INDEX TO ELECTRICAL SPECIFICATIONS

DIVISION 26 – ELECTRICAL

END OF INDEX

SECTION 26 01 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 SUMMARY

A. The work described in this specification applies to two (2) buildings:

- Morristown Middle School
- Waterville High School and Elementary

B. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 26.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Divisions 21, 22, 23, 25, 26, 27 and 28 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Divisions 21, 22, 23, 25, 26, 27 and 28 Contract Documents to determine where these composite crews are required.
4. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project.
5. Pay all fees and costs charged by utility company for installation of temporary utility services.
6. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
7. Pay all fees and costs charged by utility companies for utility services.
8. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
9. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
10. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

C. Commissioning – Mechanical and electrical systems on this project will be commissioned by an independent commissioning agent. Scope of electrical work includes, but is not limited to the following:

1. Attending all commissioning meetings.

2. Verifying electrical connections and operation of commissioned systems, including but not limited to lighting, electrical distribution, fire alarm, security and low voltage systems.
3. Measuring, testing and documenting statuses of components within the scope of mechanical and electrical commissioning.
4. Demonstrating electrical systems to the Owner and commissioning agent.
5. Correcting Work as indicated by the Commissioning agent if also directed by the Engineer.
6. Providing written reports and test reports as indicated in specific specification sections.

D. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 26 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 26 01 00 takes precedence. Section 26 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.
2. Division 0 and 1 and Section 26 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 26 work. Copy these documents to all Sub-contractors receiving other Sections of Division 26.
3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.4 UNIT PRICES

1. Refer to Bid Form and Instructions to Bidders.

1.5 ALTERNATES

A. Refer to Bid Form and Instruction to Bidders.

1.6 ALLOWANCES

A. Refer to Allowances in Division 0.

1.7 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations

State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers
ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories
EIT/TIA Standards: Commercial Bldg Telecommunications wiring and spaces.
BICSI: Building Industry Consulting Services International.
NECA: National Electrical Contractors Association

1.8 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in the 2007 AIA Document A201: "The term 'Work' means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project."
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.
5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.

9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.9 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

H. Comply with NECA, NEIS (National Electrical Installation Standards) for workmanship and installation requirements.

1.10 SUBMITTALS

A. Refer to section 26 01 05, Submittals, Closeout Documents, Training and Spare Parts.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and casual site observations, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.

2. Install all conduit, cable tray, busduct, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.

3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.

4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.

6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.

7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.

8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.12 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Provide UL listed components installed by a certified and factory trained personnel.

1.13 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 TAMPERPROOF HARDWARE

A. Where tamperproof hardware is called out, provide torx head with center pin reject hardware for the following electrical work:

1. Light fixture housings

2. Covers to electrical enclosures, pullboxes, cabinets, junction boxes, wireways
3. Coverplates (both maximum security and stainless steel coverplates)

2.2 SLEEVES

A. Provide Schedule 40 galvanized steel pipe sleeves 1 ½" larger than O.D. of pipe that adhere ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Provide minimum of three (3) concrete anchors for Schedule 40 pipe sleeves.

D. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-selection rectangle perimeter less than .50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter equal to, or more than .50 inches and 1 or more sides equal to, or more that 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Rectangular Pathways:

1. 4" x 4-5/8" nominal pathway cross section with accommodations for wall thicknesses up to 20".
2. UL tested and classified in accordance with ASTM E814 (UL1479).
3. Fire and smoke sealing system that automatically adjusts to the amount of cables installed.
4. Manufacturers:
   a. Specified Technologies Inc. (STI), "EZ-PATH 44".
   b. Approved equal.

PART 3 EXECUTION

3.1 CONSTRUCTION LIGHTING & POWER SYSTEM – REMODELING

A. Provide construction power and lighting that adheres to 2014 Article 590 – "Temporary Installations"

B. See Division 1 for temporary electrical services.

C. For remodeling work in the existing building, use existing building distribution systems for construction power.

D. Replace all receptacles, switched, coverplates, etc., damaged by any Contractor during the course of construction.

E. Materials furnished for the temporary light and power system remain Contractors property. Remove when there is no longer any need for temporary light and power or when directed by the Architect.

F. Electrical energy costs shall be paid by the Owner.

3.2 PREPARATION

A. Continuity of Service:

1. No Division 26 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.
2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.
3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.
2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.3 INSTALLATION

A. Material and Workmanship:

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the electrical system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.
2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.
3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.
4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed under a different Division.
2. Obtain special permission from the Engineer before cutting structural members or finished material.
3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:

1. Refinish all electrical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Sleeves:

1. Set all sleeves true to line, grade and position and plumb or level after concrete is poured. Correct any deviation from proper position.
2. Caulk spaces between pipe and floor sleeves inside the building with a waterproof caulking material. Caulk spaces between pie and exterior partition sleeves with glass fiber insulation.
3. Tighten sleeve seal nuts until sealing grommets have expended to form watertight seal.
4. Furnish sealable penetration pockets compatible with the building roofing system where conduits pass through the roof. Turn pockets over to the General Contractor.
5. Provide fire barriers around conduit, pipe, tubing, bus ducts and cables passing through smoke and fire rated floors and walls. Provide CP 25, 303, and PSS7904 Series by 3M, or “flame-Safe” system by Thomas and Betts Corp for fire seals.
6. Subject to compliance with requirements, provide water-tight seals by Thunderline or pre-approved equal.

F. Structural Bracing:

1. Refer to Architects and Structural Engineer drawings for cross bracing within sheetrock walls. The electrical contractor is required to route conduit and conduit stubs to avoid bracing.

3.4 FIRESTOPPING

A. Provide firestopping around all new penetrations, sleeves and openings through all partitions, walls and floors.

B. Install firestopping on both sides of each partition, completely filling the void around the opening.

C. Firestopping of interior of conduits and sleeves is by the contractor providing the cabling inside the conduit or sleeve.

3.5 FIELD QUALITY CONTROL

A. Testing: Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems.

B. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.6 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.7 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

3.8 FINAL OBSERVATION

A. A final observation of the electrical systems by the Architect/Engineer will be conducted before the contract can be considered complete. The Contractor shall inform the Engineer when the electrical installation is complete and ready for final observation. The Engineer shall visit the project and provide a list of items that need to be corrected or completed to achieve final completion. Should the Engineer attaend the project to conduct the final observation and discovers that the work is not sufficiently complete to perform this task, then the contractor shall compensated the Engineer for this time. The Contractor shall remain responsible for completing their work and requesting the Engineer to return for a final observation.

B. Submit Form 310 for Substantial Completion to the Engineer before Architect/Engineer visits site.

SUBMISSION FOR SUBSTANTIAL COMPLETION – FORM 310

Project:_____ Project Number:_____

Date:_____

Owner:_____ Contractor:_____

_____ (Contractor) is requesting substantial completion for part or all of the work on the above named project. The project is at a stage where the work within the contractor is sufficiently completed so the Engineer can make a final observation of the work and the owner can occupy. Once the Engineer has made a final observation of the project, a Certificate of Substantial completion will be filled out by Architect/Engineer and copies returned to the Owner and Contractor.

Sufficiently complete indicates that the mechanical and electrical systems are functional and all major equipment is in place and operational, with only minor items remaining incomplete. A list of items incomplete shall be listed below. All punchlists and issue tracking forms shall be completed and returned by the contractor(s) within 30 days of substantial completion. If items are found to be incomplete during the re-verification process, the contractors will be charged for the time spent by the Owner, Design Team, and Commissioning Agent, until the issues are resolved.

The electrical checklist shall accompany this form.

_____	_____	_____
Contractor Representative Name	Signature	Date

END OF SECTION

SECTION 26 01 05

SUBMITTALS, CLOSEOUT DOCUMENTS, TRAINING AND SPARE PARTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 PRIOR APPROVALS

A. Submit approval form for each request for prior approval.

B. Submit hard copy, bound, written requests to use unspecified items, to the Engineer, no later than ten (10) calendar days prior to the bid opening. Submit detailed information for proposed material or equipment specific to the project, clearly indicating all options included in the submittal.

C. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

D. Contractor is responsible for dimensional differences, electrical requirements and any other resulting changes, when using accepted substitutions. Contractor is responsible for any additional costs incurred as a result of substitutions, including other contractors and Architect/Engineer fees.

E. Material and equipment not specified or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

1.4 PAY REQUEST COST BREAKDOWN

A. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.

B. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or requested by the Engineer.

1. General Conditions
2. Demolition
3. 600 V Conductors and Cables
4. Raceway, Fittings, and Boxes
5. Occupancy Sensors, Daylight Sensors
6. Transformers
7. Distribution Panelboards
8. Panelboards
9. Wiring Devices
10. Safety Switches
11. Motor Control Equipment

12. Surge Protection Devices
13. Gym Area Lighting Control Systems
14. Light Fixtures – exterior and interior
15. Lamps & Ballasts
16. LED Lamps and Drivers
17. Emergency Lighting
18. Exit Signs

1.5 SHOP DRAWINGS AND SAMPLES-ELECTRONIC COPY

A. Submit in accordance with the Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.

B. Submit separately-compiled electronic documents in PDF format for each submittal listed in the table at the end of this section. Combination submittals will be returned to the contractor without review. Do not combine submittals.

C. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacture, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.

D. Where equipment wiring diagrams, floorplans, equipment arrangements, etc are specified as required submittals in individual specification sections, provide contractor-created documentation. Scans, copied reproductions, etc of Engineer's drawings are unacceptable and will be rejected without review.

E. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.

F. Submit all shop drawings electronically using the established file transfer system in place as part of this project. Coordinate distribution with General Contractor, other team members, etc.

G. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.

H. Shop Drawings will be reviewed by the Engineer who will attach a review letter pdf with submittal comments and with one of the following actions checked on the submittal stamp:

1. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.

2. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

3. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.

4. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

I. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

J. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

K. Refer to the end of this section for list of Shop Drawings required for this project.

L. Provide all order service, commissioning, shop drawing preparation, on-site field-service and testing, etc. for all electrical equipment and materials through local representation.

1.6 CAD DRAWING FILES:

A. The electrical CAD drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.7 DEMONSTRATION / TRAINING

A. Fully lubricate, charge, fill, etc. all equipment, per manufacture's recommendation, prior to start-up.

B. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final inspection and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

C. Fully instruct the Owner's designated operating in the operation of each electrical system at the time it is put into service. Provide instruction using competent instructors and factory-trained personnel.

D. Include documentation of instructions in the Operation and Maintenance Manuals.

E. Obtain a written statement from the Owner that his designated personnel have been instructed.

F. Refer to the end of this section for training requirements for each system

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriate marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer's warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.

5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Adjustable circuit breaker and ground fault settings and field-testing procedures.
10. Local equipment suppliers/reps names, addresses, and telephone numbers.
11. Equipment manufacturers names, addresses, and telephone numbers.
12. Sub-contractors names, addresses, and telephone numbers.
13. Refer to individual Sections in Division 26 for additional requirements.
14. Test reports.

1.9 RECORD DRAWINGS

A. Provide record drawings in accordance with the requirements of Division 0, Division 1 and this section.

B. Preparation of as-built drawings does not constitute authorization to make changes unknown to or unapproved by Owner or the Owners representative.

C. As work progresses, in a neat and legible manner, record the following information on the record set of plans:

1. Update the contract documents to show all modifications including but not limited to Addendums, Change Orders, approved Proposal Requests and Architect's Supplemental Instructions. Cut and paste original documents to the as-built set.
2. Indicate exact location and depth of underground feeders to panelboards, transformers, distribution panels, generators, complete from each end. Indicate the routing of the conduits as accurately as possible, showing elbows, sweeps, and turns.
3. Provide plans that indicate exact routing of outside underground feeders and services, showing dimensions from structural foundation walls or columns. Indicate depth and type of conduits.
4. Provide plans that indicate routing of conduit from outlet to outlet, routing of conduit underfloor, overhead, in walls or exposed, combining of circuits into a common conduit, exact sizes of conduits and conductors, revisions to circuit breaker quantity or arrangement in panelboards.
5. Record exact location and elevation of underground conduits dedicated to technology systems including backbone fiber conduits, telephone conduits and cable TV conduits. Where spare underground conduits are terminated underground (i.e. property line), indicate exact dimensions from two different points of the foundation wall corner or structural columns.
6. Indicate exact locations and depth of spare conduits stubbed from concrete pole bases.
7. Record routing of cable tray where it varies from the plans.
8. Record changes to branch circuit numbers on the plan when they deviate from the circuit numbers shown on the Contract Documents.
9. Include the locations of the following devices on the record drawings:

a. Emergency Lighting Relays (Section 26 09 25) mounted above ceilings.

b. Occupancy Sensor Power Packs (Section 26 09 23) mounted above ceilings.

c. Daylight Sensor Power Packs (Section 26 09 24)

D. The Engineer will recommend withholding payment if as-built drawings are not being maintained on-site.

E. Submit record drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

1.10 DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Construction Documents

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 150DPI Color

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Specifications

a. PDF Creation: All specifications shall be scanned or converted to one single PDF file.

1) Scanning:

i) 150DPI Color

b. Bookmarking: Not required.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

3. Operation and Maintenance Manuals
   a. O & M's shall be turned over by the Contractor.
   b. PDF Creation: All Operation and Maintenance Manuals shall be scanned or converted to one single PDF file.
      1) Scanning:
         i) 150DPI Color
   c. Bookmarking: Bookmarking of O & M Manuals shall be extensive.

1.11 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect unless a longer warranty period is specified in the individual specification sections or indicated in the forms table included in this section.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specifically called for.

E. Refer to the end of this section for a list of specific warranty items for each system.

1.12 FORMS

Section	Equipment	Shop Dwgs Req'd?	Warranty (all 1-year unless noted otherwise)	Owner Training	AHJ Cert. Req'd?	System Testing and report required?
26 05 19	Wire and cable	Yes		No	No	Yes
26 05 33	Surface Raceway	Yes		No	No	No
26 05 34	Technology Raceway System	Yes		No	No	No
26 05 50	Floorboxes	Yes		No	No	No
26 09 23	Occupancy Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 09 24	Daylight Sensors	Yes	1 Yr parts &labor 5 Yrs sensor	2 Hrs	No	Yes
26 24 16	Distribution Panelboards	Yes		No	No	No
26 24 16	Panelboards	Yes		No	No	No
26 27 26	Dimmers	Yes		No	No	No
26 27 26	Wiring Devices	Yes		No	No	Yes
26 28 13	Low Voltage Fuses	Yes		No	No	No
26 28 16	Safety Switches	Yes		No	No	No
26 29 13	Combination Starters	Yes		No	No	No
26 29 13	MSS	Yes		No	No	No
26 29 13	Overload Relays	Yes		No	No	No
26 29 13	Phase Monitoring Relays	Yes		No	No	No
26 29 13	Starters	Yes		No	No	No
26 51 13	Ballasts	Yes	5 Yrs	No	No	No
26 51 13	Lamps	Yes		No	No	No
26 51 13	Light Fixtures	Yes		No	No	No
26 52 00	Emergency Lighting	Yes	Unit Equip:3 Yrs Battery Ballasts:5 yr	No	Yes	No
26 53 00	Exit Signs	Yes	5 Yrs Unit / 10 yrs Pro-rated battery, lifetime LED	No	Yes	No

END OF SECTION

SECTION 26 01 10

SELECTIVE ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Sections 26 01 00 and all references contained therein form a part of this Section of the Specifications.

B. This Section includes all labor, material, equipment and services necessary and incidental to complete all the selective and or complete demolition and removal of electrical systems in the areas of remodeling or affected by remodeling, and the rework and extension of electrical systems indirectly affected by electrical system served "downstream" from the demolished electrical systems.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the building to determine actual conditions and extent of work prior to bidding the project. Refer any unclear details or conflicts to the Architect/Engineer for clarification prior to bidding the drawings.

B. Verify that field measurements and circuiting arrangements are as shown on Drawings.

C. Verify that abandoned wiring and equipment serve only abandoned facilities.

D. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Coordinate phasing of the demolition work with the construction sequence schedule.

B. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

C. Coordinate utility service outages with Utility Company.

D. Identify and provide new supporting means for existing electrical equipment such as low voltage cabling, conduits, boxes, pullboxes, conduit bodies, and conduit racks that will need additional support due to the demolition of the existing supports, including ceilings.

E. Erect, and maintain temporary safeguards, including warning signs and lights and barricades for protection of the public, Owner, Contractor's employees, and existing improvements to remain.

F. Provide temporary emergency lighting and illuminated exit signage as required by the Building Official or AHJ.

G. Electrical Service: Maintain existing system throughout construction in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify and obtain permission from Owner, Architect/Engineer at least 24 hours before partially or disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

H. Conduct demolition to minimize interference with adjacent and occupied building areas.

I. Perform noisy work before or after the Owner's working hours to minimum disruption.

J. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish electrical systems in walls, floors, and ceilings identified to be demolished.

B. Demolish and extend existing electrical work under and this Section or as indicated on the Drawings. Remove devices, conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

C. Remove, relocate, and extend existing installations to accommodate new construction or to maintain systems downstream from demolished area.

D. Provide supports for all existing electrical equipment that was supported previously by demolished walls, floors, ceiling or other structures. Provide new supports from structural members not slated for demolition, prior to any demolition.

E. Owner reserves the right of first refusal to obtain material shown to be removed under this contract. Items not retained by the Owner become the property of the Contractor and must be removed from the premises.

F. Demolish and remove all electrical systems indicated for demolition. No portion of these systems may be abandoned in place.

G. Remove abandoned wiring to source of supply.

H. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit in walls, floors, or columns back to a point where patching can be adequately performed and patch surfaces.

I. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

J. Disconnect and remove abandoned panelboards and distribution equipment.

K. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

L. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

M. Repair adjacent construction and finishes damaged during demolition and extension work.

N. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

O. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. Relocate and reroute conduit and wiring as required for conduit concealed in walls or structure being altered as part of the remodeling. Maintain continuity to all devices in and downstream of remodeled work.

P. Reroute existing raceway and wiring which is exposed due to removal of existing construction. Conceal new raceway and wiring and maintain operation.

Q. If conductors are required to be removed from existing raceways, install with new conductors.

R. Provide new coverplates throughout the remodeled areas.

S. Dispose of fluorescent lamps, ballasts, and other hazardous materials in accordance with State and Federal regulations.

T. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finish. Cut embedded support elements flush with walls and floors. Patch surfaces.

3.4 EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Reuse breakers if possible. Provide new breakers for new equipment unless breakers are specifically noted on the plans to be reused.

B. Tag unused circuits as spare and turn breakers and/or switches off.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits have been modified or rewired.

F. Where existing panels are indicated to be demolished, extend any remaining live circuits to the nearest suitable panelboard.

3.5 CLEANING AND REPAIR

A. Prior to reinstallation of used equipment, thoroughly inspect each item and report any defects to the Engineer/Architect in writing. Instructions for corrective measures will be given at the time and the Contract amount adjusted accordingly. If no defects are reported, the material will be included under the contractor's one year guarantee.

B. Warranty as outlined in Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

D. Luminaries: Where existing luminaries are indicated to be re-used, remove existing luminaries for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace non-functioning ballasts, and broken electrical parts. Provide new lamps.

E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.6 INSTALLATION

A. Install relocated materials and equipment as indicated on the drawings.

END OF SECTION

SECTION 26 01 20

TESTING AND ADJUSTMENTS TO ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 20: Testing and Adjustments to Electrical Systems

1.3 DESCRIPTION OF WORK

A. Testing of electrical systems.

B. Submissions of reports of tests.

PART 2 PRODUCTS

2.1 MATERIALS

A. Miscellaneous testing equipment as detailed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Test the equipment and systems and demonstrate their proper operation to the Engineer.

1. Do not test equipment until it has been fully prepared, connected, and made ready for normal operation. Repair any equipment damaged by improper operation or testing at no cost to the Owner, before final inspection and acceptance.

