with momentary voltage dips down to 200V. Luminaire manufacturer shall supply test data to show compliance with all requirements. Ballasts for recessed luminaires shall be thermally protected.

B. Pulse start metal halide lamps shall be specifically designed to operate with the ballast specified. Enclosed metal halide lamps shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Wattage</th>
<th>Avg. Life (Hours)</th>
<th>Initial Lumen</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>15,000</td>
<td>16,600</td>
<td>4000K</td>
</tr>
<tr>
<td>250</td>
<td>15,000</td>
<td>25,000</td>
<td>4000K</td>
</tr>
<tr>
<td>400</td>
<td>20,000</td>
<td>42,000</td>
<td>4000K</td>
</tr>
<tr>
<td>750</td>
<td>16,000</td>
<td>80,000</td>
<td>4000K</td>
</tr>
</tbody>
</table>

C. Open metal halide lamps shall contain a safety shroud and shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Wattage</th>
<th>Avg. Life (Hours)</th>
<th>Initial Lumen</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>15,000</td>
<td>15,800</td>
<td>4000</td>
</tr>
<tr>
<td>250</td>
<td>15,000</td>
<td>23,800</td>
<td>4000</td>
</tr>
<tr>
<td>400</td>
<td>20,000</td>
<td>40,000</td>
<td>4000</td>
</tr>
</tbody>
</table>

2.8 QUARTZ LAMP AUXILIARY SYSTEM

A. Cold Start Quartz Auxiliary System: Where specified, HID luminaires shall be furnished with auxiliary quartz tungsten halogen lamp re-strike system. Operation of re-strike system shall be as follows:

1. Normal Cold Start:
   a. Step 1 - Main and quartz lamp both energized.
b. Step 2 - When lamp reaches 40% of rated output, quartz lamp automatically extinguishes. (Note: The combined main and auxiliary lamp line current shall not exceed operating current of main lamp at 100% output).

2. Hot Start:
   a. Step 1 - When power is restored the quartz lamp will be energized and will remain so until the main lamp cools and re-strikes.
   b. Step 2 - Same as Step 2 above.

B. Hot Start Quartz Auxiliary System: Where specified, HID luminaires shall be furnished with auxiliary quartz tungsten halogen lamp re-strike system. Operation of re-strike system shall be as follows:

   1. Hot Start:
      a. Step 1 - When power is restored the quartz lamp will be energized and will remain so until the main lamp cools and re-strikes.
      b. Step 2 - When lamp reaches 40% of rated output, quartz lamp automatically extinguishes. (Note: The combined main and auxiliary lamp line current shall not exceed operating current of main lamp at 100% output).

C. Voltage: Match luminaire voltage.

2.9 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

A. Fluorescent luminaires indicated as emergency units shall be complete with an automatic battery pack assembly to operate one lamp. Installation shall be done at the luminaire manufacturer’s factory. Unit may be field installed if installation does not void UL label of battery pack or luminaire. Battery pack assemblies for T8 lamps shall provide an initial 1350 lumen, a minimum of 800 lumen of light output after 1½ hours of operation, and shall be equal to Bodine B50 series. Battery pack assemblies for 2-pin twin, quad, or triple twin tube lamps shall provide an initial 950 lumen (for 26W lamp), a minimum of 570 lumen of light output after 1½ hours of operation, and shall be equal to Bodine B426 series. Battery pack assemblies for 4-pin twin, quad, or triple twin tube lamps shall provide an initial 750 lumen (for 26W lamp), a minimum of 450 lumen of light output after 1½ hours of operation, and shall be equal to Bodine B94C series. Luminaire shall have valid UL label with battery-pack installed and be warranted for five years.

B. Include TEST switch and AC ON indicator light, installed to be operable and visible from the outside of an assembled luminaire.

2.10 LAMPS

A. Lamp Manufacturers: General Electric, Osram/ Sylvania, Philips, or approved equal. Metal halide lamps shall also be as manufactured by Venture Lighting. Where proprietary lamps are indicated by manufacturer’s name, they shall be furnished exactly as specified.

B. Unless otherwise noted on the fixture schedule, fluorescent lamps shall be T8 energy saving type producing approximately 2950 initial lumen equal to General Electric Trimline F32T8/SPX35.