3.2 LIFE SAFETY LIGHTING SYSTEM TESTING

A. Unit Battery Equipment Testing

1. Test all emergency light fixtures and the Lighting Control Equipment to ensure proper operation during a normal power outage. Coordinate with the generator testing.

2. Simulate a power outage at each emergency light by turning off the normal power lighting circuit and observing the operation of the battery, and the observe the lighting be energized in the room or area. Verify that the toggle switch in the same room or area cannot turn OFF the emergency lighting as long as the normal source is not present.

3. Simulate a power outage at the lighting control panel(s), and observe that the emergency relays are forced ON, energizing the life safety light fixtures controlled by the lighting control panel(s).

B. Battery Ballast Testing

1. Test all emergency lights with integral battery ballasts and the Lighting Control Equipment to ensure proper operation during a normal power outage. Coordinate with the generator testing.

2. Simulate a power outage at each emergency light by turning off the normal power lighting circuit and observing the operation of the battery, and the observe the lighting be energized in the room or area. Verify that the toggle switch in the same room or area cannot turn OFF the emergency lighting as long as the normal source is not present.

3. Simulate a power outage at the lighting control panel(s), and observe that the emergency relays are forced ON, energizing the life safety light fixtures controlled by the lighting control panel(s).

C. A full functional test of all emergency lighting systems will be made in the presence of the Engineer.

D. Provide a certification of verification with the operating and maintenance manual confirming that the emergency lighting system has been tested and functions correctly and conform to all local codes.

3.3 FEEDER TESTING

A. Megger all lighting and power circuit feeders. If insulation resistance on any circuit is less than 1 megohm, such circuits are to be considered defective and must be replaced. Submit test results for each phase of each feeder from the output report files of the tester. Document all readings and submit to the Engineer.

3.4 OVERALL ELECTRICAL SYSTEM

A. Conduct voltage tests at the time of energization of the distribution system, in the presence of the Engineer and carry out such corrective measures as may be required.

B. Adjust all systems and leave in proper operating condition.

C. Test all wiring and leave free of defective installation and unintentional grounds.

D. Balancing Three Phase Loads

1. Prior to turning the building over to the Owner turn on all equipment in the building including lighting and with an amprobe, read the current drawn on each hot leg of feeder supplying each distribution panel. If the current in any one leg varies more than 5% (plus or minus) from the arithmetic average of the current in all the hot legs, reconnect the branch circuits to obtain a balanced loading.

3.5 GROUNDING ELECTRODE TESTING

A. Perform ground resistance testing in accordance with IEEE 142 at the main service grounding electrode.

3.6 OCCUPANCY SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each occupancy sensor to insure proper operation.

B. General rooms and offices: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the room, but not so sensitive to trigger the lights on from motion outside the room.

C. Corridors and hallway: Set the time delay to OFF as indicated in the sequence of operations on the drawings. Set the sensitivity of each device to trip the lights ON from anywhere in the corridor/hall.

D. For dual technology sensors, set the sensor to maintain an ON condition if either technology is triggered from within the room after an initial ON. Set the device to initiate an ON condition only if both technologies sense motion from within the room.

E. Test all operational features of the system at this time.

F. Where required, make appropriate correction(s) and adjustments.

3.7 DAYLIGHT SENSOR TESTING

A. Upon completion of the installation phase, test and adjust each daylight sensor to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Specific adjustments:

1. At night (or with the shades closed) set a digital light meter at floor level, and while increasing the light level in the space, set the ON, OFF and deadband footcandle setpoints to the levels specified.

E. Repeat adjustments for all spaces.

3.8 LIGHTING CONTROL SYSTEM TESTING

A. Refer to specific section for requirements.

END OF SECTION

SECTION 26 05 19

600 VOLT CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. This section includes these materials as defined by the 2014 NEC:

1. Multi-Wire Branch Circuit: (NEC Article 210.4)
2. Conductors for General Wiring (NEC Article 310)
3. Metal Clad Cable: Type MC (NEC Article 330)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Provide copper conductors with 90ºC insulation system, 600 volt rating, U.L. approved and listed for specific application. Aluminum conductors are not allowed

B. Indoor, dry location, single conductor, insulated wire.

1. Provide THHN, THHW, THWN-2, XHHW, XHHW-2 insulation.
2. No. 12 AWG and No. 10 AWG or smaller: Provide solid conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

C. Underground or wet location, single conductor, insulated wire.

1. Provide THHW, THWN-2, XHHW, XHHW-2 insulation
2. No. 12 AWG and No. 10 AWG: Provide solid or stranded conductors.
3. No. 8 AWG and larger: Provide stranded conductors.

D. Provide conductors for other systems as specified in the section in which they are described.

E. Provide minimum No. 12 AWG conductor size, unless noted otherwise.

F. Class 1 Control Circuits: Type THHN-THWN, in raceway.

G. Class 2 Control Circuits: Type THHN-THWN, in raceway.

H. Acceptable manufacturers

1. Southwire
2. Essex

3. General Cable

I. Copper Conductors: Comply with NEMA WC 70

PART 3 EXECUTION

3.1 CABLE CONDUCTOR INSTALLATION

A. Encase all conductors in a continuous raceway system.

B. Examine all conductor before installation. Do not use any conductor with insulation that is damaged in any way.

C. Do not pull conductor into the conduit until the conduit system is complete. Pull all conductors into raceway at the same time.

D. Route one A phase conductor and one B phase conductor and one C phase conductor (and neutral and grounding conductors if applicable) within the same raceway for each of the parallel raceways. Provide identical length conductors for all phases and neutrals for each parallel feeder.

E. Test all cable and wire for continuity and for shorts prior to energizing any circuits.

F. Provide separate hot, neutral and ground conductors for each circuit wired to Technology Panelboards.

G. Provide separate hot and neutral conductors for each multi-conductor branch circuit. Do not share neutral conductors.

H. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Provide conductors color coded as follows:

1. 208/120 Volt Systems
    a. Phase A - Black.
    b. Phase B - Red.
    c. Phase C - Blue.
    d. Neutral - White.
    e. Ground - Green.
2. 480/277 Volt Systems
    a. Phase A - Brown.
    b. Phase B - Orange.
    c. Phase C - Yellow.
    d. Neutral - Gray.
    e. Ground - Green.

K. All Conductors are No. 12 AWG copper unless indicated or specified otherwise.

L. All conductor sizes indicated on the drawings are based on copper conductors. Do not substitute smaller conductors with higher temperature rated insulation.

M. Maximum number of conductors in raceways and boxes shall conform to the requirements of the National Electrical Code. Neatly trim and lace wiring inside boxes, equipment, and panels.

N. If copper-clad aluminum, or aluminum alloy conductors are used in lieu of copper conductors, the conductor size must be adjusted to provide equal or greater ampacity of the conductor indicated. This adjustment shall be based on using the ampacity for the equivalent insulation of the conductor indicated.

O. If copper clad Aluminum or aluminum-alloy conductors are used, all raceways must be adjusted to accommodate increased conductor sizes.

P. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.2 SPLICES, TAPS AND TERMINATIONS

A. Splices to feeders and service entrance conductors are not permitted unless specifically noted on the plans.

B. Provide "pigtail"type splices and taps in conductor No. 8 AWG and smaller. Use "wire-nut" self insulating connectors.

C. Use pressure or compression type connectors for all splices or taps in copper conductors.

D. Do not splice conductors of dissimilar metals together.

E. Use only compression type connectors for all splices, taps, and terminations using copper-clad aluminum or aluminum alloy conductors.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

G. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

3.3 ADJUSTING AND TESTING

A. Test all wiring and leave free of defective installation and unintentional grounds.

B. Refer Section 26 01 20: “Testing and Adjustments to Electrical Systems”.

END OF SECTION

SECTION 26 05 24

CONNECTIONS TO EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

B. This section is a Division-26 Basic Electrical Materials and Methods section, and is part of each Division 21, 22, 23, 25 and 26 section making reference to electrical connections for equipment specified herein.

1.2 DESCRIPTION OF WORK

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:

1. From electrical source to motor starters.
2. From motor starters to motors.
3. To lighting fixtures.
4. To lighting control system terminations and control devices.
5. To temperature control equipment.
6. To miscellaneous equipment forming part of other divisions.

C. Make electrical connections to all motors, appliances and other equipment and the associated control devices in accordance with the schedules on the drawings and as hereinafter specified.

1. In each case verify connections and physical data from approved shop drawing, manufacturers' wiring diagrams and/or detail drawings provided by relevant trade subcontractor.
2. Make connections to all motors and equipment furnished and set in place by others. Provide starters, manual controls and auxiliary equipment where indicated in schedules and specified herein. Provide all disconnect switches as indicated in schedules, specified herein and required by code.

D. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division 21, 22, 23, 25 and 26 sections, and are work of this section.

E. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division 26 sections.

F. Refer to Division 21, 22, 23 and 25 sections for connection requirements for temperature control equipment.

G. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

H. Electrical identification for wire/cable conductors is specified in Division 26 section, "Electrical Identification".

I. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 26 sections.

J. Refer to sections of other Divisions for specific individual equipment power requirements.

1.3 QUALITY ASSURANCE

A. Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

B. Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.

C. Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are listed and labeled by nationally recognized testing laboratories.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Provide complete assembly of materials, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations for each electrical connection indicated.

B. Raceways and Fittings:

1. Provide raceways and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Provide products complying with Division 26 basic electrical materials and methods section "Raceways".

C. Conductors, Cables and Connectors:

1. Provide wires, cables, and connectors complying with Division 26 basic electrical materials and methods section "Wires and Cables".

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

H. Provide flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes”

I. Fasten identification markers to each electrical power supply wire/cable conductor in accordance with “Section 26 05 53: Identification for Electrical Systems.” Affix markers on each terminal conductor, as close as possible to the point of connection.

3.3 CONNECTIONS TO LIGHTING CONTROL SYSTEM EQUIPMENT

A. Make electrical connections required for a complete operating system. Follow manufacturer's written instructions. Coordinate with the manufacturer.

3.4 CONNECTIONS TO TEMPERATURE CONTROL EQUIPMENT

A. Make electrical connections as indicated in the plans and specifications to temperature control devices according to the manufacturer’s written instructions. Coordinate with Divisions 21, 22, 23 and 25.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Grounding and Bonding (NEC Article 250)

B. Section 26 05 53: Identification for Electrical Systems

1.3 DESCRIPTION

A. Grounding Electrode System

B. Equipment Grounding Conductors.

C. Main Bonding Jumpers, Supply-Side Bonding Jumpers, and System Bonding Jumpers

D. Telecommunications Grounding System

E. Connections to Systems

1.4 SUBMITTALS

A. Submit shop drawings and descfiptive data in accordance with Section 26 01 05: "Submittlas, Closeout doucments, Trainng and Spare Parts".

PART 2 EQUIPMENT

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 GROUND RODS

A. Ground Rods: Copper-clad stainless steel, sectional type; 3/4 inch by 10 feet 5/8 by 96 inches in diameter.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturers recommended material.

C. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.3 GROUNDING CONNECTORS

A. Clamps and pressure connectors.

1. Clamps for connection to piping and conduit, OZ Gedney type ABG or equal.
2. Clamps for connection to enclosures and buswork, OZ Gedney type KGM or equal.

B. Welded connections using non-reversable exothermic process. Acceptable manufacturers: Cadweld, Thermoweld.

2.4 GROUND BUSBAR

A. Solid copper grounding busbars, minimum ¼" thick, in sizes as shown on the drawings or otherwise specified in part 3 below.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/2 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Compliant with ASTM®B187-C11000.

D. 2" Polyamide Standoff Isolators with 1/8" stainless steel brackets and stainless steel fasteners.

E. For use with two-hole connector lugs as specified in paragraph 2.5.

F. Acceptable Manufactures:

1. Erico
2. Approved Equal

2.5 GROUNDING LUGS

A. Acceptable Manufacturers:

1. Thomas and Betts
2. ILSCO
3. Approved equal

B. Acceptable Materials:

1. Two hole compression lugs: Thomas and Betts, "Two Hole Lugs Long Barrel Type" color code blue 54800 series, high conductivity wrought copper, electro tin plated, or approved equal.

PART 3 EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

A. Grounding Electrode Conductors. Provide grounding electrode conductors, sized at minimum sizes required by NEC Article 250 and NEC Table 250.66 or as otherwise shown on the drawings.

1. Provide a grounding electrode conductor from each of the grounding electrodes listed in Paragraph 3.1.C below to the Grounding Electrode System Busbar.
2. Provide a properly-sized bonding jumper over water meters and similar equipment on water main services.
3. At each separately-derived 3 phase/4 wire wye-secondary service derived from a transformer, provide an unspliced Grounding Electrode Conductor from the transformer XO terminal (Neutral) to the nearest grounding electrode (building steel, ground bar, or as otherwise indicated on the drawings).
4. Provide a grounding electrode system conductor from the Grounding Electrode System Busbar to the service entrance equipment ground busbar.
5. Provide a grounding electrode conductor from the TMGB to the Grounding Electrode System Busbar.
6. Comply with NEC 250.64 (B) for securing and protection of grounding electrode conductors against damage.

B. Grounding Electrode System Busbar

1. Provide a 4”x24” grounding busbar, located as shown on the drawings and connect grounding electrode conductors from the electrodes/connections specified in Paragraph 3.1.A.

C. Grounding Electrodes

1. Provide a minimum of 20'-0” of #3/0 concrete-encased electrode installed within the foundation of the building, tied to the steel reinforcing, in accordance with NEC section 250.50.
2. Underground metal water piping within 10’-0” of the point of entrance.
3. Metal frame of building or structure.

D. Minimum of three (3) ground rods, or as otherwise shown on the drawings, installed in equilateral triangular fashion, spaced at a minimum of 10’-0” center to center of rods. Bond all rods utilizing Grounding Electrode Conductor.

3.2 EQUIPMENT GROUNDING CONDUCTORS/EQUIPMENT GROUNDING

A. Provide equipment grounding conductors, sized as shown on the drawings or at minimum sizes required by NEC Table 250.122. Solidly ground all conduit systems, switch boxes, cabinets, motor frames, switchgear, transformers, and all other permanently installed equipment to form a continuous, permanent and effective grounding system. Bond expansion joints and metal raceway sections.

B. Provide equipment ground conductors in all feeder and branch circuits. Use of raceway systems to serve exclusively as equipment ground conductors is prohibited.

3.3 MAIN BONDING JUMPERS, SYSTEM BONDING JUMPERS, AND SUPPLY-SIDE BONDING JUMPERS

A. Provide bonding jumpers, sized as shown on the drawings or at minimum sizes required by NEC Table 250.102(C)(1), at each of the following locations:

1. At the electrical service, provide an unspliced main bonding jumper to connect the equipment grounding conductor(s) and service disconnect enclosure to the grounded conductor (neutral) within the service enclosure (if manufacturer-provided N-G bond is not installed).

2. At each separately-derived 3 phase/4 wire wye-secondary service derived from a transformer, provide:

    a. An unspliced system bonding jumper from the transformer X0 terminal (neutral) to the transformer ground bar or enclosure (as provided).

    b. As part of the associated secondary feeder, provide an unspliced supply-side bonding jumper from the transformer X0 terminal (neutral) to the ground bus of the secondary overcurrent device enclosure, and from this ground bus to the enclosure of the secondary overcurrent device. See Feeder Schedule on drawings for requirements.

    c. See Grounding Electrode System for Transformer Secondary Grounding Electrode Connections.

3.4 CONNECTIONS TO OTHER SYSTEMS

A. Refer to specific systems equipment sections for additional grounding and bonding information.

3.5 FIELD QUALITY CONTROL/TESTING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 IDENTIFICATION

A. Comply with requirements in Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. 26 01 00: Common Work Results for Electrical

B. 26 05 33: Raceways, Fittings, and Boxes

C. 26 05 34: Technology Raceway System

D. 26 05 35: Wireways

E. 26 51 13: Lighting

F. 26 52 00: Emergency Lighting

G. 26 53 00: Exit Signs

1.3 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers
2. Riser clamps
3. C-clamps
4. I-beam clamps
5. One-hole conduit straps
6. Two-hole conduit straps
7. Round steel rods
8. Expansion anchors
9. Toggle bolts
10. Wall and floor seals

B. Supports, anchors and sleeves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 26 sections.

1.4 QUALITY ASSURANCE

A. Provide supporting devices, of types, sizes, and ratings required that are manufactured by firms regularly engaged in the manufacture of such devices.

B. Comply with NEC as applicable to construction and installation of electrical supporting devices.

C. Comply with applicable requirements of ANSI/NEMA std Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies".

D. Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports and equipment mounting.

E. Provide electrical components which are UL-listed and labeled.

PART 2 PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. Where more than one type of device meets indicated requirements, selection is Installers' option.

B. Provide supports and anchors constructed of stainless steel or equivalent corrosion resistant material in chemical storage rooms.

C. Provide supporting devices of types, sizes and materials indicated, and having the following construction features:

1. Provide clevis hangers for supporting 2" rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
2. Provide riser clamps for supporting metal conduit; black steel; with 2 bolts and nuts, and 4" ears.
3. Provide C-clamps of black malleable iron; 1/2" rod size.
4. Provide I-Beam clamps of galvanized steel, 1-1/4" x 3/6" stock; 3/8" cross bolt; flange width 2".
5. Provide one-hole conduit straps for supporting metal conduit; galvanized steel.
6. Provide two-hole conduit straps for supporting metal conduit; galvanized steel; 3/4" strap width.
7. Provide hexagon nuts for 1/2" rod size; galvanized steel.
8. Provide round steel rod of galvanized steel; 1/2" dia.

D. Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Expansion Anchors: 1/2".
2. Toggle Bolts: Springhead; 3/16" x 4".

E. Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, or types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

1. Fixture hangers
2. Channel hangers
3. End caps
4. Beam Clamps
5. Wiring stud
6. Thinwall conduit clamps
7. Rigid conduit clamps
8. Conduit hangers

9. U-bolts

PART 3 EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hanger, anchors and sleeves in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements of NECA, NEC and ANSI/NEMA. Extend sleeves 3/4" above floor surface.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Support suspended conduit runs threaded rod and galvanized conduit hangers. Attach the hanger rod to concrete structural members with malleable iron inserts, to existing or precast concrete structural members with self-drilling anchors, to structural steel with steel "C" clamps, and to wood with suitable sized lag screws and angles. Support multiple parallel conduit runs on trapeze hangers constructed of steel rod hangers and structural channel. Include three (3) nuts jam-locked, on all threaded rod hangers, to rigidly support the conduit. Install supports with maximum spacings indicated.

D. Support surface mounted conduit runs with galvanized pipe straps. Fasten pipe straps to masonry surfaces with self-drilling anchors or toggle bolts. Fasten pipe straps to wood or sheetmetal surfaces with pan head sheetmetal screws.

E. Support wall mounted electrical equipment on 3/4" thick C-D exterior fir plywood painted with two (2) coats of ASA-49 gray enamel.

F. Provide stainless steel screws where electrical equipment is mounted on or attached to fire treated plywood. Hold equipment away from the plywood with either plastic or stainless steel washers or spacers.

G. Support all ceiling mounted receptacles with a listed tile bridge spanning the suspended ceiling grid, plus a 1/4" threaded rod anchored to a structurally sound member directly above the outlet box.

H. Provide finish of supporting devices in the chemical storage room as follows:

1. Provide PVC-coated galvanized concrete inserts and pipe straps.
2. Provide stainless steel for all bolts, nuts, washers, and screws.
3. Provide PVC-coated individual hangers and trapeze hangers.
4. Provide individual galvanized rods with two (2) coats of epoxy paints.

3.2 LIGHT FIXTURE SUPPORTS

A. Securely support all light fixtures directly from building structural members or 11/2” or larger steel ceiling framing channels. Use steel channel equivalent to Kindorf #6029 where it is necessary to span the building structural members for fixture support. Wood supporting members or wires will not be acceptable. Provide minimum ¼” diameter lag screws when anchoring into wood structural members. Penetrate wood structural members a minimum of 2” with all screws. Provide steel or lead, expandable type, anchors with minimum penetration of 11/2” when anchoring to concrete.

B. DO NOT suspend any conduit, light fixtures, or ballasts from metal roof deck or from the ceiling suspension wires. Support all lay-in fixtures independent of the ceiling support system. Provide fastening clips on each corner of each fixture.

C. Equip all fixtures using conduit stems with ball swivel hangers. In finished areas, provide canopies for the hangers.

D. Support all surface mounted fluorescent fixtures with a minimum of one hanger per fixture plus one per row. Support individual fixtures with a minimum of two hangers. Attach fixture hangers to the ceiling grid per code.

E. Support all suspended fluorescent fixtures with a minimum of two fixture hangers. Attach each hangar to a dedicated anchor. Locate hangars directly above the corners of the light fixtures.

END OF SECTION

SECTION 26 05 33

RACEWAYS, FITTING, AND BOXES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 29: Supporting Devices

D. Section 26 27 26: Wiring Devices

E. Intermediate Metal Conduit (NEC Article 342).

F. Rigid Metal Conduit (NEC Article 344).

G. Flexible Metal Conduit (NEC Article 348).

H. Liquidtight Flexible Metal Conduit (NEC Article 350).

I. Rigid Nonmetallic Conduit (NEC Article 352).

J. Electrical Metallic Tubing (NEC Article 358).

K. Multioutlet Assembly (NEC Article 380)

L. Surface Metal Raceways (NEC Article 386)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground feeders to-and-between all panelboards, switchboards and distribution panels. Indicate locations where feeders rise up through the floor and transition to overhead feeders.

2. Routing of all overhead feeders to panelboards, switchboards and distribution panels. Indicate locations of all pullboxes and sizes.

3. Routing of all underground conduits exterior to the building.

C. Precast Concrete:

1. Submit a coordinated set of shop drawings with the precast manufacturer, that indicates electrical box locations, cabinet locations and conduit routing locations.

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING AND FITTINGS

A. Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot-dip galvanized or electro-galvanized (inside and outside) conduit having a bichromate finish conforming to UL standard UL-6.
2. Provide zinc coated, threaded type fittings, couplings, and bushings.

B. PVC-coated Steel Rigid Metal Conduit (RMC) and fittings.

1. Provide hot dip galvanized or electro-galvanized rigid steel conduit.
2. 40 mil. PVC coated inside surface and outside surface.
3. Provide threaded type fittings, couplings and bushings with the same coating as the conduit.
4. Provide brush-on PVC touch-up compound.
5. Comply with NEMA RN-1.

C. Intermediate Metal Conduit (IMC) and fittings.

1. Provide hot-dip galvanized steel conduit conforming to UL Standard 1242 and Federal Specification WW-C-581E.
2. Provide zinc coated, threaded type fittings, couplings, and bushings.

D. Electrical Metallic Tubing (EMT) and fittings.

1. Provide electro-galvanized tubing conforming to UL Standard UL797, with the interior having a smooth coating of aluminum lacquer or enamel.
2. Do not thread tubing.
3. Provide concrete-tight steel compression or set-screw type fittings, couplings and bushings. Cast or indentor type devices are not acceptable.

E. Flexible Metal Conduit (FMC) and fittings.

1. Provide Type U.A., hot-dip galvanized tubing conforming to U.L. Standard ULI.
2. Provide steel or malleable iron type fittings, couplings and bushings. Cast type devices are not acceptable.

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

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. O-Z/Gedney; a brand of EGS Electrical Group.
3. Republic Conduit.
4. Robroy Industries.
5. Thomas & Betts Corporation.

2.2 OUTLET AND JUNCTION BOXES

A. Provide galvanized code gauge metal outlet and junction boxes with screw-on covers of type, shape and size listed for each application.

B. Provide gasketed covers in damp and dusty locations, and also where required to meet the listed use (i.e. wet locations).

C. Provide cast metal boxes (FS and FD) for all locations where IMC and RMC is required under Section 26 05 33 under the Raceway Application Table.

D. Provide 4" square, welded minimum trade size square boxes for all outlet and junction boxes. Provide appropriate mudrings, tile rings or raised covers, depending on the application and allowable installation.

E. Provide 4 11/16" square minimum trade size boxes where indicated on the drawings (edit – rare). Provide with minimum 1" knock-outs.

F. Provide 3½" deep boxes where installed in masonry, including precast construction. Provide 2⅛" minimum deep boxes where installed in non-masonry locations. Shallower boxes (1½", 1¼") are allowed only at locations where the wall cavity depth does not permit deeper boxes to be installed concealed within the wall.

G. Provide outlet boxes with green grounding pigtail pre-terminated to the interior of the box, to be used to ground the wiring device(s).

H. Refer to other sections for additional outlet box requirements specific to other systems.

I. Approved steel box manufacturers:

1. Raco
2. Steel City
3. Pre-approved equal

J. Approved cast metal box manufacturers:

1. Appleton
2. Crouse-Hinds
3. Killark
4. Bell
5. Red Dot
6. Pre-approved equal

2.3 INTERIOR PULLBOXES

A. Provide listed metal boxes with removeable screw-on covers.

B. Size pullboxes boxes to adhere to the NEC.

C. Provide enclosures that have a NEMA rating that meet or exceed the environment in which they are installed.

D. Approved manufacturers:

1. Hoffman Enclosures
2. Electro Mechanical Industries (EMI)
3. American Midwest Power (AMP)
4. Pre-approved equal

2.4 CONDUIT BODIES

A. Provide malleable cast iron or aluminum conduit bodies of type, shape and size required to suit each installation and conduit system. Do not use conduit bodies for conduits larger than 1½" unless specifically allowed on the plans.

B. Approved manufacturers

1. Appleton
2. Crouse-Hinds
3. Killark
4. Bell
5. Red Dot
6. Pre-approved equal

2.5 SURFACE RACEWAY – SINGLE CHANNEL

A. Surface Metal Raceway

1. Single-channel, metal paintable two-piece raceway.
2. Matching fittings, coverplates, boxes, endcaps, connectors and accessories to provide a complete system.
3. Ivory-colored factory-painted raceway, boxes, fittings and hardware.
4. Listed for the rated voltage of the wiring installed in the raceway.
5. Approved Manufacturers:
   a. Wiremold 200/500/700 series
   b. Pre-approved equal

PART 3 EXECUTION

3.1 RACEWAY USAGE TABLE

A. Refer to table at the end of section for allowable usages of raceways and conduit.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Refer to Section 26 05 29: "Supporting Devices" for supporting requirements.

C. Install all line voltage (120, 208, 277 and 480 volts) conductors in a continuous raceway system. Refer to individual low voltage and communications specification sections for raceway requirements for non-line voltage wiring.

D. Provide pull and junction boxes as required by the NEC.

E. Provide minimum 3/4" conduit size for branch circuit homeruns. Provide minimum 1/2" conduit size everywhere else.

F. Verify conduit sizes indicated on the plans prior to installation. Provide proper size conduit based on the NEC maximum fill requirements, including any derating factors. Where conduit sizes are indicated on the plans, it is a minimum size allowed and it is based on based on EMT usage. If other allowable types of conduits are used, it is the Contractor's responsibility to provide the proper conduit size, including any grounding conductors and flexible connections to equipment.

G. Do not route any conduits across rooftops, unless specifically allowed and noted on the plans to do so. If conduits are allowed to be routed across rooftops, install conductors in Rigid Metal Conduit and provide proper derating of the conductor ampacities to account for the high ambient temperature as required in NEC Art. 310-15. Mount on roof blocks specifically designed for the intended environment.

H. Support all trapezes and all above-ground conduits from the building structure. Provide conduit supports, not to exceed 7' 0", for all conduit less than 1" in diameter.

I. Route all horizontal raceway above water piping, where possible.

J. Do not support conduit with wire, nylon ties, nor perforated pipe straps. Remove wire used for temporary supports.

K. Do not attach conduit to ceiling support wires.

L. Conceal all conduit work in new construction, except mechanical rooms. Conduit and boxes in mechanical spaces may be run exposed. Run all exposed conduit in a neat, workmanlike manner parallel to the building lines, tight to the wall and ceiling surfaces, and firmly support with conduit clamps or hangers. Provide one (1) hole mounting straps, minimum three (3) feet on center, for all surface conduit mounted on walls less than six (6) feet above finished floor.

M. Do not run conduits in columns except to feed column mounted devices. Do not route conduit through structural slabs, beams, or columns, unless approved by the Structural Engineer. Do not route any conduit in any concrete topping.

N. Place conduits at least 8" away from all hot piping and surfaces including domestic hot water lines. Do not route conduits through the same penetrations through floors and walls as mechanical piping unless noted otherwise or if approved by the Engineer.

O. Do not mount conduit on mechanical equipment except where necessary to connect electrical devices mounted on the equipment. Provide flexible conduit in all runs "bridging" vibration mountings.

P. Do not run conduit on or directly in front of access doors, removable panels, equipment removal spaces, control devices or other spaces necessary for normal maintenance and repair of the equipment.

Q. Install all exterior underground branch circuit conduits continuous from the source to the load. Do not install in-ground boxes as pull boxes. Oversize the conduits if required.

R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Install exterior underground conduits to drain away from the building.

S. Provide suitable fittings to accommodate expansion, contraction and deflection where conduits cross seismic, control and expansion joints. Avoid crossing expansion joints where possible.

T. Cap or plug conduit ends during construction. Cap or plug ends of conduit that are to remain empty and make watertight. Clean and swab conduits prior to pulling in conductors.

U. Provide nylon pull string in all empty conduit with a stamped plastic label indicating future use.

V. Provide watertight seal, approved by the Architect, for all roof penetrations.

W. Provide air tight seals for all raceway penetrating air plenums. Repair all damage to insulation and vapor barriers. Seal vapor barriers tight to conduit penetrating vapor barriers.

X. Seal all conduit penetrations of smoke or fire rated walls or floors with intumescent type fire barriers, 3M or equal.

Y. Seal all conduits where they pass through exterior walls and where they enter exterior fixtures.

Z. Seal all conduits where temperature differential between adjacent spaces is greater than 30 degrees Fahrenheit.

3.3 OUTLET AND JUNCTION BOX INSTALLATION

A. Maintain accessibility to all outlet and junction boxes as required by the NEC.

B. Provide recessed outlet boxes in all new construction, except mechanical rooms. Outlet boxes in mechanical rooms may be installed exposed.

C. Provide concealed junction boxes in all new construction, except mechanical rooms. Junction boxes in mechanical rooms may be installed exposed.

D. Mounting heights indicated on the drawings are from the center of the outlet box to the finished floor directly below the outlet. Exterior heights are from inside adjacent door, or if no door, from the first floor above grade, unless noted otherwise.

E. Coordinate the location of all outlets with Architectural and Mechanical drawings before installation. Verify mounting heights and locations of all outlet boxes, including the following:

1. Outlets located on walls with baseboard radiation. Mount to the side of radiation covers.
2. Switch boxes at doors. Verify door swings. Install switchboxes on the latch side of the door if possible.
3. Outlet boxes at casework. Mount outlet boxes above counters and above backsplashes.
4. Outlet boxes at undercounter refrigerators. Mount outlet boxes in the space reserved for the refrigerator.
5. Outlet boxes adjacent to marker boards or other wall-hung Architectural items. Verify top edge and bottom edge of wall-hung items and mount outlets on clear wallspace.

F. Do not mount boxes back-to-back and nippled together.

G. Do not use through-wall boxes unless specifically called out on the plans.

H. Field-gangable boxes are not allowed. Provide manufactured, multi-gang boxes.

I. Provide separate switch boxes for lighting dimmer switches to maintain full dimmer rating.

J. Close openings in all outlet boxes during plaster and concrete work with plain paper or slip-on plastic or metal plates.

K. Provide knockout closures to cap used knockout holes.

L. Provide FS and FD boxes in wet, damp and exterior locations.

M. Maintain vapor barriers around boxes and/or provide suitable boxes listed for use in vapor barriers.

N. Provide air-tight seals for all boxes in air plenums that can allow air to pass through connecting conduit. Repair all damage to insulation and vapor barriers.

O. Where boxes and concrete are installed in masonry, provide listed equipment or the means acceptable to the AHJ necessary to provide concrete-tight connections and boxes required by the NEC.

3.4 INTERIOR PULLBOX INSTALLATION

A. Provide concealed pullboxes in all new construction, except mechanical rooms. Pullboxes in mechanical rooms may be installed exposed.

B. Terminate all conduits at cabinets and boxes with locknuts and bushings. Provide insulating bushings on all conduit 1" and larger.

C. Provide pull boxes in accessible locations. Provide accessiblility to the pullbox cover. Coordinate location of pull/junction boxes with other divisions (trades) prior to installation. Do not locate pull boxes in exposed finished spaces without the specific approval of the Engineer and Architect.

D. Provide ½" clear space behind boxes when mounting in wet or damp locations.

3.5 CONDUIT BODY INSTALLATION

A. Provide conduit bodies in accessible locations. Provide accessiblility to the cover. Coordinate location of conduit bodies with other divisions (trades) prior to installation. Do not locate conduit bodies in exposed finished spaces without the specific approval of the Engineer and Architect.

3.6 SURFACE RACEWAY INSTALLATION

A. Coordinate frames with technology cabling installer, and provide the proper frame and coverplate.

B. Provide surface raceway for lighting, power, low voltage systems and technology systems in finished areas of existing construction, or at other locations specifically called out on the plans. Surface raceway is not allowed in areas of new construction unless specifically called out on the plans.

C. Verify routing of surface raceway with the Architect, Owner and Engineer prior to installation. Route surface raceway orthogonal to building lines.

D. Provide the shortest lengths of surface raceway possible, following building lines. Route raceway into accessible ceiling space and/or accessible tunnel space.

E. Unless specifically sized on the plans, use the smallest (cross-sectional area) size raceway for the use or number of conductors installed in the raceway.

F. Provide bushing on raceways stubbed into ceiling spaces for technology cabling.

G. Do not route surface raceway through walls or floors.

H. Use manufacturer's base and cover cutter to make field cuts to the raceway.

I. Ground and bond all metal raceways.

3.7 IDENTIFICATION

A. Provide identification of each junction box and pullbox located in accessible areas (i.e. above accessible ceilings) in accordance with Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

3.8 RACEWAY APPLICATION TABLE

Raceway Type→ Application ↓	Steel RMC	Alum. RMC	PVC-coated RMC	IMC	EMT	FMC	LFMC	RNMC	Surface Metal Raceway	Surface Non-metallic Raceway
Dry, concealed interior locations not listed below	A	A		A	A					
Exposed exterior locations	A		A							
Exposed unfinished interior locations installed below 46" above finished floor	A			A						
Exposed unfinished interior locations installed above 46" above finished floor					A					
Underground or under concrete slabs on grade	A		A					A[1]		
Inside exterior masonry wall cavities	A			A						
Wet Locations	A		A							
Exposed inside tunnels	A		A	A						
Motor Connections – dry locations						A[2]				
Transformer Connections – dry locations						A[2]				
Non-Transformer Vibrating Equipment – dry locations						A[2]				
Motor Connections – wet or damp locations							A[2]			
Transformer Connections – wet or damp locations							A[2]			
Vibrating Equipment – wet or damp locations							A[2]			
Lay-in light fixture connections						A[3]				
Service entrance feeder			A					A[4]		
Floorboxes in slab on grade	A		A					A[1]		
Floorboxes in concrete topping above grade			A					A		
Exposed finished areas									A[55]	A[5]
Voltages over 600 volts	A									
Lightning Protection System downlead conduits								A[6]		

Legend: A=Acceptable; (blank) = Not Acceptable

[1] Provide PVC Coated RMC elbows for all elbows installed under and/or through concrete slabs on grade.
[2] Provide conduit minimum length of 18" and a maximum length of 48".
[3] Provide maximum 6' long whip from outlet box located at building structure.
[4] Provide concrete-encased ductbank with PVC-coated Steel RMC elbows. Steel RMC elbows not required if the entire elbow is encased in concrete.
[5] Provide surface raceway only in areas of existing construction where recessed conduit and boxes are not possible.
[6] Install raceway in non-plenum spaces only.

SECTION 26 05 34

TECHNOLOGY RACEWAY SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 29: Supporting Devices

D. Section 26 05 33: Raceways, Fittings, and Boxes

E. Section 26 05 50: Floorboxes

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit a coordinated, dimensioned plan drawing prior to installation that indicates the following information:

1. Routing of all underground conduits to-and-between data rooms. Indicate locations where conduits rise up through the floor and transition to overhead conduits.

2. Routing of exterior conduits used for utility entrance cables (CATV, Telephone, Fiber, Outside Plant cables, spares, etc.).

3. Routing of all overhead backbone conduits to-and between data rooms. Indicate locations of all pullboxes and sizes.

1.4 SYSTEM DESCRIPTION

A. Provide all labor and materials for a complete raceway system including some or all of the following components:

1. Outlet boxes

2. Conduit

3. Surface raceway and matching boxes

4. Sleeves and approved fireproofing

5. Pullboxes, pullstrings, bushings

6. Backboards

7. Grounding

1.5 CABLE TRAYS

A. Refer to Section 26 05 36: "Cable Trays" for requirements.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Provide 4" welded square boxes for each recessed outlet box. Provide 3½" deep masonry type in recessed masonry installations.

B. Provide single gang mud or tile ring as required for all boxes.

C. Refer to specification Section 26 05 33: "Raceways, Fittings and Boxes" for approved box manufacturers.

2.2 OUTLET DEVICES AND COVERPLATES

A. Outlet devices and coverplates are provided under Section 27 13 00: "Technology Cabling System".

B. Provide blank coverplates meeting the requirements of Section 26 27 26: "Wiring Devices".

2.3 FLOORBOXES

A. Provide floorboxes as described in Section 26 05 50: "Floorboxes and Pokethroughs".

2.4 MISCELLANEOUS

A. Provide plywood terminal boards on all walls of each IDF, MDF, Technology and Data rooms. Plywood to be 3/4" x 8'-0" high and shall be painted with two coats of fire retardant marine grey enamel on both sides. Mount plywood 2" above finished floor, with the 8' dimension in the vertical plane.

B. Provide grounding system per Section 26 05 26: "Grounding and Bonding for Electrical Systems."

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide empty raceway system from each technology outlet box to accessible lay-in ceiling space.

B. Rough-in requirements

1. Accessible ceiling (lay-in grid)
    a. Provide an empty box with (1) 1" conduit stubbed into ceiling space for each telephone outlet indicated on the drawings.
    b. Provide an empty box with (2) 1" conduits stubbed into ceiling space for each voice/data outlet indicated on the drawings.
    c. Provide an empty box with (2) 1" conduits stubbed into ceiling space or each data outlet indicated on the drawings.
    d. Provide an empty box with (2) 1" conduits stubbed into ceiling space for each fiber optic outlet indicated on the drawings.
2. Inaccessible ceilings (plaster, spline, gypsum, security grid, plank, etc.)
    a. Provide an empty box with (1) 1" conduit routed to the nearest telephone backboard location for each telephone outlet, unless noted otherwise on the plans.
    b. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each voice/data outlet, unless noted otherwise on the plans.

c. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each data outlet, unless noted otherwise on the plans.

d. Provide an empty box with (2) 1" conduits routed to the nearest communications closet backboard location for each fiber optic outlet, unless noted otherwise on the plans.

3. Floorboxes

a. Provide floorboxes with (2) 1" conduits routed in the slab or under the slab to the nearest accessible ceiling space or accessible tunnel space.

C. Provide a minimum of (2) 4" conduit sleeves between floors at each backboard location, unless noted otherwise. Provide a minimum of (4) 2" conduits from each backboard location to the accessible ceiling space in the corridor adjacent to the backboard location, unless noted otherwise.