C. Compact fluorescent biaxial lamps shall be T5 energy saving type with 4-pin bases producing approximately 3150 initial lumen (39 watt) or 4000 initial lumen (50 watt) equal to General Electric High Lumen Biax F40/30BX/SPX35.
D. Compact fluorescent twin tube lamps shall be T4 energy saving type producing approximately 600 initial lumen (9 watt) or 900 initial lumen (13 watt) equal to General Electric F9 or 13BX/SPX35/835.

E. Compact fluorescent triple tube lamps shall be T4 energy saving type with 4-pin bases with the following characteristics:

<table>
<thead>
<tr>
<th>Watts</th>
<th>Initial Lumen</th>
<th>Catalog No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>1200</td>
<td>PL-T-18/35</td>
</tr>
<tr>
<td>26</td>
<td>1800</td>
<td>PL-T-26/35</td>
</tr>
<tr>
<td>32</td>
<td>2400</td>
<td>PL-T-32/35</td>
</tr>
<tr>
<td>42</td>
<td>3200</td>
<td>PL-T-42/35</td>
</tr>
</tbody>
</table>

1. Lamps shall be as manufactured by Phillips, or approved equal.

F. Compact fluorescent quad tube lamps shall be T4 energy saving type with 4-pin bases producing approximately 1800 initial lumen (26 watt) or 1200 initial lumen (18 watt) equal to General Electric F26 or 18DBX/SPX35/4P.

G. Metal halide lamps shall be color corrected, phosphor coated type. High pressure sodium lamps shall be clear. All high intensity discharge lamps shall be designed for mounting positions as required by the luminaire in which they are installed and specifically selected for complementary operation with installed ballasts.

H. Mercury and metal halide lamps installed in open luminaires shall be the self-extinguishing type.

I. Reflector Lamp Beam Patterns shall be in accordance with ANSI C78.379 and the following beam patterns in terms of range for cone of light:

<table>
<thead>
<tr>
<th>Beam Pattern</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely narrow</td>
<td>0 to 4.9</td>
</tr>
<tr>
<td>Very narrow</td>
<td>5 to 9.9</td>
</tr>
<tr>
<td>Narrow</td>
<td>10 to 15.9</td>
</tr>
<tr>
<td>Spot</td>
<td>16 to 23.9</td>
</tr>
<tr>
<td>Narrow flood</td>
<td>24 to 34.9</td>
</tr>
<tr>
<td>Flood</td>
<td>35 to 49.9</td>
</tr>
<tr>
<td>Wide flood</td>
<td>50 to 64.9</td>
</tr>
<tr>
<td>Very wide flood</td>
<td>65 and up</td>
</tr>
</tbody>
</table>

J. Re-lamp fluorescent or HID fixtures if lamps exhibit color variation or burn out within 90 days of substantial completion.

2.11 LUMINAIRE POLES AND BOLLARDS

A. Provide poles, bollards, and poured in-place concrete bases as called for on the drawings. Poles shall be complete with anchor bolts and all required fittings, base covers, handholes and handhole closures. Pole bases shown on the drawings are for bidding purposes only. Pole bases shall be designed by a licensed structural engineer to withstand a wind force of 100 mph with 125 mph gusts. Submit pole base design with shop drawings for approval.

B. Pole finish shall be as noted on the drawings or if not so noted shall match luminaire. Aluminum poles shall be anodized. Steel poles shall have factory applied prime paint and two (2) coats of baked enamel finish paint. Furnish owner with one (1) pint of touch up paint for steel poles.
2.12 ACCESSORIES

A. Furnish wire guards for fixtures where specified.

   1. Guards for wall mounted fixtures (e.g. exit and emergency lights) shall be secured to the wall surface independently of the fixture itself.
   2. Guards for other fixtures shall be a product of the fixture manufacturer. Guards shall be removable without dismantling the fixture or reflector.

END OF SECTION 26 50 00
SECTION 27 05 28
TELECOMMUNICATIONS PATHWAYS

PART 2 - PRODUCTS

2.1 RACEWAY SYSTEM

A. Provide a 4 11/16 inch square × 2 1/8 inch deep box with single-gang device ring for each wall-mounted telephone/data outlet. Where outlets are mounted in concrete or masonry walls, provide a standard double-gang masonry box with single-gang device ring for each wall-mounted telephone/data outlet.