D. Provide at least one isolated grounding double duplex receptacle wired to a dedicated 120 volt, 20 amp circuit at each backboard location for Owner equipment. Provide a separate hot, neutral and ground conductor. Coordinate with the Owner or designated installer. Refer to the plans for additional information.

E. Fireproof all sleeves with an approved fireproofing sealer to maintain the fire integrity of the slab or wall. Refer to Section 26 01 00: "Common Work Results for Electrical".

F. Bush all conduits. Provide a pullstring in each conduit.

G. Permanently label the ends of each conduit stub with the Architectural room numbers, in order to identify each outlet box for the technology cable installer.

END OF SECTION

SECTION 26 05 35

WIREWAYS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 29: Supporting Devices

C. Metal Wireways (NEC Article 376)

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIREWAYS

A. Provide "lay-in" type wireway with lengths and connectors hinged to provide unobstructed lay-in of conductors. All fittings must be so constructed to continue the "lay-in" feature through the entire installation.

B. Provide all sheet metal parts with a rust-inhibiting phosphatizing coating and finished in baked enamel. Plate all hardware to prevent corrosion.

C. Provide raintight construction with gasketed cover for all exterior wireways.

D. Provide wireways without knockouts, except for exterior wireway.

E. Provide hinged cover.

F. Provide U.L. label and listing for all lengths, connectors and fittings. Install in accordance with the National Electrical Code and the drawings. U.L. listing of lengths without listing connectors or fittings is not acceptable.

G. Approved manufacturers:

1. Square D "Square-Duct"
2. Hoffman
3. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide wireways only where specifically allowed by the Engineer, and only prior to installation. Wireway is not allowed to be a substitution for conduit, pullboxes or other raceways or conduit bodies. Do not use wireway as an auxiliary gutter above or below panelboards.

B. Install parallel and perpendicular to building lines.

C. Provide all fittings required along the entire route of wireway.

D. Size wireways for a maximum of 20% fill after any ampacity derating factors have been applied to the cables.

E. Provide wireway sufficiently sized to accommodate the cable bending radius requirements for cables.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Refer to individual Division 27 and 28 sections.

B. Section 26 05 26 – Grounding and Bonding for Electrical Systems

C. Section 26 05 33 – Raceways, Fitting and Boxes

D. Section 26 22 13 – Transformers

E. Section 26 24 16 – Panelboards

F. Section 26 28 16 – Safety Switches

G. Section 26 29 13 – Motor Control

PART 2 PRODUCTS

2.1 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Minimum 1/8” thick laminated bakelite: White face with black lettering.

B. Engrave characters with a minimum height of 1/4".

C. Minimum plate size: 1” x 3.5”. Provide larger plate if necessary to fit all lettering on it.

D. Approved manufacturers

1. Square D
2. Siemens
3. Cutler Hammer
4. General Electric
5. Pre-approved equal

2.2 SERVICE IDENTIFICATION NAMEPLATES

A. Provide signage per NEC Articles 110.22, 230.2(E) and 230.70(B)

B. Provide nameplates on each main service disconnecting means describing what areas are served by the disconnecting means, and where the other disconnecting means are located.

2.3 EMERGENCY SOURCE IDENTIFICATION NAMPLATES

A. Provide signage per NEC Article 700.8.

B. Provide nameplates near each main service disconnecting means indicating that the building has an on-site generator and where it is located.

2.4 ARC FLASH WARNING SIGNS

A. Provide Arc Flash warning signs on all electrical equipment as required by 2008 NEC 110-16:

"Electrical equipment, such as switchboards, panelboards, industrial control panels,meter socket enclosures, and motor control centers, that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment."

B. Minimum size: 3½"x 5"; B302 polyester or vinyl with laminate overlay.

C. Approved manufacturers

1. Brady
2. Seton
3. Pre-approved

2.5 BOX IDENTIFICATION

A. Approved manufacturers

1. Sharpie
2. Avery Marks-A-Lot
3. Pre-approved equal

2.6 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits located in accessible areas.

B. Provide black epoxy spray paint and 1" high stenciled lettering.

2.7 COVERPLATE IDENTIFICATION

A. Provide ¼" high engraved black-infilled lettering or laser etching when engraved coverplates are specified or noted on the plans.

B. Approved manufacturers

1. Cooper
2. Pass and Seymour
3. Hubbell
4. Leviton
5. pre-approved equal

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with governing regulations and governing authority for identification of electrical work.

3.2 EQUIPMENT IDENTIFICATION NAMEPLATES

A. Provide identification plates on the following electrical equipment:

1. Each panelboard, distribution panel, switchboard, motor control center and switchgear. Provide the following information on each nameplate: panel name, voltage, wire configuration, feeder conduit size, phase wire size, neutral size, ground wire.

Example:

TLP-1-1
208/120V, 3P4W
2”C - 3#2/0, #350 NEUT
#4 GND, THWN

2. Each overcurrent device in distribution panels, switchboards, motor control center and switchgear
3. Transformers
4. Disconnect switches (engrave per the equipment served)
5. Motor starter switches, motor starters, remote motor control stations (engrave per the equipment served)
6. Power factor correction capacitors
7. SPD equipment cabinets
8. Contactor cabinets
9. Lighting control panels

B. Install nameplate parallel to equipment lines.

C. Install nameplates inside covers in finished areas using approved contact cement.

D. Install nameplates outside covers in unfinished areas by mechanical fasteners (screws or rivets).

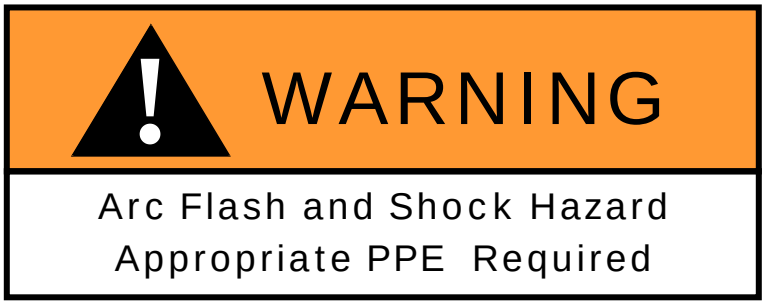
3.3 ARC FLASH WARNING SIGNS

A. Provide signs suitable for the environment in which they are located:

1. Provide engraved plates with the physical specifications called out in paragraph 2.1 above for exterior equipment.
2. Provide laminated, pressure sensitive signs adhered to the outside covers of equipment in unfinished areas.
3. Provide laminated, pressure sensitive signs adhered to the inside covers of equipment in finished areas.

B. Provide signs that indicate that an arc-flash hazard exists at this location, and that proper personnel protective equipment should be worn prior to serviving the equipment.

Example:



3.4 BOX IDENTIFICATION

A. Provide panel and circuit number(s) identification on the cover of all junction boxes and pullboxes located in accessible areas (i.e. above accessible ceilings).

B. Provide clear, hand-printed lettering using black permanent marker.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this specification section. Re-label any boxes that have been painted over by the painter.

3.5 CONDUIT IDENTIFICATION

A. Provide stenciling of conduits and pullboxes of the following:

1. Medium Voltage and High Voltage feeder conduits and pullboxes
2. Panelboard, distribution panel, switchboard, motor control center and switchgear feeder conduits and pullboxes.
3. Service entrance conduits and pullboxes at the point of accessibility for cable TV, Telephone and Fiber Optic cables.
4. Lightning Protection System downlead conduits

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Perform stenciling after the building has been painted so that overspray from building painting does not cover up stenciling performed under this section.

D. Perform stenciling on 50’ centers, maximum, along entire accessible length of conduits

3.6 COVERPLATE IDENTIFICATION

A. Provide engraving or laser-etching on the plate immediately above the wiring device, unless noted otherwise.

END OF SECTION

SECTION 26 05 60

CONCRETE PADS FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Division 03: Concrete

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 24 13: Switchboards

D. Section 26 24 16: Panelboards

E. Section 26 27 13: Electricity Metering Cabinets

F. Section 26 29 13: Motor Controls

G. Section 26 56 13: Lighting Poles and Standards

PART 2 EQUIPMENT

2.1 UTILITY TRANSFORMER PAD

A. Provide a concrete transformer pad built to Xcel Energy current standards, including the following illustrations found in *Xcel Energy Standard for Electrical Installation and Use*:

1. Drawing CC-10 & CC-10A – Customer Owned Secondary Connection Cabinet
2. Drawing CC-50 & CC-50A – Secondary Connection Cabinet and Transformer Poured-in-Place Pad.
3. Refer to the end of this section for copies of these drawings.

B. If a connection cabinet is included in the project under Section 26 27 13: Electricity Metering Cabinets, provide a continuous pad for both the utility transformer and the connection cabinet.

2.2 EQUIPMENT PADS

A. Provide concrete pads for all floor-mounted equipment, unless already called out to be provided under Division 3, which may include the following equipment:

1. Switchboards
2. Distribution Panelboards
3. Transformers
4. Electricity Metering Cabinets
5. Any other floor-mounted electrical equipment.

PART 3 EXECUTION

3.1 UTILITY TRANSFORMER PAD

A. Provide proper soil correction and preparation as indicated on the Xcel Energy drawings listed in section 2.1 above.

B. Primary Conduits: Provide two (2) 4" conduits with 36" sweep elbows stubbed up into the primary opening of the transformer, and extended out 5 feet from the pad location for utility primary cables.

3.2 EQUIPMENT PADS

A. Provide minimum 4" high concrete pads for all floor mounted equipment.

B. Provide 8" minimum thick concrete pads for engine-generator sets. Coordinate structural requirements of engine-generator pads with the generator manufacturer.

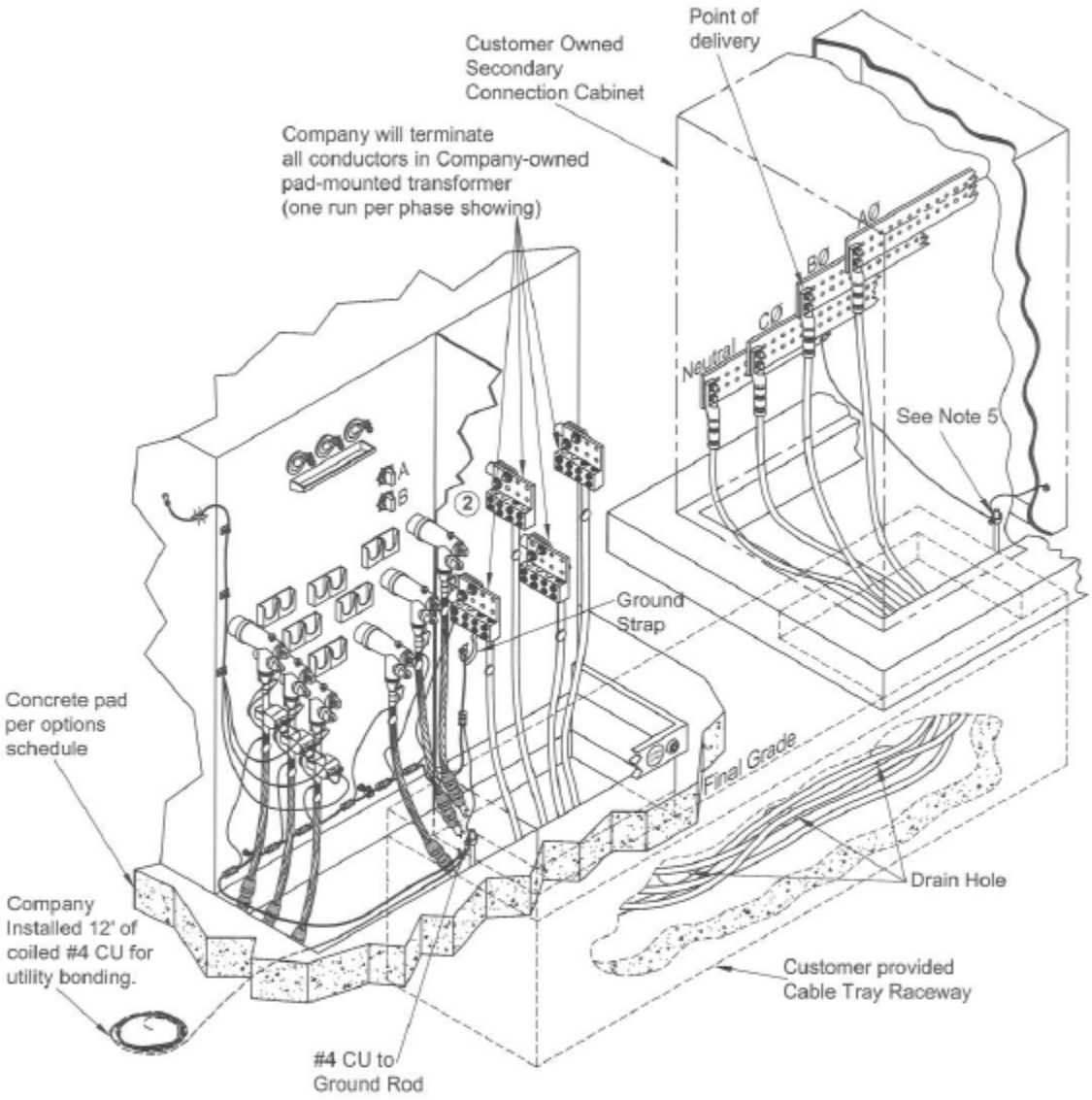
C. Size pad to provide a minimum 2" overlap around perimeter of equipment, including future sections to switchboards.

D. Provide steel reinforcement as required for load or as indicated on the drawings.

3.3 DRAWING CC-10

DRAWING CC-10

CUSTOMER OWNED SECONDARY CONNECTION CABINET (SCC)



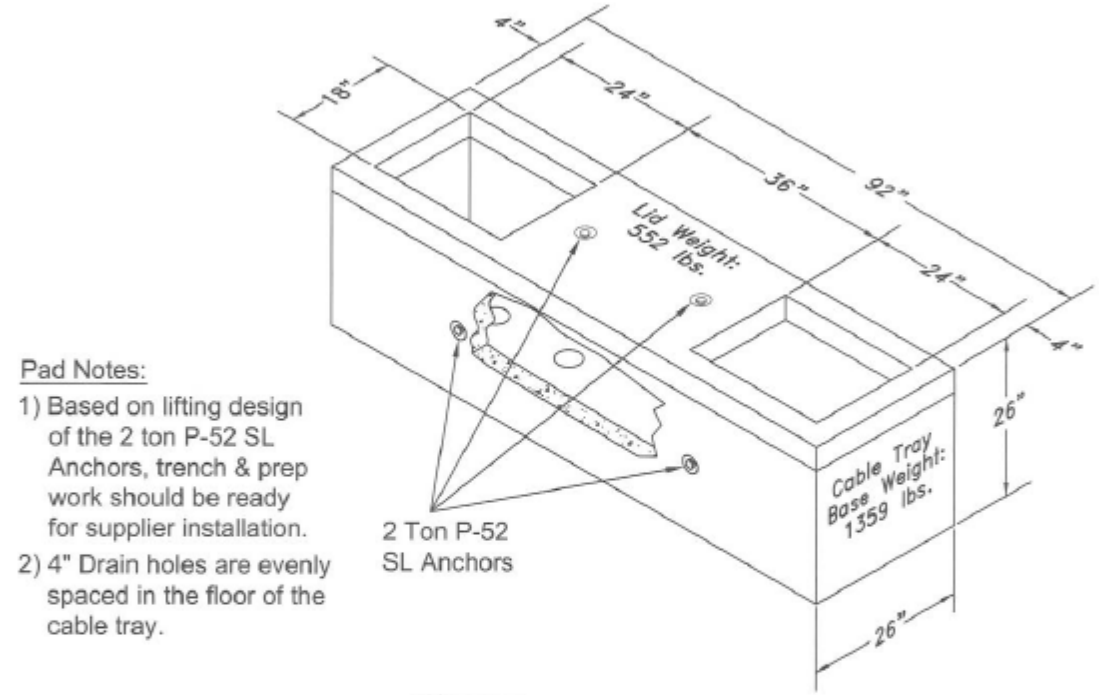
NOTES:

1. Company will furnish and install pad-mounted transformer.
2. Company will furnish and install conductors from transformer secondary connection cabinet including termination lugs at secondary connection cabinet.
3. Customer shall furnish, install and maintain continuous and/or separate pad for transformer and secondary connection cabinet per schedule, page I-6.21 and drawing pages CC-40 through CC-40G.
4. Customer shall furnish, install and maintain secondary connection cabinet and bus bar hole pattern shall have NEMA spacing (1-3/4" on center) and be centered on bar. SCC bus bar holes to accommodate 1/2" bolts
5. Customer to furnish ground rod for bonding to enclosure and at right side of neutral bus bar installed per NEC® .

3.4 DRAWING CC-10A

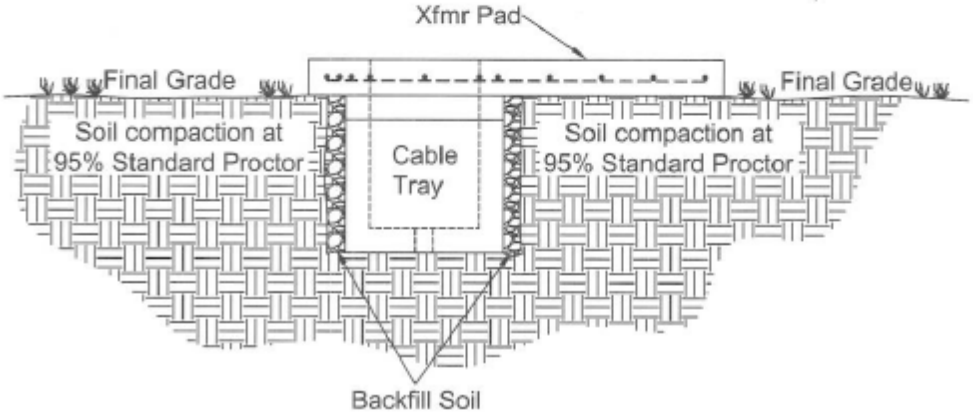
DRAWING CC-10A

SECONDARY CONNECTION CABINET (SCC)
PRE-CAST CABLE TRAY SPECIFICATION



Pad Notes:

1) Based on lifting design of the 2 ton P-52 SL Anchors, trench & prep work should be ready for supplier installation.
2) 4" Drain holes are evenly spaced in the floor of the cable tray.