B. Provide 1 inch conduit from each wall-mounted telephone/data outlet to the nearest cable tray or nearest Telecommunications room. Provide 1 inch conduit from each wall-mounted telephone/data outlet to the nearest telephone terminal board, intermediate distribution frame or location indicated on the drawings.

C. Provide (2) 1 inch conduits from the floor boxes to telephone terminal board location, intermediate distribution frame or location indicated on the drawings.

D. Provide 2 inch conduit sleeves for penetrations through floors and fire rated walls.

E. Provide 2 inch conduit where required to provide a pathway for cables to cross from one area of accessible ceiling to another through an area where the ceiling space is inaccessible.

F. Telephone service conduit shall be 4 inch trade size, unless otherwise indicated. Bury conduit 24 inches below grade, minimum. All bends in service conduit shall be long-radius sweeps.

G. Provide plastic end bushings on all conduit terminations.

2.2 PLYWOOD BACKBOARDS

A. Backboards shall be exterior grade Douglas fir plywood, treated with fire retardant material, 3/4 inch thick and finished on one side.

B. Prime paint all surfaces and edges and finish paint the front with light gray enamel.

END OF SECTION 27 05 28
PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways and boxes per Section 27 05 28

END OF SECTION 27 53 13
PART 2 - PRODUCTS

2.1 CENTRAL WORK STATION HARDWARE

A. The “Central Workstation” is existing and shall not be modified under this contract unless specific changes/upgrades are required to implement the work specified herein.

2.2 FIELD HARDWARE

A. Network Router:

1. Network routers (NR) shall be provided to interface the existing campus network to Network Controllers (NC).
   a. Routers shall be TAC Xenta 527
   b. Rack mounting device shall be TAC Zenta 400

B. Network Controllers:

1. Network Controllers shall be provided to interface the network routers to the sub LAN interface (SLI) on which the Security Control Units (SCU) reside. Network Controllers (NC) shall be TAC 7798 I/Site LAN (SLI) and ViewCon. Provide network controllers as indicated on the Drawings.

2. Provide 5 custom pages on the ViewCon to include the following.
   a. All doors status.
   b. All points in each Controller LAN controller.
   c. All points in alarm in each Controller LAN controller

3. When not in use the ViewCon shall display the date and time.

C. Security Control Units (SCU)

1. Security control units (SCU) shall be provided to interface individual door controls with the network controllers. Security control units shall be TAC I/Net 1284 door processing units capable of handling four (4) reader inputs and controlling four (4) individual doors.

2. The SCUs shall be located in a NEMA-1 enclosure at the locations indicated on the Drawings and shall monitor and/or control all doors. Provide controllers sufficient to allow for connection of all monitored points, and future door connections, to be labeled “spare”. Unused I/O points on the SCUs may be used for auxiliary points not directly associated with the doors being controlled.

3. Each SCU shall support end-of-line resistor supervision on input circuits for door status monitoring. And annunciate whether the circuit is in “Alarm” or “Normal,” and whether the alarm is a “Short” or an “Open”. Each DPU shall monitor its enclosure for tamper alarm and monitor the battery for low charge conditions.

4. The SCU's and the system shall support multiple reader technologies, including I/DISC touch memory, Wiegand (26 and 32 bit), CSI magnetic Key, CSI magnetic card, proximity, ABA (track 2), Watermark Magnetics, PIN Pad and biometrics.

5. SCUs shall be connected to the network routers through the network controllers.
2.3 OPERATIONAL SEQUENCE

A. Exterior Zone

1. All exterior doors that are not emergency or “exit only” doors shall be fitted with all components that make up a “fully prepped” access controlled door, and shall function as specified herein. Note: A fully prepped door includes a reader, electrified exit device or electric strike, request to exit (REX), and a door position indicator switch (DPIS). Exit only doors shall have a request to exit (REX) and a door position indicator switch (DPIS). Both doors in a double door entry shall have electrified exit devices.
   a. When activated by passing a properly authorized card by the exterior reader, the associated door(s) shall unlock and remain unlocked for a preset (adjustable up to 60 seconds) time period to allow entrance into the building.
   b. Based on the building schedule, the following shall occur:
      1) If the access to the building occurs outside the preset building occupied hours, the doors shall relock and the exterior zone shall re-arm.
      2) If the access to the building occurs after the preset building open time and prior to the preset building closure time, (occupied hours), the doors shall remain unlocked and the exterior zone disabled.
      3) The building shall remain locked and the exterior zone remained armed until a properly authorized card activates the system. Subsequent activations of the exterior zone shall not change the status (i.e. unlocked and unarmed) until the occupied hours have elapsed.
      4) The exterior zone shall automatically lock and arm at the preset building closure time.

2. There shall be a card reader supplied as indicated on the drawings that is programmed to override the building time schedule for a preset (adjustable) time period. This reader shall be identified and mounted in such a way as to distinguish it from the other card reader(s) in the building.

B. Interior Zone:

1. Each Office shall be considered its own zone, and shall be armed as needed either by a time schedule or with activation/reactivation of the card reader.
2. Activation of the card reader at the office door shall disarm the system and release the lock or strike allowing entry.
3. Each zone shall automatically rearm upon reaching the building closure time, or expiration of the exterior zone override time.

C. Maintenance Zone:

1. Maintenance zones include mechanical and electrical rooms and the custodial room. These zones shall be programmed to always be armed. Activation of a card reader shall disarm the system and activate the lock or latch to allow entry. The zone shall rearm after a preset period, and the REX device shall allow exit without alarm. It shall be possible to program the sequencing for these spaces on a room-by-room basis to a sequence which disarms and then rearms the zone based only on activation/reactivation of the card reader.

2.4 SECURITY DEVICES

A. Note: All devices shall have their own home run to the head-end electronics.
B. Motion Detectors: Where shown on the drawings, provide Passive Infrared (PIR) motion detectors to detect intruder movement when building ACSS system is alarmed. PIR’s shall employ balanced dual-opposed sensing technology with multiple sensor zones and be resistant to false alarms due to environmental disturbance and RFI. Motion detectors shall not be wired in series. Each shall have its own home run.

C. Proximity Readers: Proximity readers shall be used for controlled entry and shall employ programmable technology for greater security and for use with cards with varying protocols. Readers shall be rated for outdoor use, and be UL-listed to meet the requirements of UL-294. A multi-color LED indicator shall be provided offering red, green and amber indications to show user the status of the read operation. Color shall be black and be designed to mount on a standard electrical handy box. Proximity card readers shall be HID ThinLine II. Proximity readers shall be wired with 8 conductor cables.

D. Door Position Switches: Provide magnetic door switches to detect door openings. Switch shall be designed for wide gap operation on metal doors, Sensor shall be a Sentrol 1076 or approved equal. Coordinate installation with the door and hardware suppliers to assure that the door frame is properly fabricated to receive the position switch.

E. Request-To-Exit (REX) Devices: Provide PIR-based motion detectors designed for access control to unlock doors when exiting areas. Detectors shall have narrow beam and be designed for access control applications only, (i.e., unit shall have narrow beam able to be focused across door only to eliminate false tripping due to personnel walking by area). The REX devices shall be a DS 150i Series Request to Exit PIR Sensor as manufactured by Detection Systems, Inc. or approved equal.

F. Electric strikes and/or locks and exit devices: The electrified hardware devices are provided under Division 8 Sections. Coordinate the installation of these devices to tie them into the system to provide the functionality and meet the sequencing specified. It shall be the responsibility of the security system installer to verify the proper type, model, handing, and operation of all hardware that must interface with the security system. Failure to coordinate device connections and interfaces prior to their incorporation into the Work shall result in the removal and replacement of the Work at no additional cost to the Owner.

G. Automatic Door Openers: The ADA openers shall be interfaced with the access control system. All devices associated with the opener shall have their own home run to the head-end electronics, i.e.: Push Pads and the door opener Trigger. This will allow the access control system to have complete control over the opener operation.