3.5 DRAWING CC-50

DRAWING CC-50

SECONDARY CONNECTION CABINET AND TRANSFORMER POURED-IN-PLACE PAD

15 & 25 kV for 75-500 kVa

In-Line Orientation-Preferred

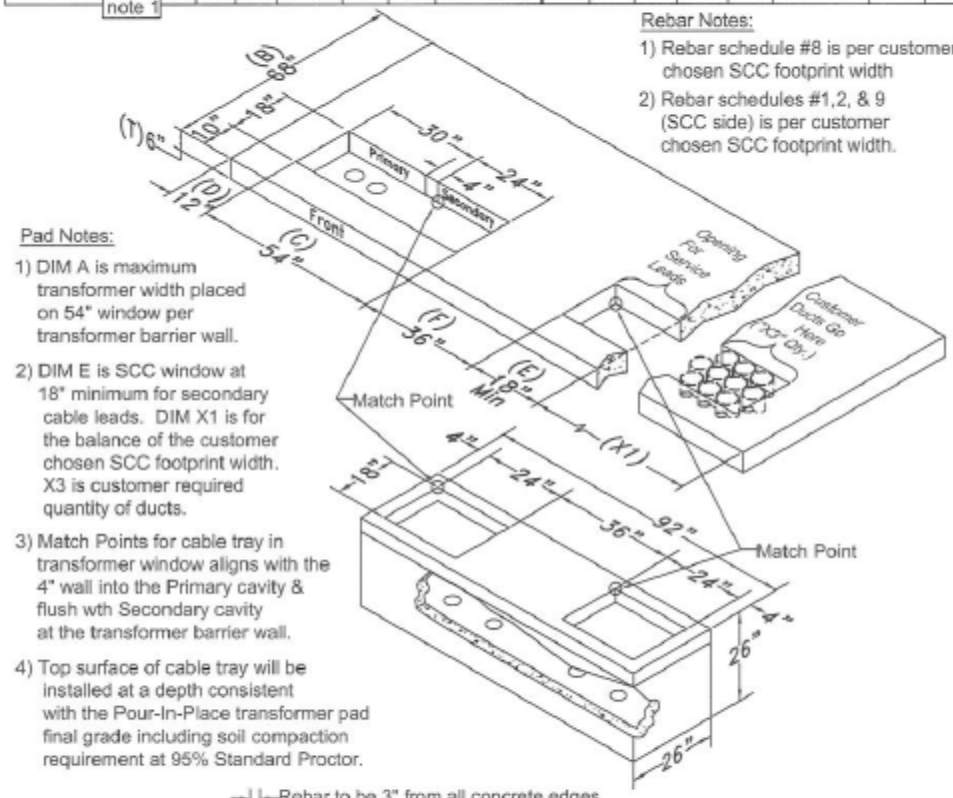
15 & 25 kV 75-500 kVA	PAD DIMENSIONS (DIM)								REINFORCED STEEL SCHEDULE								
	A	B	C	D	E	F	T	X1	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	78" See note 1	68"	54"	12"	18" Min	36"	6"	Bal of SCC width	5-#4	3-#4	3-#4	7-#4	3-#4	2-#4 x 3'0"	14-#4	4-#4	#4

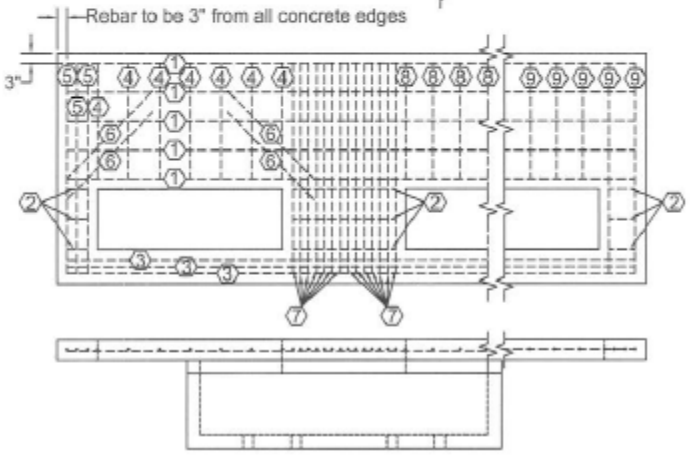
Rebar Notes:

1) Rebar schedule #8 is per customer chosen SCC footprint width
2) Rebar schedules #1,2, & 9 (SCC side) is per customer chosen SCC footprint width.

Pad Notes:

1) DIM A is maximum transformer width placed on 54" window per transformer barrier wall.
2) DIM E is SCC window at 18" minimum for secondary cable leads. DIM X1 is for the balance of the customer chosen SCC footprint width. X3 is customer required quantity of ducts.
3) Match Points for cable tray in transformer window aligns with the 4" wall into the Primary cavity & flush wth Secondary cavity at the transformer barrier wall.
4) Top surface of cable tray will be installed at a depth consistent with the Pour-In-Place transformer pad final grade including soil compaction requirement at 95% Standard Proctor.





3.6 DRAWING CC-50A

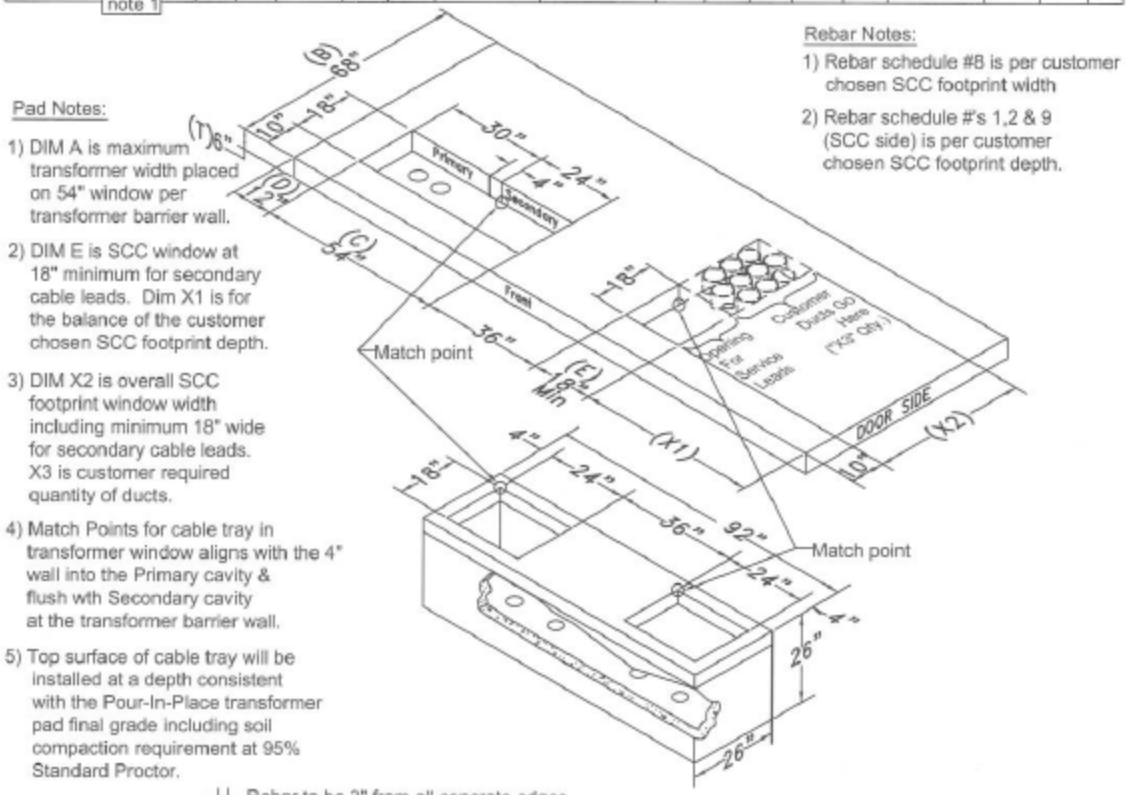
DRAWING CC-50A

SECONDARY CONNECTION CABINET AND TRANSFORMER POURED-IN-PLACE PAD

15 & 25 kV for 75-500 kVa

90° Orientation

15 & 25 kV 75-500 kVA	PAD DIMENSIONS (DIM)									REINFORCED STEEL SCHEDULE								
	A	B	C	D	E	F	T	X1	X2	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	78" See note 1	68"	54"	12"	18" Min	36"	6"	Bal of SCC depth	Bal of SCC width	5-#4	3-#4	3-#4	7-#4	3-#4	2-#4 x 3'0"	14-#4	4-#4	#4

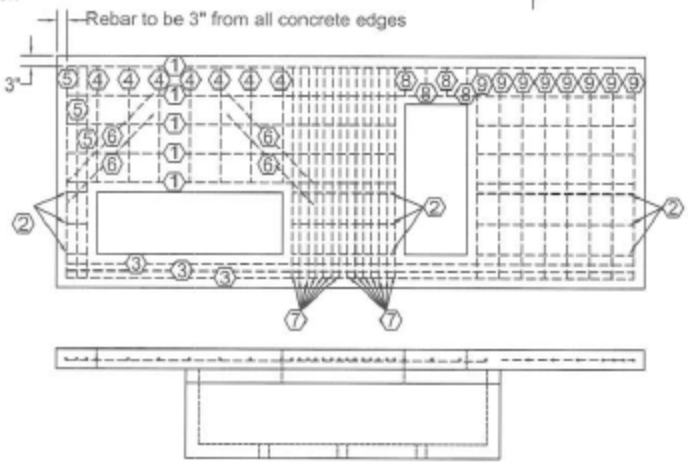


Pad Notes:

1) DIM A is maximum transformer width placed on 54" window per transformer barrier wall.
2) DIM E is SCC window at 18" minimum for secondary cable leads. Dim X1 is for the balance of the customer chosen SCC footprint depth.
3) DIM X2 is overall SCC footprint window width including minimum 18" wide for secondary cable leads. X3 is customer required quantity of ducts.
4) Match Points for cable tray in transformer window aligns with the 4" wall into the Primary cavity & flush wth Secondary cavity at the transformer barrier wall.
5) Top surface of cable tray will be installed at a depth consistent with the Pour-In-Place transformer pad final grade including soil compaction requirement at 95% Standard Proctor.

Rebar Notes:

1) Rebar schedule #8 is per customer chosen SCC footprint width
2) Rebar schedule #'s 1,2 & 9 (SCC side) is per customer chosen SCC footprint depth.



SECTION 26 09 23

OCCUPANCY SENSORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 09 24: Daylight Sensors

D. Section 26 09 43: Lighting Control Equipment

E. Section 26 51 13: Lighting

1.3 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to location and installation.

B. UL Compliance: Provide equipment which is UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a complete shop drawing package of the proposed system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit rough-in requirements including box sizes, conduits, mounting heights, etc.

F. Submit wiring diagrams indicating all system components and the wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

G. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

H. Submit reproducible floor plans that indicate quantity and locations of power packs and sensors required to provide total coverage. Include orientation of directional sensors where applicable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project. Indicate clearly the locations of additional sensors (if any) recommended by the manufacturer in order to provide adequate coverages (see paragraph 3.1.B below).

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit complete description of system operating sequence.

M. Submit complete mounting details and instructions for all equipment to be installed.

N. Submit complete operating description of the devices. Indicate how to make sensitivity and time delay adjustment to each type of device.

O. Shop drawings not containing all the information listed above will be rejected without review.

1.5 SYSTEM DESCRIPTION

A. Where occupancy sensors are indicated on the plans or specified herein, provide all components, power packs, mounting hardware, brackets, wiring and terminations required to provide on/off control of the light fixtures in the space served by the occupancy sensors.

B. Provide occupancy sensors with sufficient coverage to ensure positive detection of activity from any location within the room or space. Provide additional occupancy sensors than those shown on the plans if required or recommended by the manufacturer to ensure proper coverage of the entire space.

C. Provide the proper type of occupancy sensor based on the type of space, use, and size of the room. The following chart indicates the proper type of occupancy sensor based on typical use spaces. Refer to the plans for specific types and applications.

Type of space	Dual Technology (DT)	Ultrasonic (US)	Passive Infrared (PIR)
Public Restrooms		√	
Stairwells		√	
Corridors		√	
Conference Rooms		√	
Classrooms	√		
Hard Offices		√	
Open Office Areas			√
Work Rooms	√		
Vestibules			√
Adverse environments			√

D. Dual technology occupancy sensors are identified on the plans as type “DT”. Ultrasonic motion sensors are identified on the plans as type “US”. Passive infrared motion sensors are identified on the plans as type “PIR”.

1.6 SYSTEM OPERATION

A. In locations where light switches and occupancy sensors are indicated in the room or space, provide the following operation:

1. If the light switch(es) are in the OFF position, the lights shall remain OFF. Activity in the room shall <u>not</u> energize the lighting.

2. If the light switch (es) are in the ON position, the lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

B. In locations where occupancy sensors are the sole controlling unit in the room or space, provide the following operation:

1. The lights shall be controlled by the occupancy sensor(s). Activity in the room shall energize the lighting. Lack of activity (maintained for a predetermined time period) shall de-energize the lighting.

C. Provide occupancy sensors that fail in the energized state for occupancy sensors controlling egress lighting (i.e. corridors).

D. Provide occupancy sensors with integral Form C relay to allow control of external devices including the following:

1. Thermostats
2. EMS data gathering modules
3. Ceiling fans
4. HVAC equipment such as VAV boxes, unit ventilators and fan coil units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. Dual Technology Sensors
    a. Ceiling:
        1) Wattstopper DT300 (for 500 sq. ft. rating and 1000 sq. foot rating only)
        2) Wattstopper DT200 (for 2000 sq. ft. rating only)
        3) Leviton OSC (05) (10) (20)-MOW
        4) Hubbell Mytech OMNIDT series
        5) Sensorswitch equal
2. Ultrasonic Sensors
    a. Rooms - Ceiling
        1) Wattstopper WT (600) (1100) (2200)
        2) Leviton OSC (05) (10) (20)-UOW
        3) Hubbell Mytech OMNIUS series
        4) Sensorswitch equal
    b. Corridors - Ceiling

1) Wattstopper WT (2250)
2) Hubbell Mytech approved equal
3) Sensorswitch equal

3. Passive Infrared Sensors
   a. Ceiling
      1) Wattstopper CI-(200) (200-1)
      2) Leviton OSC(04) (15)-IOW
      3) Hubbell Mytech approved equal
      4) Sensorswitch equal

2.2 OCCUPANCY SENSORS - ALL

A. Provide the following specifications for all occupancy sensors

1. Solid state, operates at 24VDC supplied by a power module.
2. Load Ratings: 20 amps fluorescent, 20 amps HID and 13 amps incandescent loads.
3. Optional integral isolated Form C relay rated at 0.5 amp @24VDC.
4. High impact, injection molded plastic housing.
5. Mounting hardware designed for the particular application: wall, ceiling, corner surface, wall switch retrofit, etc.
6. Immune to RFI and EMI.
7. Adjustable time delay (8 minutes to 30 minutes).
8. Adjustable sensitivity.
9. LED activity indicators.
10. Operating temperature: +32°F to +104°F at 5% to 95% non-condensing humidity.
11. UL Listed.
12. 5 year replacement warranty.

2.3 DUAL TECHNOLOGY OCCUPANCY SENSORS (TYPE DT)

A. Provide dual technology occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. Utilizes passive infrared and ultrasonic technologies for detection.
2. Field configurable to allow any combinations of one, either or both technologies to energize, de-energize or maintain ON status.

2.4 ULTRASONIC OCCUPANCY SENSORS (TYPE US)

A. Provide ultrasonic occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. Operates at a minimum frequency of 32kHz

2.5 PASSIVE INFRARED OCCUPANCY SENSORS (TYPE PIR)

A. Provide PIR occupancy sensors that adhere to the specification listed above in paragraph 2.2, plus the following specifications:

1. 360° coverage
2. Dense Fresnel lens

2.6 VANDAL GUARDS

A. Where vandal guards are indicated on the plans, provide heavy duty guard over the entire device, mounted to structure using dedicated tamperproof hardware (torx head with center pin reject).

B. Provide unbreakable polycarbonate guards.

C. Approved manufacturers:

1. Safety Technology International
2. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide complete and operational system including all line voltage wiring, power packs, occupancy sensors, low voltage wiring, conduit, terminations, setup, testing, calibration, etc.

B. Provide occupancy sensor coverage at rooms and spaces shown on the plans. It is the intent of the plans and specifications to show all necessary occupancy sensors; however, because coverages vary from manufacturer to manufacturer and model to model, additional (or fewer) sensors may be required in each space. Coordinate locations and quantities with the manufacturer prior to bidding. **If additional sensors are required, they will be added at no extra cost to the Owner.**

C. Verify the practical location of each occupancy sensor prior to rough-in. Locations or applications that obviously will not provide the intended coverage or that have obstructions should be brought to the attention of the Engineer immediately. Changes required after the occupancy sensors are installed because of obstacles or other detrimental conditions that were obvious when the sensor was installed shall be done at no cost to the Owner.

D. Connect the power pack(s) on the line side of any local switches serving the controlled lighting. Locate the required power packs above the ceiling in the room served by the sensor(s), or in an adjacent space away from the finished area. Maintain accessibility to the power pack(s) as required by the NEC.

E. Mount ultrasonic detectors away from HVAC diffusers and away from doors leading out of the space.

F. Mount PIR sensors at “line of sight” locations to maximize probability of detection.

G. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

H. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to devices furnished by others.

I. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

J. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

3.2 TESTS AND ADJUSTMENTS

A. Refer to Section 26 01 20: Testing and Adjustments to Electrical Systems

3.3 TRAINING

A. Provide a minimum of two (2) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.4 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s).

B. Verify the following before scheduling the system demonstration:

1. The installation is complete.
2. The installation is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.5 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of **one (1) year**. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period. Provide a **five (5) year** replacement warranty on occupancy sensors and power packs.

3.6 SPARE PARTS

A. Provide the following spare parts:

1. Provide five (5) dual technology 1000 square foot rated occupancy sensors
2. Provide five (5) power packs.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 26: Grounding and Bonding for Electrical Systems

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fittings, and Boxes

F. Section 26 05 53: Identification for Electrical Systems

G. Section 26 05 60: Concrete Pads for Electrical Equipment

H. Section 26 24 16: Panelboards

I. Section 26 27 13: Electricity Metering Cabinets

J. Section 26 28 13: Low Voltage Fuses

K. Section 26 43 13: Surge Protection Devices

L. Comply with Nema PB2, NFPA 70 and UL 891.

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Submit "time-current data" with shop drawings for main switchboard overcurrent device, all distribution fuses, and all ground-fault interrupters. Proper trip settings will be indicated on the shop drawings during review. Adjust "trip settings" as indicated by the Engineer.

D. Submit shop drawings of the utility metering provisions to the Utility Company for approval prior to submittal to the Architect/Engineer.

PART 2 EQUIPMENT

2.1 SERVICE ENTRANCE EQUIPMENT – CIRCUIT BREAKER TYPE MAIN

A. Provide a 208/120 volt, 3 phase, 4 wire switchboard with bolt-on tin-plated aluminum bus bars braced to withstand a 100,000 ampere RMS symmetrical fault.

B. Provide 100%-rated main service disconnect switch.

C. Provide service section containing the following:

1. A main disconnect switch consisting of a stationary mounted, electronic trip circuit breaker, with LSIG trip settings and a minimum UL listed interrupting rating of 85,000 RMS symmetrical pickup. Provide main device with Arc Energy Reduction Device as required by National Electric Code.
2. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
3. Utility metering equipment (see "UTILITY METERING" paragraph below).

D. Distribution Sections

1. Provide separate distribution section(s) with full height bussing and suitable for mounting 3 pole, molded case circuit breakers. Provide full bussing for all space so that no additional work will be required to add devices or sections in the future.
2. Cricuit Breakers
   a. Electrical circuits shall be protected by molded case circuit breakers. Each pole of these breakers shall provide inverse time delay and instantaneous circuit protection by means of a thermal magnetic element on each pole.
   b. The breakers shall be operated by a toggle type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free from the handle so that the contact cannot be held closed against short circuits and abnormal currents. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positons. All latch surfaces shall be grounded and polished. All poles shall be so constructed that they open, close and trip simultaneously.
   c. Breakers must be completely enclosed in a molded case. Non-interchangeable trip breakers shall have their cover sealed; interchangeable trip breakers shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of high pressure butt type and shall be of non-welding silver alloy. Arc extinction must accomplished by means of DE-ION arc chutes, consisting of metal grids mounted in an insulating support.
   d. All load conductor terminals must be listed for use with copper of aluminum conductors rated 90^0F. All terminals must be the box lug or clamp-type design. Screw-head terminals are not acceptable for conductor terminals.
   e. All breaker frame sizes, 600 amps and larger, shall be equipped with solid state trip units that are insensitive to changes in ambient temperature. Breakers are to be furnished with rating plugs that permit changing of the breakers cover. Where shown on the drawings, breakers are to be furnished with adjustable rating plugs with setting as shown to provide maximum overload protection and coordination. The ratings plugs are to be interlocked to prevent interchangeability between breaker frame sizes.
   f. Circuit breakers are to be supplied with short time delay to provide system selectivity. The short time delay is to be adjustable from instantaneous to 10 cycles using one control that simultaneously adjusts each phase's magnetic pick-up and time delay.
   g. 2000 ampere and larger frame sizes shall be available for application of 100% of frame rating per NEC exception when installed in a properly listed enclosure.

h. Circuit breakers shall be listed with Underwriters' Laboratories Inc. (UL 489), conform to the applicable requirements of NEMA Standards Publication No. AB-1-1975, and meet the appropriate classifications of Federal Specifications W-C-375a.

i. Line side terminals shall be bolted to switchboard bus.

j. Circuit breaker ratings, modifications, etc. shall be as indicated on the drawings.

3. Mount all of the above components as shown on the Drawings in a UL approved and labeled, NEMA Class 1 floor mounted steel cabinet constructed of finished steel cleaned, primed, and painted with a baked enamel finish prior to shipment to the job site.

4. Busing

a. Provide non-tapered, 100% rated horizontal busing for all sections.

b. Provide 100% rated neutral bus.

c. Provide a 50% ground bus running full length of the switchboard and ground all non-current carrying parts of the switchboard to this ground bus.

E. Acceptable manufacturers

1. General Electric
2. Siemens
3. Square D
4. EMI
5. AMP (American Midwest Power)
6. States Electric
7. Pre-approved equal.

2.2 UTILITY METERING

A. Provide a metering compartment within the main switchboard service section containing only the Utility Company's instrument transformers with approved means of locking and sealing.

B. Install the current transformers furnished by the Utility Company. Make line and load side connections to the current transformers with removable bolted links to the switchboard bussing.

C. Locate meters per the Utility requirements.

D. Refer to Section 26 27 13: "Electricity Metering Cabinets" for metering requirements if metering is located at connection cabinet, remote from the service switchboard.

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. Provide service entrance equipment in accordance with the rules and regulations of the Power Company. Electrical energy will be received as indicated on the drawings.

B. Transformer and primary provided by the Utility.

C. Provide transformer pad per Utility requirements. Refer to Section 26 05 60: "Concrete Pads for Electrical Equipment".

D. Verify that the neutral to ground bond is in place at the service entrance equipment prior to energizing.

3.2 SERVICE CONDUCTORS

A. Provide the service feeder, wire in conduit, from the transformer or cable termination cabinet to the main distribution switchboard.

B. Provide Type XHHW or THWN service conductors.

C. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes” for approved raceway system for underground service entrance conductors.

3.3 GROUNDING

A. Provide grounding per Section 26 05 26: “Grounding and Bonding for Electrical Systems”.

3.4 IDENTIFICATION

A. Provide identification nameplates on all switchboards, and on each overcurrent device in the switchboard per Section 26 05 53: “Identification for Electrical Systems”

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Switchboards and Panelboards (NEC Article 408)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 26: Grounding and Bonding for Electrical Systems

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fittings, and Boxes

F. Section 26 05 53: Identification for Electrical Systems

G. Section 26 05 60: Concrete Pads for Electrical Equipment

H. Section 26 24 13: Switchboards

I. Section 26 43 13: Surge Protective Devices

1.3 SUBMITTALS

A. Provide switchboards and panelboards from the same manufacturer.

B. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

C. Submit "time-current data" with shop drawings for all distribution panel overcurrent devices.

PART 2 EQUIPMENT

2.1 DISTRIBUTION PANELBOARDS

A. Provide distribution panelboard assemblies adhering to the following specifications:

1. Compliant to Article 408 of the NEC: “Switchboards and Panelboards”.
2. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
3. Provide 90” high enclosure with full busing where “full height” panels are indicated on the plans.
4. Provide welded metal frame with typed circuit directory for each panel.
5. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C
6. Provide panelboards with interrupting ratings as shown on the plans. Provide switchboards, panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.

7. Provide 600 volt rated panelboards.
8. Provide sub feed or feed through lugs as indicated on the plans.
9. Provide tin-plated copper bus bars or tin plated aluminum bus bars.
10. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
11. Provide all panels by the same manufacturer.
12. Circuit Breaker Distribution Family:
    a. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, bolt-on type circuit breakers. Refer to the schedules on the plans for sizes and quantities.
    b. Compliant to the following standards: UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
    c. Series rating of circuit breakers is not allowed.
    d. Acceptable Manufacturers:
        1) Square D type I-Line series
        2) Siemens type P4 and P5 series
        3) Cutler Hammer Pow-R-Line 4B series
        4) General Electric CCB series
        5) Pre-approved equal

2.2 BRANCH CIRCUIT PANELBOARDS

A. Provide lighting and appliance panelboard assemblies adhering to the following specifications:

1. Enclosures constructed of galvanized sheet steel of thickness as required by Code, with enameled steel trim, distributed busing, hinged steel doors latches, locks and adjustable trim clamps. Provide NEMA 3R enclosures for exterior locations.
2. Provide welded metal frame with plastic-covered typed circuit directory for each panel. Directory card must be removeable to allow updating off-site if necessary. Permanently adhered panel directories are not allowed.
3. Compliant to the following standards: UL 50, UL 67, NEMA PB-1, NFPA 70 and Fed. Spec W-P-115C , UL 489, NEMA AB-1, Fed. Spec. W-C-375B/GEN, IEC 157-1 and BS 4752.
4. Provide panelboards with interrupting ratings as shown on the plans. Provide panelboards and overcurrent devices with full interrupting ratings. Reducing the interrupting rating of downstream ratings through the use of series-rated equipment is not permitted.
5. Provide 240 volt AC rated panelboards for 208/120 and 240 volt AC systems. Provide 480/277 volt rated panelboards for 480/277 volt systems.
6. Provide double main or feed through lugs as indicated on the plans.
7. Provide tin-plated copper bus bars or tin-plated aluminum bus bars.
8. Provide proper lugs (75° C. minimum temperature rating) and gutter space for cable size indicated on the plans.
9. Provide all panels by the same manufacturer.

10. Provide molded case, non-adjustable, thermal-magnetic, quick-make, quick-break, bolt-on type circuit breakers. Refer to the schedules on the plans for sizes and quantities.
11. Provide muli-pole breakers where indicated on the schedules. Handle ties on single pole breakers are not acceptable.
12. Tandem breakers are not allowed.
13. Provide circuit breakers with engraved ratings on the handle that are visible without removing the panel cover.
14. Series rating of circuit breakers is not allowed.

B. Acceptable Manufacturers:

1. 240 Volt
    a. Square D type NQOD or NF
    b. Siemens type P1 series
    c. Cutler Hammer Pow-R-line 1a series
    d. General Electric AQ series
    e. Pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Distribution Panelboards

1. Mount panels and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
2. Provide 1" empty conduits from each flush mounted panel. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
3. Provide concrete pads under all floor-mounted or free-standing distribution panelboard per Section 26 05 60: “Concrete Pads for Electrical Equipment”.

B. Branch Circuit Panelboards

1. Mount panelboards and cabinets to building structure or interior wall construction. Mount independent of conduit and raceways entering boxes.
2. Mount panelboards with topmost overcurrent device no higher than allowed by the NEC (6’-7”) above finished floor.
3. Provide 3/4" empty conduits from each flush mounted panelboard. When the floor is on grade, provide three (3) conduits into the ceiling cavity above. When the floor has accessible space below, provide two (2) conduits into the ceiling space above and two (2) conduits into the accessible space below the floor. Ends shall be capped and shall be tagged at both ends with permanent tags.
4. Provide each circuit in the panel(s) with a circuit number securely fastened to the breaker for identification purposes.

5. Provide a circuit directory completely typed on the interior of each panel door.

3.2 GROUNDING

A. Provide grounding per Section 26 05 26: “Grounding and Bonding for Electrical Systems”.

3.3 IDENTIFICATION

A. Provide typed circuit directories in the inside cover of all panelboards and distribution panels.

B. Provide identification nameplates on all panelboards and distribution panels, and on each overcurrent device (including spares) in distribution panelboards per Section 26 05 53: “Identification for Electrical Systems”.

END OF SECTION

SECTION 26 27 13

ELECTRICITY METERING CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 33: Raceways, Fittings, and Boxes

C. Section 26 05 60: Concrete Pads for Electrical Equipment

D. Section 26 24 13: Switchboards

E. Section 26 28 13: Low Voltage Fuses

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of meters and auxiliaries whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of meters.

C. UL Compliance: Provide meters and components which are UL listed and labeled.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit shop drawings of the connection cabinet meters/sockets/enclosures to Utility for approval prior to submittal to the Engineer. Include data substantiating that units comply with utility requirements.

PART 2 EQUIPMENT

2.1 CABLE TERMINATION CABINET

A. Provide UL listed cabinet that meets Utility requirements.

B. Provide fully-assembled, free standing, NEMA type 3R cabinet. Provide minimum 12 gauge (min.) galvanized steel structure with 14 gauge (min.) panels.

C. Provide 3-point latch, padlock hasps and wind stops on doors.

D. Paint the enclosure transformer green.

E. Provide 600 volt rating, 3 phase 4 wire.

F. Provide electrical grade aluminum (max. 750 A/sq.in.) or copper (max 1000 A/sq.in.) busing. Support bus bars on plastic insulators with provisions for utility current transformers.

G. Provide lugs in sufficient quantity and size to terminate all conductors. Provide 75 degree C rated lugs, minimum.

H. Size cabinet for the service entrance conductors. Provide minimum short circuit withstand rating of 85,000 amperes RMS without cable lashing required.

I. Provide busing with at least the same ampacity as the main switchboard if not specifically sized otherwise on the plans.

J. Provide a metering compartment containing only Utility's current transformers with approved means of locking and sealing.

K. Locate meters per Utility requirements, following the recommended clearance requirements from Utility.

L. Acceptable Manufacturers

1. EMI
2. States Electric
3. American Midwest Power
4. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF SERVICE ENTRANCE EQUIPMENT

A. The service is to be installed in strict accordance with the rules and regulations of the Power Company. The Electrical Contractor is responsible for all negotiations with the Power Company with regard to the service connections, and shall initiate the necessary request to the Power Company for the work which will be performed by the Power Company.

B. The Electrical Contractor is to pay all fees and charges submitted by the Power Company for their part of the service installation and connections. Provide all work required by the Power Company to facilitate the complete installation of the services. No extras will be allowed because of the failure of the Electrical Contractor to contact the Power Company and determine what will be required by the Contractor in order to complete the service installation.

3.2 CABLE TERMINATION CABINET

A. Install on same contiguous concrete pad as the utility transformer. Refer to Section 26 05 60: "Concrete Pads for Electrical Equipment"

B. Provide raceway between transformer and connection cabinet per the Utility company requirements.

C. Terminate secondary service entrance conductors.

D. Install the current transformers (furnished by Utility). Make line and load side bolted connections of the current transformers at the removable bolted links on the bussing.

E. Provide 3/4" (minimum) conduit from connection cabinet to meter location(s). Provide conductors between CT's and meters.

F. Provide and make terminations to the service entrance conductors on the load side of the connection cabinet busing. Refer to the Power Riser Diagram for sizes and quantities.

3.3 IDENTIFICATION

A. Provide identification in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 29: Supporting Devices

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 05 53: Identification for Electrical Systems

E. Section 26 28 13: Low Voltage Fuses

1.3 DESCRIPTION OF WORK

A. Furnish and install where shown electrical cabinets and enlcosures. The electrical cabinets and enclosure shall contain the electrical equipment, metering, and control equipment as detailed on the drawings.

B. The cabinet shall be fabricated and assembled as complete units, complete with all components in place and internally prewired with terminals and terminal strips provided for connections to be made in the field.

C. Refer to other Division 26 sections for cable, wire, connectors, electrical raceway work, motor starters and supervisory control required in conjunction with electrical cabinets and enclosures.

1.4 QUALITY ASSUSANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical cabinets and enclosures of types, ratings and characteristics required, whose products have been in satisfactory use.

B. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of electrical cabinets and enclosures.

C. UL Compliance: Provide equipment and components which are UL listed and labeled.

D. NEMA and ANSI Compliance: Comply with applicable requirement so NEMA and ANSI standards as referred herein.

1.5 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Product Data: Submit manufacturer’s data including specifications, installation instructions and general recommendations for each type of cabinet required. Include data substantiating that units comply with requirements.

PART 2 EQUIPMENT

2.1 EQUIPMENT RACKS AND ENCLOSURES

A. Sound System racks and enclosures – Refer to Division 27 for specifications.

B. Technology equipment racks – Refer to Division 27 for specifications.

C. Video Equipment racks – Refer to Division 27 for specifications.

2.2 TELEPHONE CABINETS

A. Provide recessed phone cabinets that adhere to the following minimum specifications:

1. 16 gauge (min.) housing and door.
2. Continuous recessed LH hinge.
3. Clear polycarbonate (0.188" min. thickness) insert with 1" high letters stenciled "Emergency Phone"
4. Recessed handle
5. Minimum dimensions: 12" wide x 12" high x 7" deep
6. Provisions for ¾" knockouts on top, sides or back of box for routing low voltage cabling and mounting of 2-post telephone outlet.
7. Grounding lug.

B. Approved manufacturers:

1. EMI
2. Hoffman
3. Pre-approved equal

2.3 SWITCH CABINETS

A. Provide recessed switch cabinets that adhere to the following minimum specifications:

1. Sized to accommodate toggle switches for gym lighting control, key switches for backboard motor control, toggle switches for scoreboard power, key switches for gym curtain control and future space for additional switches if called out on the plans.
2. 14 gauge (min.) housing and 12 gauge (min.) door.
3. Interior hinged panel to allow access to all switch wiring and to mount devices.
4. Provide a minimum of two horizontal stiffener reinforcing members on the door and internal hinged panel.
5. Continuous recessed LH hinge.
6. Provide painted cover to match surrounding finish.
7. Recessed "T" handle with single point latch.
8. Minimum dimensions: 24" wide x 16" high x 6" deep
9. Provisions for ¾" knockouts on top, sides or back of box for conduit connections.
10. Provide mechanically-fastened, engraved nameplates under each switch.
11. Grounding lug.

B. Approved manufacturers:

1. EMI
2. Hoffman

3. Pre-approved equal

2.4 PULLBOXES

A. Refer to Section 26 05 33: “Raceways, Fittings, and Boxes” for pullbox requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical cabinets and enclosures as indicated, in accordance with equipment manufacturer’s written instructions, and with recognized industry practices.

B. Coordinate with other electrical work including, wiring and raceway work, as necessary to properly interface installation of electrical cabinets and enclosures.

C. Verify mounting heights for cabinets installed in finished areas with Architect prior to installation.

D. Provide recessed cabinets in areas of finished construction.

E. Touch-up scratched or marred surfaces to match original finishes.

F. Grounding: Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground.

G. Flush-mount telephone boxes no higher than 50” above finished floor to center of cabinet.

H. Mount spare fuse cabinet(s) on wall adjacent to the main distribution switchboard or as indicated on the plans.

3.2 IDENTIFICAITON

A. Equipment/System Identification: Provide equipment/system identification nameplates complying with Section 26 05 50: Electrical Identification.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 26: Grounding and Bonding for Electrical Systems

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 27 19: Multi Outlet Assemblies

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 WIRING DEVICES

A. Provide new wiring devices in each outlet indicated on the drawings.

B. Provide devices from one manufacturer.

C. Provide white wiring devices for receptacles connected to normal utility power.

D. Provide toggle white switches that adhere to the following specifications:

1. Federal Specification WS896-E.
2. Rated for 20 amperes, 120-277 volts unless noted otherwise.
3. NEMA WD1 standards.
4. UL listed.
5. Side and back wiring options.

E. Provide momentary contact white switch that adher to the following specification:

- Heavy duty toggle
- Low voltage momentary contact
- 3 amp, 24-AC/DC rating
- Design to match convational switches

F. Approved toggle switch manufacturers/model numbers:

Mfr.	20A/120-277V Wall Switches						
	1-pole	1-pole w/Pilot	2-pole	3-way	4-way	Keyed 1-pole	Mom. Contact
Cooper	2221	2221PL	2222	2223	2224	2221L	1995
Hubbell	HBL1221	HBL1221PL	HBL1222	HBL1223	HBL1224	HBL1221L	HBL1557
P&S	PS20AC1	**PS20AC1-RPL**	PS20AC2	PS20AC3	PS20AC4	**PS20AC1-L**	1251
Leviton	1221-2	1221-2PL	1222-2	1223-2	1224-2	1221-2L	1257

G. Provide receptacles that adhere to the following specifications:

1. Federal Specification WC596.
2. UL listed.
3. Side and back wiring options.
4. One piece solid brass ground strap with integral ground, except GFI receptacles.
5. NEMA 5-20R configuration, rated for 20 amperes at 125 volts, unless noted otherwise. Provide special purpose receptacles rated for the equipment used.
6. Provide SPD (Surge Protective Devices) receptacles that adhere to UL 1449 (second edition), UL 498 and ANSI/IEEE 62.41-1991.

H. Approved standard receptacle manufacturers/model numbers:

Mfr.		20A/125V Standard Receptacles					
	Simplex	Duplex	GFI	IG	DUP W/ USB	SPD	Tamper Resistant
Cooper	5361	5362	XGF20	IG5362	TR9345	5362S	TR8300
Hubbell	HBL5261	HBL5362	GFR5352A	IG5362	USB8300GY	HBL5360SA	HBL8300SGA
P&S	5361	5362A	2094	IG6300	TR8300HUS	8300SP	TR63H
Leviton	5361	5362	8899	5362-IG	T5832-HGG	7380	8300-SG

I. Provide specification grade special purpose receptacles as indicated on the plans.

J. Provide combination recessed, 120 volt, 20amp duplex receptacle with (2) high powered USB charging ports (3.6amps). Capability to charge both USB ports and allows the receptacles to be utilitzed at the same time. Grounding, side wired and back wired.

2.2 WALLBOX DIMMERS

A. Provide solid state, slid-type dimmers suitable for mounting behind a standard depth faceplate and for operation on common neutral circuits.

B. Provide sufficient capacity dimmer to accommodate the connected load of the light fixtures controlled by the dimmer. Provide 600 watt minimum size dimmers.

C. Provide power pack where required for loads gerater than 8 amps.

D. Provide dimmers that are compatible with any IEC 60929 annex E compliant LED driver and ballasts.

E. Coordinate dimmer selection with LED driver and ballast manufactuer specification for 0-10V sink currents.

F. Approved Manufacturers:

1. Lutron Nova T-star series
2. Pre-approved equal.

2.3 COVERPLATES

A. Interior Coverplates: Provide new coverplates over all boxes with the following minimum specifications:

1. All finished areas and unfinished areas with recessed boxes: Provide type 302 stainless steel with smooth satin finish.
2. Unfinished areas over surface mounted boxes: Provide raised metal cover to match the surface metal box.
3. Provide appropriate covers over special purpose receptacles.

B. Exterior Coverplates: Provide new 2-gang, "while in use", weatherproof coverplates for outlets and switches as indicated on the Drawings. Provide weatherproof boots for all dropcords as indicated on the Drawings.

1. Weatherproof switch coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing switch; or cast aluminum with lever and weatherproof gasket.
2. Weatherproof receptacle coverplates: Cast aluminum or Lexan with cover and vinyl gasket for weatherproofing receptacle.
3. Approved manufacturers:
    a. Red Dot 2CKD Series
    b. Leviton 5977-CL series
    c. Pass and Seymour WIU series
    d. Pre-approved equal
4. Weatherproof boots: Yellow rubber, with overlapping design to seal out water and dirt. Rubber boot shall keep weatherproof seal intact when plug is used with wall mounted receptacles.

PART 3 EXECUTION

3.1 WIRING DEVICES

A. Provide new devices for outlets indicated. Provide individual GFI, isolated ground and surge suppression device for each duplex receptacle in ganged outlets.

B. Wire each device by wrapping the conductors around the terminals and torquing the screw terminal tight.

C. Mount all receptacles with the ground lug on the top.

D. Replace receptacles and plates that have been damaged, burned or discolored during construction, prior to Substantial Completion.