END OF SECTION 28 13 00
SECTION 28 23 05
TELEVISION DISTRIBUTION SYSTEM

PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways and boxes per Section 27 05 28.

END OF SECTION 28 23 05
PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways as specified in Section 26 05 30.

B. Boxes as specified in Section 26 05 32.

C. Cables as indicated on the drawings.

D. Ceiling mounted Speakers:

1. Speakers shall have:
   a. 80-wattts continuous program power
   b. 70-volt line-matching transformer
   c. 130-degree conical coverage
   d. 16-ohm nominal impedance
   e. Steel back can and white baffle.

2. Speakers shall be JBL 24CT.

END OF SECTION 28 23 40
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Edwards System Technology (EST-3) series.

B. Fire alarm system equipment is included in this Section to provide the Contractor with an understanding of the type of equipment the Owner plans to furnish and install.

2.2 CONTROL PANEL

A. Edward System Technology, Model EST-3.

2.3 INITIATION DEVICES

A. Manual Stations:

1. Edwards SIGA-278 series.

B. Multi-Sensor Detectors:

1. Ceiling or area type smoke/heat detectors shall be EST #SIGA-PHS.
2. Ceiling or area type heat detectors shall be EST #SIGA-HRS.
3. Duct smoke detectors shall be EST #SIGA-SD.

C. Duct Smoke Detectors

1. Duct smoke detectors shall be EST #SIGA-SD with air sampling tube of sufficient length to traverse the duct in which they are installed.

D. Fire Sprinkler System Monitoring

1. Monitoring modules shall be EST #SIGA-CT1/2.
2. Flow switches shall be UL-04 listed vane type water-flow switch with adjustable retard, enclosed cast aluminum housing, tamper resistant hardware and (2) single-pole double throw snap action switches.
   a. Acceptable Manufacturers:
      1) Potter VSR-F and VSR-SF
      2) Notifier
      3) Grinnel.

3. Tamper Switches shall be UL-04 listed weatherproof unit with formed steel base, die-cast aluminum cover, red spatter enamel finish, tamper resistant hardware and (2) single pole double throw snap action switches.
   a. Acceptable Manufacturers:
      1) Potter PCVS or PIVSU-A
      2) Notifier
      3) Grinnel
2.4 NOTIFICATION DEVICES

A. Audible alarm devices:
   1. Speaker/Strobes shall be EST Genesis Series – White

B. ADA strobe lights (visual alarm):
   1. Visual alarm signals shall be wall mounted EST Genesis Series – White

2.5 PERIPHERAL DEVICES

A. Annunciator:
   1. Edwards System Technology Model LCD-ANN with microphone and framed, colored building floor plan(s) mounted adjacent to annunciator.

B. Network Devices
   1. Network devices shall consist of (2) each NETCOM-IS Ethernet device server network interfaces in each new fire alarm control panel(s).

C. Heat Detectors in Elevator Shafts and Mechanical Rooms:
   1. Fixed temperature, 57 degrees C (135 degrees F), non-addressable, dual contact. One contact shall be used to shunt-trip power to the elevator machinery and controls; the other shall be connected to an addressable monitoring module.

D. Exterior Bell:
   1. Heavy-duty vibrating type, with yard hood design for use outside.

E. Fire Suppression Inert Gas System:
   1. Control modules for interface shall be EST #SIGA-REL.

2.6 WIRE AND CABLE

A. Provide wire and cable as indicated on the Drawings and the approved shop drawings provide by ECS.

B. All wire and cable shall be approved for Fire Protective Signaling Circuit use.

C. Addressable loop cable shall be #16 AWG twisted-pair cable with overall jacket as required by manufacturer's recommendations. Minimum acceptable quality shall be West Penn or engineer approved equivalent. Speaker cable and RS-485 cable shall be #16 AWG twisted-pair cable with overall shield and jacket as required by manufacturer's recommendations. Minimum acceptable quality shall be West Penn or engineer approved equivalent. Wire for strobes shall be #14 AWG. Other wire shall be #14 AWG minimum, except power wiring shall be #12 AWG minimum.

2.7 MANUFACTURERS

A. All fire alarm equipment will be Edwards System Technology (EST), EST-3 Series.
END OF SECTION 28 31 10