E. Install wall plates after all painting has been completed.

F. Mount wall mounted dimmers in separate boxes from switches.

G. Test wiring devices for continuity, proper polarity connections and grounding.

3.2 WALLBOX DIMMERS

A. Provide all devices (dimmers, accessories and wallplate kits), labor and other services necessary for the proper installation of the devices as indicated on the drawings and specified herein.

B. Contactor shall be responsible for derating dimmer capacity if side sections are removed.

C. Provide separate neutral wires in 120/208V installations. Provide control wiring in separate conduit. Comply with manufacturer's restrictions or length of run for control wiring.

D. Devices shall be installed utilizing manufacturers recommended application, wiring and installation instructions.

E. Provide seamless wallplate covers for all devices ganged in a common box. Provide barriers within the box where required by code.

END OF SECTION

SECTION 26 28 13

LOW VOLTAGE FUSES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 24 13: Switchboards

C. Section 26 24 16: Panelboards

D. Section 26 27 16: Electrical Cabinets and Enclosures

E. Section 26 28 16: Safety Switches

F. Section 26 29 13: Motor Control

G. Section 26 29 23: Variable Frequency Drives

H. Section 26 56 13: Lighting Poles and Standards

I. Comply with Nema FU 1 for cartridge fuses.

J. Comply with NFPA 70.

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit "time-current data" with shop drawings for all fuses.

PART 2 EQUIPMENT

2.1 FUSES

A. Provide fuses of the following types (Bussman used as reference):

1. 601 amps and larger: Time-delay type designed to hold 500% of rated current for a minimum of 4 seconds and clear 20 times current in 0.01 seconds or less with interrupting ratings of 200,000 amperes RMS symmetrical and peak let-through current and energy let-through values established by U.L. Standard for Class L fuses. Provide KRP-C fuses.

2. 600 amps and smaller: Dual-Element construction with interrupting rating of 200,000 amperes RMS symmetrical and peak let-thru current established by U.L. Standard for Class RK-1 fuses. Provide LPN-RK/LPS-RK.

3. Motor circuits: Protect all individual motor circuits with full load ampere rating (FLA) of 480 amperes or less with dual-element time-delay fuses. Provide LPN-RK/LPS-RK. Protect larger horsepower motors with time-delay fuses. Provide KRP-C fuses. Provide U.L. Class RK1, dual-element time-delay for all other motors.

4. Motor Controllers: Protect NEMA and IEC style motor controllers with dual-element, time-delay fuses to provide Type 2 coordination for the controller. Provide LPS-RK fuses.

5. Protect circuit breaker panels with U.L. Class RK1, Class L fuses. Provide LPN-RK, LPS-RK, or KRP-C fuses.

B. Class J fuses are not allowed.

C. Acceptable manufacturers:

1. Bussman
2. Ferraz-Shawmut
3. Littelfuse
4. Pre-approved equal.

2.2 IN-LINE FUSEHOLDERS

A. Provide in-line fuseholders with fuses for parking lot light poles, walkway light poles and bollard type light fixtures.

B. Provide dual fuse holders for multi-pole applications

C. Provide load-side breakaway style fuseholders.

D. Provide proper size crimp type connection for load and line side connetions.

E. Provide 200,000 AIC rated Class CC fuses.

F. Approved manufacturers:

1. Ferraz-Shawmut FEC-BA (single pole) & FEY-BA (two pole)
2. Littelfuse LEC-S (single pole) & LEY-S (two pole)
3. Pre-approved equal

PART 3 EXECUTION

2.3 FUSES

A. Provide fuses for all equipment utilizing fused switches or fused safety switches.

B. Verify proper size fuses for all equipment prior to ordering fuses.

END OF SECTION

SECTION 26 28 16

SAFETY SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 14 00 00: Conveying equipment (Elevators)

B. Section 26 01 00: Common Work Results for Electrical

C. Section 26 05 33: Raceways, Fittings, and Boxes

D. Section 26 05 53: Identification for Electrical Systems

E. Section 26 28 13: Low Voltage Fuses

F. Section 26 29 13: Motor Control

G. Section 26 29 23: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit a table (see Forms at the end of this section), listing all components by equipment tag with the following information indicated:

1. Safety Switch type, size, rating, enclosure type, switches poles, solid poles, HP rating
2. Fuse size and type (if fused)
3. Identification tag/nameplate

PART 2 PRODUCTS

2.1 SAFETY SWITCHES (DISCONNECT SWITCHES)

A. General requirements

1. Provide safety switches as disconnects for all utilization equipment as indicated on the Drawings.
2. Provide lockable handle with multiple hasps to allow proper lockout-tagout procedures.
3. Provide NEMA 3R enclosures when mounted outside. Provide bolt-on hub kit(s) for conduit connections in order to maintain NEMA 3R rating.
4. Provide NEMA 4X non-metallic KRYDON™ switch enclosure for all pool equipment.
5. Unless specifically noted otherwise, provide 3-pole with solid neutral bus for landing line and load side neutral conductors.
6. Provide proper size and quantity of lugs to terminate all phase conductors and neutral conductor. Neutral conductors may require more lugs, and a larger size.
7. Provide interior ground lug.

8. Provide auxiliary contacts in safety switches when used for the following situations:
    a. Elevator disconnect: To allow power to be shut off to the elevator without initiating battery lowering function.
    b. When used in conjunction with VFD's remote from the equipment: To signal the VFD to shut off to avoid voltage spikes.

B. Fused or unfused switch type
1. Provide heavy duty switch with quick-make, quick-break mechanism with positive interlock.
2. Hinged door with mechanical interlock in the ON position, with defeat mechanism.
3. Provide switch with switch mechanism suitable for the type and size fuses specified in Section 26 28 13: "Low Voltage Fuses", whenever fused switches are required.
4. Provide horsepower rated disconnects, fully rated for load-break and load-make operation.
5. Provide service entrance rated switches where required.
6. Provide 200% neutral connection in the switch when serving a SPD grade technology panelboard. Refer to the panelboard summary schedule on the plans, power riser diagram and/or Section 26 43 13: Surge Protective Devices.
7. Approved manufacturers:
    a. Cutler-Hammer DH series
    b. General Electric TH series
    c. Siemens Type VBII series
    d. Square-D Class 3110 series
    e. Allen Bradley 1494 series
    f. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install safety switches with operator handle no higher than 6'-7" above finished floor in front of the safety switch unless otherwise allowed by the NEC.

B. Mount safety switch as close to the equipment as possible. Provide unistrut rack if necessary.

C. Do not mount safety switches on removeable panels on the equipment served. Coordinate location of safety switches with the equipment provider prior to installing the switch.

D. Install safety switches with proper working clearances about the switch.

3.2 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 05 53: "Identification for Electrical Systems" on all safety switches. Label per the name of the device controlled unless noted otherwise on the plans.

3.3 FORMS

A. Fill out the attached form with the information for each safety switch.

END OF SECTION

SAFETY SWITCHES FORM

Tag/ID or Equipment served by Safety Switch	Volts	Ampacity	Fused, Nonfused or Circuit breaker	NEMA Enclosure	Location of Safety Switch (Room #)

SECTION 26 29 13

MOTOR CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 05 53: Identification for Electrical Systems

C. Section 26 05 60: Concrete Pads for Electrical Equipment

D. Section 26 27 26: Wiring Devices

E. Section 26 28 13: Low Voltage Fuses

F. Section 26 28 16: Safety Switches

G. Section 26 29 23: Variable Frequency Drives

1.3 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

B. Submit a table, listing all components by equipment tag with the following information indicated:

1. Starter type and size
2. Disconnect type and size
3. Combination motor starter type and size and if it has a phase failure relay in the enclosure.
4. Control station type and mounting type (surface or flush mounted)
5. Motor starter switch type and mounting type (surface or flush mounted)
6. Phase failure relay.

C. Indicate short circuit current ratings for all equipment.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. All motors will be provided by the Contractor providing the equipment to be driven.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide equipment with a short circuit current rating equal to or larger than the available fault current at the source panel.

2.2 MANUAL STARTER SWITCHES - TYPE MSS

A. Provide "on-off" toggle type manual starter switch with thermal overload protection for single phase motors.

B. Provide each switch with a red pilot light indicating when motor is on.

C. Provide switches located outdoors in a NEMA 4 enclosure and switches located indoors in a NEMA 1 enclosure unless indicated otherwise.

D. Approved Manufacturers (surface mounted):

1. Allen-Bradley bulletin 600 TAX4/TAX5, with pilot light bulletin 600 TAX216/TAX109
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent

E. Approved manufacturers (flush mounted):

1. Allen-Bradley bulletin 600 TXQ4/TXQ5, with pilot light bulletin 600 TQX216/TQX109
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent

2.3 MANUAL STARTERS

A. Provide full voltage type starters and thermal overload protection for three phase motors, requiring manual starters, unless indicated otherwise. Provide each switch with a red pilot light indicating when motor is on.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Acceptable Manufacturers for manual starters:

1. Allen-Bradley bulletin 609 series with pilot light
2. Square D equivalent
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent
6. pre-approved equal.

2.4 MAGNETIC STARTERS

A. Provide full voltage type starters and thermal overload protection and external manual reset for all three phase motors, unless indicated otherwise.

B. Provide starters located indoors in NEMA 1 enclosure, and starters located outdoors in NEMA 3R enclosure unless indicated otherwise.

C. Equip each starter with 120 volt coil, control power transformer, secondary fuse block and fuses, 1 set of spare N.O and 1 set of spare N.C. auxiliary contacts, red "ON" pilot light, and "HAND-OFF-AUTO" control switch.

D. Provied additional aux contacts as required to allow power factor correction capacitors to be installed properly without modifications to the starter.

E. Provide phase failure relays for all three-phase motors 3 HP and larger.

F. Acceptable Manufacturers for magnetic starters:

1. Allen-Bradley Bull. 509 &512
2. Square D Class 8536
3. Cutler Hammer equivalent
4. General Electric equivalent
5. Siemens equivalent
6. Pre-approved equal.

2.5 COMBINATION MAGNETIC STARTERS

A. Provide unit with fused disconnect and magnetic starter as specified in paragraph 2.3. Provide disconnect with quick make-quick break mechanism and interlock so switch must be in off position before covers can be open. Provide disconnect handle capable of accepting padlocks.

B. Provide phase failure relays for all three-phase motors 3 HP and larger.

C. Acceptable manufacturers: As specified in paragraph 2.3.

2.6 PHASE FAILURE RELAYS

A. Provide motor protection relay that sense phase loss, phase reversal, low voltage and voltage unbalance conditions for all three phase motors three (3) HP and larger.

B. Provide auto-reset with time delay.

C. Provide octal base plug-in type relays.

D. Verify proper voltage for all relays.

E. Approved manufacturers:

1. TimeMark Model #A-258 series
2. Allen Bradley #8135
3. Square D #8430MPS
4. SymCom Model 201A
5. Cutler Hammer / Eaton D65VMLP
6. pre-approved equal.

2.7 CONTROL STATIONS

A. Provide HP rated toggle switches per Section 26 27 26 where toggle switches are called out to control equipment.

B. Provide standard duty control stations in NEMA 1 enclosures, unless indicated otherwise.

C. Provide flush mounted devices and plates in all finished areas.

D. Acceptable manufacturers (surface mounted):

1. Allen Bradley (number indicated for reference)
   a. Momentary start-stop - 800S-2SA.
   b. Maintained start-stop - 800S-2SCM.

c. Momentary start-stop with pilot light - 800S-2SAP.

d. Maintained start-stop with pilot light - 800S-2SBMP.

e. Momentary 3 unit - 800S-3S series.

f. Hand-Off-Auto - 800S-R44SX.

g. Hand-Off-Auto with pilot light - 800-R3SXP.

2. Cutler Hammer equivalents
3. General Electric equivalents
4. Siemens equivalents
5. Square D equivalents
6. Pre-approved equal.

E. Acceptable manufacturers (flush mounted):

1. Allen Bradley (number indicated for reference)

a. Momentary start-stop - 800S-2ASQ.

b. Maintained start-stop - 800S-2BSMQ.

c. Momentary start-stop with pilot light - 800S-2ASPQ.

d. Maintained start-stop with pilot light - 800S-2BSMPQ.

2. Cutler Hammer equivalents
3. General Electric equivalents
4. Siemens equivalents
5. Square D equivalents
6. pre-approved equal.

2.8 DISCONNECTS

A. Provide disconnect switches as specified in Section 26 28 16: Safety Switches.

B. Provide NEMA-3R enclosures for safety switches mounted outside.

C. Provide NEMA 4X non-metallic safety switches when used in exposed unprotected exterior locations, or for pool equipment.

PART 3 EXECUTION

3.1 WIRING

A. Make connections to all motors and power equipment and leave equipment in working order. Check all motors for proper rotation. Tighten connectors and terminals in accordance with manufacturers' recommendations.

B. Coordinate motor location, controls, wiring, etc. with other Divisions as required for proper interface.

C. Make connections to control devices as indicated in the Drawings. Install all control devices in starter covers unless indicated otherwise. For remote mounted control devices and manual starter switches, surface mount devices in unfinished areas and flush mount devices in finished areas.

D. Extend power and/or control wiring for roof mounted equipment to the equipment within the unit curb. Separate roof penetrations are not allowed.

3.2 OVERLOAD PROTECTION

A. Provide properly sized overcurrent and overload protection for each motor called out to have overcurrent and overload protection.

B. Measure the full load current and provide motor overload elements accordingly. Indicate the overload element manufacturer, type, and size of the inside cover of each starter.

C. Submit complete list of "Motor and Starter Installation Data" to the Engineer prior to final completion. Include as a minimum the following information: Motor Name, Motor Location, Starter Location, Starter Type, Starter Manufacturer, Starter Model, Overload Type, Overload Size and Control Station Type and Model.

3.3 PHASE FAILURE RELAYS

A. Install phase failure relays inside the starter enclosure including manual starter enclosures, magnetic motor starter enclosures, motor control center starter tubs, and combination starter/disconnect enclosures.

B. Provide all required control wiring between relay and the starter.

3.4 SAFETY SWITCHES (DISCONNECTS)

A. Provide a lockable disconnect mounted on or adjacent to each motor starter (including VFD's) as required by NEC Article 430.102(A).

B. Provide a lockable disconnect mounted on or adjacent to each motor as required by NEC Article 430.102(B).

3.5 IDENTIFICATION

A. Provide engraved nameplates as specified in Section 26 05 53: "Identification for Electrical Systems" on all motor starter switches, magnetic starters, combination starters, contactors, disconnects, and control devices. Label per the name of the device controlled unless noted otherwise on the plans. Provide "SPARE" nameplates over spare equipment.

3.6 FORMS

A. Fill out the attached form with the information for each motor control device.

END OF SECTION

MOTOR CONTROL SCHEDULE

Tag/ID or equipment served	Volts	HP	RLA	Starter Type • MSS • FVNR • VFD	Starter Size (NEMA)	Starter Location (Room #)	Combination Starter/Disc?			
							Yes / No	Fused / NF		

SECTION 26 51 13

LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 09 21: Contactors

E. Section 26 05 29: Supporting Devices

F. Section 26 05 33: Raceways, Fitting and Boxes

G. Section 26 09 23: Occupancy Sensors

H. Section 26 27 26: Wiring Devices

I. Section 26 52 00: Emergency Lighting

J. Section 26 53 00: Exit Signs

1.3 DEFINITIONS

A. The term 'lighting fixtures' shall be considered the same as Luminaires per the definition Luminaires in the NEC, Article 100-Definitions.

1.4 SUBMITTALS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: "Submittals, Closeout Documents, Training and Spare Parts".

B. Submit shop drawings in booklet form with separate sheet for each fixture assembled in alphabetical order by 'type'. Submit manufacturer's data including dimensioned drawings and photometric data prepared by an independent nationally recognized testing lab.

C. Submit shop drawings for each ballast type as specified and/or indicated on the drawings.

D. Additional requirements for indirect linear lighting:

1. Submit scaled plan of each room or areas where the above types are used. Indicate fixture lengths, anchoring locations, feed points, internal wiring diagram of each fixture that shows all switchleg wiring any all low voltage dimming ballast wiring.

2. Identify each light fixture with type and room number used. Provide shipping label that identifies the room number and installation location of each light fixture. Include the plan described above in #1, inside each fixture box shipped to the site.

PART 2 PRODUCTS

2.1 LIGHT FIXTURES

A. Provide fixtures with lamps, ballasts and/or drivers, for each outlet shown on the Drawings and as specified herein. Refer to light fixture schedule on the drawings.

B. Provide U.L. approved fixtures.

C. The type fixtures required are as noted by a capital letter on the Drawings. Contractor is solely responsible for the exact quantities.

D. Provide color stabilized clear virgin acrylic diffusers for interior fixtures. Provide a minimum thickness of 0.156" for troffer lenses.

E. Provide required disconnects at each light fixture as required under the 2014 NEC 410.130(G).

2.2 LED FIXTURES

A. LED fixtures shall be provided as a complete luminaire.

B. Driver

1. The driver's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

C. Housing

1. The electronics/power supply enclosure shall be internal to the luminaire and be accessible per UL requirements.

D. Technical

1. Fixtures shall be tested and rated per most recent edition of IESNA LM-79 and IESNA LM-80, with rated life of 50,000 hours or greater.
2. LED fixture shall be qualified with DLC (Design Lights Consortium).
3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
4. The operating temperature range shall be 10°F to 104°F.
5. Parameters and tests shall be conducted at different ambient temperatures.
6. Thermal management shall be of sufficient capacity to assure proper operation of the luminaire over the rated life.
7. The maximum junction temperature for the rated life shall not be exceeded at the average operating ambient.
8. The maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
9. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
10. Power Factor: The luminaire shall have a power factor of 0.90 or greater at all standard operating voltages.
11. THD: Total Harmonic Distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage.

12. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
    a. The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 for Location Category A-Low. Where failure does not mean a momentary loss of light during the transient event.
    b. Surge protection performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41 definitions for standard and optional waveforms for Location Category A-Low.
13. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
14. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
15. Dimming is required. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output. Dimming shall be controlled by a 0-10V signal.
16. Lumen Management (where indicated): The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation function.
17. Output Color: Minimum CRI 80, and color temperature 3500 D (+/- 100K) unless noted otherwise.
18. Manufacture shall provide a minimum of five year warranty of coverage. Warranty shall include, fixture construction, LED light engine and driver.
19. Energy Star Rated.
20. LED's shall be manufactured by CREE or PHILLIPS.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide 100 hour initial burn in for fluorescent lamps connected to dimmers or daylight sensors. Refer to Section 26 09 24: "Daylight Sensors".

B. Provide hangers, rods, mounting brackets, supports, frames, etc. for proper and safe fixture installation. Install fixtures in accordance with manufacturers' recommendations and instructions. Refer to Section 26 05 29: "Supporting Devices" for approved supporting methods.

C. Provide fixtures complete with all auxiliaries required for proper, safe and distortion free installation in the various ceiling constructions in which they appear. Coordinate ceiling types with the Architectural drawings and provide compatible fixtures.

D. Where master/slave or inboard/outboard switching is indicated, provide tandem-wired ballasts between light fixtures as required by the Minnesota Energy Code.

3.2 CONDUCTORS

A. Wire recessed lay-in fixtures with 6 feet of flexible metal conduit with Type "THHN/THWN" conductors to the outlet box. Provide grounding type connectors for conduit and cable.

B. Provide outlet boxes adjacent to each recessed fixture outlet in suspended ceilings to permit each fixture to be adjusted to fit ceiling pattern and to permit "Feed Through" wiring.

C. Provide conduit for conductors to exterior site fixtures including but not limited to parking lot, walkway, athletic field and/or bollards.

3.3 QUALITY CONTROL

A. At the time of substantial completion, fixtures must be installed and lamped with new lamps. Install fixtures complete with lenses, diffusers, reflectors, louvers and other required accessories. Furnish a minimum of one case of replacement lamps for each type and size lamp used. Deliver replacement stock to the Owner's storage space as directed by the Owner.

B. Replace any damaged reflectors, diffusers, louvers or other components at no expense to the Owner.

C. Clean fixtures free of dust, finger prints, paint, etc..

D. Perform aiming and adjustment of lighting fixtures in accordance with instructions issued by the Engineer. Adjust directional type fixtures (interior and exterior) after dark under the direction of the Architect, Engineer, and/or Owner.

E. Replace defective ballasts within the guarantee period at no cost to the Owner.

END OF SECTION

SECTION 26 52 00

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fitting and Boxes

F. Section 26 51 13: Lighting

G. Section 26 53 00: Exit Signs

H. Emergency Systems (NEC Article 700)

I. Life Safety Code (NFPA 101)

1.3 SHOP DRAWINGS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 UNIT BATTERY EQUIPMENT

A. Provide unit battery equipment that adhere to the following minimum specifications:

1. 120 and 277 volt operation.
2. UL 924 listed.
3. 12 volt, long life, maintenance-free, nickel cadmium type batteries.
4. Batteries sized to illuminate all lamps for 90 minutes.
5. Low voltage battery protection to prevent deep battery discharge during extended outages.
6. Brown out sensing to activate unit when line voltage drops below 80%.
7. Solid state load transfer relay.
8. Integral internal solid state charger.
9. Provide pilot light and test switch. [Self-testing diagnostics]
10. Designed to be wall and/or ceiling mountable.
11. Interior lamps/heads
    a. Thermoplastic heads with fully adjustable swivel, rotation and tilt.

b. Interior lamps: Provide a minimum of 1.0 footcandle along the path of egress at the floor, with units spaced 40'-0" on center at 7'-6" mounting height above finished floor (refer to drawings for actual mounting heights):

1) Twin 8-watt tungsten halogen, sealed beam, PAR36 lamps OR.

2) Twin 5-watt, sealed beam MR-16 lamps.

12. Exterior lamps/heads

a. UL wet label listed.

b. Cast metal or milled housing and cast mounting brackets and boxes.

c. Twin MR-16 flood lamps, 20 watts each, 12 volt operation.

B. Performance

1. Provide emergency lighting to illuminate the egress corridors and other required areas along the or to the path of egress. Refer to the light fixture schedule on the drawings for types.

2. Provide an intensity of not less than 1.0 footcandle at the floor level along the path of egress.

C. Approved manufacturers

1. Refer to the Light Fixture Schedule

2.2 BATTERY PACKS FOR LED FIXTURES

A. Provide battery packs for LED lighting that meets the following minimum requirements:

1. Provide long life, maintenance-free nickel-cadmium batteries.

2. Provide batteries capable of maintaining the required egress illumination for 90 minutes.

3. Low voltage protection to prevent deep battery discharge during extended outages.

4. Brown out protection to activate unit when line voltage drops below 80%.

5. Solid state load transfer relay.

6. Solid state charger.

7. Automatic self-testing.

8. Provide pilot light and test switch visible from below, inside door frame.

B. Verify case size in order to fit inside light fixture housing. Units that do not fit inside the light fixture housing are not acceptable.

C. Approved manufacturer:

1. Bodine. No substitutions. Refer to the Light Fixture Schedule.

2.3 VANDAL GUARDS FOR UNIT BATTERY EQUIPMENT

A. Provide vandal guards where indicated on the plans, that adhere to the following minimum specifications:

1. Separate polycarbonate enclosure, mounts to wall. Shields that mount directly to fixtures are not acceptable.

2. Separate wire guards, mounts to wall. Guards that mount directly to fixtures are not acceptable.

3. Provide guard sized to allow full aiming of heads without binding on the guard.

B. Approved Manufacturers

1. Safety Technology International, Inc.
2. Pre-approved equal

PART 3 EXECUTION

3.1 UNIT BATTERY EQUIPMENT

A. Install a complete and operational emergency lighting system in accordance with NEC article 700 and Chapter 5 of NFPA 101 Life Safety Code.

B. Install equipment as recommended by the Manufacturer. Notify the Engineer of any discrepancies.

C. Support battery units directly from building structural members. Mount units to walls wherever possible.

D. Route raceway down from ceiling to wall mounted devices. Minimize the use of exposed raceway routed through finished spaces.

E. Connect emergency lights to the unswitched lighting branch circuit in the area served by the unit equipment.

F. Install remote emergency lights where indicated. Provide wiring between the remote heads and the battery packs to maintain UL listing of system.

G. Adjust emergency fixture heads for maximum effectiveness or as directed by the Engineer.

3.2 EMERGENCY BATTERY BALLASTS

A. Connect emergency battery ballasts to the unswitched lighting branch circuit in the area served by the unit equipment. Provide handle lock on breaker(s).

3.3 VANDAL GUARDS

A. Securely mount guards to structure using standard hardware with dedicated anchors. Refer to Section 26 05 29: "Supporting Devices".

B. Provide a minimum of four anchors (1 per corner), or additional if recommended by the guard manufacturer.

3.4 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide this additional manufacturers warranties:

1. Unit Battery Equipment: Provide 3 year warranty for NiCd battery type units with 5 year pro-rated warranty on NiCd batteries.
2. Emergency Battery Ballasts: Provide 5 year warranty.

END OF SECTION

SECTION 26 53 00

EXIT SIGNS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 REFERENCES

A. Section 26 01 00: Common Work Results for Electrical

B. Section 26 01 20: Testing and Adjustments to Electrical Systems

C. Section 26 05 19: 600 Volt Conductors and Cables

D. Section 26 05 29: Supporting Devices

E. Section 26 05 33: Raceways, Fitting and Boxes

F. Section 26 51 13: Lighting

G. Section 26 52 00: Emergency Lighting

H. Emergency Systems (NEC Article 700)

I. Life Safety Code (NFPA 101)

1.3 SHOP DRAWINGS

A. Submit shop drawings and descriptive data in accordance with Section 26 01 05: “Submittals, Closeout Documents, Training and Spare Parts”.

PART 2 PRODUCTS

2.1 EXIT SIGNS

A. Provide exit signs that adhere to the following minimum specifications:

1. 120 and 277 volt operation.
2. Multiple LED lamp source.
3. NFPA 101 and EPA/DEP Energy Star Compliant.
4. Green or red stenciled letters (refer to light fixture schedule)
5. Black or white housing (refer to light fixture schedule)
6. Brushed aluminum face (refer to light fixture schedule)
7. Cast aluminum housing, snap together design.
8. Universal mounting: right side (canopy), left side (canopy), top (canopy) and back.
9. Knockouts for chevrons, right and left.
10. Snap-in wiring connections to allow replacement of components without removing housing.

B. For exit signs with battery back-up, provide the following additional minimum specifications:

1. Nickel cadmium batteries sized to provide 2 hours backup.
2. Integral solid state battery charger.

3. Low battery voltage protection
4. Provide pilot light and test switch. [Self-testing diagnostics]
5. AC “ON” indicator
6. UL 924 listed

C. Approved Manufacturers
1. Refer to the light fixture schedule.

2.2 VANDAL GUARDS

A. Provide vandal guards where indicated on the plans, that adhere to the following minimum specifications:
1. Provide polycarbonate enclosure, mounts to wall. Shields that mount directly to exit signs are not acceptable.
2. Provide 9 gauge welded steel mesh wire guards, mounted to wall. Guards that mount directly to exit signs are not acceptable.

B. Approved manufacturers
1. Safety Technology International, Inc.
2. Pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to installation of exit signs, contact the Building Official and Fire Marshal to arrange a walk-through to discuss exit sign placement, approximately at the mid-point of construction.

B. Provide exit signs at each exit and along the egress path.

C. Mount exit signs to walls wherever possible. Where exit signs are shown to be installed to a lay-in ceiling, provide additional support from the building structure. Refer to Section 26 05 29: Supporting Devices for supporting requirements.

D. Connect exit signs to an unswitched lighting circuit. Circuit can be shared with unit battery equipment provided under Section 26 52 00: Emergency Lighting. Provide handle lock on breaker.

E. Connect exist signs to life safety circuit fed from the emergency generator. Provide handle lock on breaker.

3.2 VANDAL GUARDS

A. Securely mount guards to structure using standard hardware with dedicated anchors. Refer to Section 26 05 29: “Supporting Devices”.

B. Provide a minimum of four anchors (1 per corner), or additional if recommended by the guard manufacturer.

3.3 WARRANTY

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

B. Provide these additional manufacturers warranties:

1. Provide a lifetime warranty on exit sign LED's.
2. Provide 5 year warranty on the exit sign unit and electronics.
3. Provide 10 year pro-rated warranty on exit sign batteries

C. Provide lifetime warranty on vandal wire guards

END OF SECTION

SECTION 28 01 00

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work consists of furnishing labor, materials, equipment and services required for the complete installation of work shown in the Contract Documents and specified in Division 28.
2. Include all parts and labor which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents. Such items include nuts, bolts, anchors, brackets, sleeves, offsets in conduit, fittings, relays, etc.
3. Some equipment and materials provided under Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 26 Contract Documents to determine where these composite crews are required.
4. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.
5. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.
6. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.
7. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

B. Related Sections:

1. Divisions 0 and 1 apply to all work of Division 28 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 28 01 00 takes precedence. Section 28 01 00 specifies conditions, procedures, equipment and material particular to the electrical work and applies to all electrical work of the Contract Documents.
2. Division 0 and 1 and Section 28 01 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 28 work. Copy these documents to all Sub-contractors receiving other Sections of Division 28.
3. Where a Specification Section refers to other Sections under the Article on Related Sections, this is done for Contractor's convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.2 REFERENCES

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

National Electric Code
State and Local Electrical Codes
International Building Code
International Fire Code
International Mechanical Code
State and Local Building Codes and Ordinances
State Industrial Commission Regulations
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State Elevator Code
Occupational Safety and Health Administration Regulations
Americans with Disabilities Act
Uniform Federal Accessibility Standards
State Board of Health
NFPA 101 Life Safety Code
State Energy Code

D. Use the Standard where referenced in the specifications by the following abbreviations:

AIA: American Insurance Association
AIA: American Institute of Architects
ANSI: American National Standards Institute
ASTM: American Society of Testing and Materials
EPA: Environmental Protection Agency
FM: Factory Mutual Insurance Association
IEEE: Institute of Electrical and Electronic Engineers
IES: Illuminating Engineering Society of North America
ICEA: International Cable Engineers Association
NBS: National Bureau of Standards
NEMA: National Electrical Manufacturers Association
NFPA: National Fire Protection Association
NSC: National Safety Council
UL: Underwriter's Laboratories

1.3 DEFINITIONS

A. The terms defined below apply to all work included in Division 26.

1. The work – as defined in the 2007 AIA Document A201: "The term 'Work' means the construction and services required by the Contract Documents whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project."
2. Furnish – to obtain in new condition ready for installation into the work.
3. Install – to store, set in place, connect and place into operation into the work.
4. Provide – to furnish and install.

5. Connect – to bring service to the equipment and make final attachment including necessary switches, outlets, boxes, terminations, etc.
6. Conduit – includes in addition to conduit, all fittings, pull boxes, hangers and other supports and accessories related to such conduit.
7. Concealed – hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.
8. Exposed: not installed underground nor concealed as defined above.
9. Building structure or building structural members - consists of steel columns, steel beams, steel joists (top chord and at panel points), concrete walls and concrete block walls. Metal decking, joist bridging and bottom chords of bar joists shall not be construed as building structure nor as a building structural member for the purpose of support.

B. The drawing and specifications constitute the Contract Documents. Any item noted in the specification or shown on the drawings is included in the Contract Documents.

C. All electrical details and drawings are diagrammatic, unless specifically noted. Field-verify all dimensions and notify the Engineer of any conflicts of discrepancies, in writing, prior to installation.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.
2. Do not dispose of any PCB containing materials. Disposal of all PCB containing materials will be the responsibility of the Owner.

C. Provide new, first quality material for all products specified. Do not reuse materials unless indicated or approved by the Engineer.

D. Comply with the NEC as applicable to the construction and installation of equipment specified in this section.

E. Provide equipment specified in this section that has been listed and labeled by a nationally recognized testing laboratory.

F. Comply with ANSI as applicable to equipment specified in this section.

G. Comply with NEMA as applicable to equipment specified in this section.

1.5 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Conduits, pipes, ducts, lights, devices, speakers, etc., shown on the drawings as existing have been based on existing plans and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of all other Divisions for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that cannot be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.

2. Install all conduit, cable tray, equipment, etc. allowing proper code and maintenance clearances and to avoid blocking passageways and access panels.

3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.

4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.

6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.

7. Drawings and specifications are complementary and what is called for in either on is as binding as if called for in both.

8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the drawings and specifications.

1.6 SEQUENCING AND SCHEDULING

A. Refer to General Conditions and Requirements.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Continuity of existing systems:

1. No Division 28 systems are to remain inactive at the end of the workday. Assure that the systems are all operational at the end of each workday. Coordinate temporary outages with the Owner.

2. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

3. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.

2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current NECA standards.

3. The Engineer reserves the right to reject material or workmanship not in accordance with the specifications, before or after installation.

B. Excavation and Backfilling:

1. Provide all excavation and backfilling required to complete the installation of the fire alarm system. Conform with the provisions of Division 31 Earthwork of these specifications for all work.

2. Bed all conduit and structures on a 6" thick compacted layer of granular material. Should unsatisfactory soil conditions be discovered, the Engineer/Architect will inspect the excavation and determine the necessary additional support required.

3. Backfill around conduit and structures by hand using coarse sand, pit run gravel or the native material if it is similar to the above. Remove all large stones, frozen lumps, perishable rubbish and excessive amounts of clay. Carefully compact this material in 6" layers to a depth of 8" above the conduit, cable or duct. . Compact to not less than 90% outside the building and 95% within the building limits of maximum density given by ASTM D698-70T (Standard Proctor Density). Architect/Engineer reserves the right to require soil compaction tests in any areas which do not appear to be compacted properly with the cost of the test paid by the Contractor.

4. Replace all existing surface improvements (i.e.,-street pavement, curbs, sidewalks, finish sodding, etc.) removed or damaged in the course of the work unless such improvements are to be reconstructed under the general contract. Make all necessary arrangements to perform such repairs, pay all costs in connection therewith and include them in the bid.

C. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to be performed by a different Division.

2. Obtain special permission from the Engineer before cutting structural members or finished material.

3. Perform all patching in a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
4. Patch all holes left as a result of demolition of electrical equipment and devices.
5. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for electrical raceway. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
6. Prevent the spread of dust, debris, and other material into adjacent areas.
7. Replace all ceiling tiles damaged during installation of work, with new tile.

D. Painting:

1. Refinish all fire alarm equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.
2. Paint all new raceway systems in exposed finished areas to match existing finish.

E. Precast Construction

1. The new construction at the Cafeteria/Gymnasium Area will be constructed by separate Contractor using pre-cast panels.
2. The Electrical Contractor is to incluce in his/her bid all labor, material and other necessary items for the installation of outlet boxes junction boxes, cabinets, conduit, etc. within the pre-cast panels at the manufacturing plant.
3. The Electrical Contractor will furnish and install all items at the pre-cast manufacturing plant as part of the fabrication process.
4. Pre-cast panels are not to be fabricated until the Electrical Contractor has provided written confirmation that all required electrical items have been installed in the pre-cast panels.
5. Prior to fabrication, the Electrical Contractor will provide the Engineer with pre-cast panel shop drawings (elevations) indicating all electrical rough-in locations and mounting heights.

3.3 FIELD QUALITY CONTROL

A. Final Inspection:

1. A final inspection of the electrical systems will be required before the Contract can be closed out. Request a final inspection by the Engineer after all systems are fully completed and operational. The Engineer will schedule an inspection and generate a list of items to be corrected or completed before Contract Closeout. If the Engineer is requested to make a final inspection by the Contractor, and the Engineer finds the work is not complete enough to perform that inspection, the Contractor will compensate the Engineer for his time. The Contractor will then perform the necessary work to complete the project and again request a Final Inspection.

3.4 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean electrical equipment and remove temporary identification. In case of dispute the Owner will remove the rubbish and charge the cost to the Contractor.

B. After tests have been made and accepted clean light fixtures, panels and other equipment installed by the Contractor, leaving the entire work area in a clean and complete working order.

3.5 PROTECTION

A. Cover openings and equipment, where set, to prevent obstruction to conduits, breakage, misuse, or disfigurement of equipment. Cover openings in equipment immediately upon uncrating or receipt at the job site and keep covered until permanent connection is made.

B. Contractor is responsible for any damage to electrical equipment or materials until final acceptance of the entire project by the Owner. Keep all equipment clean materials until final acceptance of the entire project by the Owner.

C. If a portion of the project is to be occupied by the Owner prior to Substantial Completion of the entire project make arrangements with the Owner to transfer responsibilities for protection and housekeeping.

END OF SECTION

SECTION 28 16 13

SECURITY INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Security monitoring system

B. Interface to telephone system

1.2 REFERENCES

A. Section 26 01 00: General Provisions - Electrical

1.3 SYSTEM DESCRIPTION

A. Provide a complete operating security monitoring system that includes the following:

1. Main security control panel
2. Keypad located at the administration office as indicated on the plan
3. Interface to telephone system for remote notification of alarm and trouble conditions
4. Remote motion sensors and associated mounting brackets and hardware.
5. Remote glass break sensors and associated mounting brackets and hardware.
6. Remote magnetic door contacts and associated mounting brackets and hardware.
7. Power supplies, standby batteries and charger
8. Supervised signal and power wiring, raceways and terminations
9. Programming, setup, testing, training

B. Provide a system that transmits alarm and trouble signals to a central station, and to a backup location. Systems that cannot transmit a signal to two sites are not acceptable.

1. Transmit an alarm signal if the system detects motion at a remote zone.
2. Transmit and trouble signal if the system detects an open, short or grounded condition of the signal or power wiring for any zone; a battery failure; a power supply failure; or an internal failure.

1.4 SUBMITTALS

A. For general requirements see Section 26 01 00.

B. Submit a complete shop drawing package of the proposed system.

C. Provide clearly legible shop drawings.

D. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier's address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

E. Submit reduced scale reproducible sepia floor plans showing all rooms, stairways, corridors, horizontal exits, and all security monitoring components. Include exact wire counts and types, and point address information for each device. Single line for walls may be used.

F. Submit the following riser/wiring/connection diagrams:

1. Single line riser drawing indicating all system components and the vertical wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

2. Functional block diagram showing device wiring, loop communications wiring, power supply wiring, detection device wiring, battery wiring, communications/modem wiring, etc.

3. Branch circuit wiring to the main control panel, sub-panels, and other devices in the system requiring 120 volt power.

G. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

H. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list quantity and description of all spare parts to be turned over to the Owner at the end of the project.

I. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

J. Submit physical and schematic drawings of special and custom components or hardware.

K. Submit power supply sizing and battery sizing calculations showing total security system power draw in the supervisory and alarm conditions.

L. Submit complete description of system operating sequence.

M. Submit complete mounting details and instructions for all equipment to be installed.

N. Shop drawings not containing all the information listed above will be rejected without review.

PART 2 PRODUCTS

2.1 MAIN CONTROL PANEL

A. Provide a main control panel with the following specifications:

1. 12 zones maximum capacity

2. Communications dialer for transmission of alarm and trouble signals to a central station.

3. Supervision of all signal and power wiring for each zone, the batteries and power supplies.

4. Flexibility to configure any input zone as a normally open or normally closed detection device (i.e. door position switches, motion detectors, panic switches, glass break detector, audio threshold alarms, BAS output alarm, etc.)

5. Latching alarm circuits compatible with momentary contact detection devices.

6. Provide Silent Knight Regency 4000, Radionics equivalent or pre-approved equal main control panel.

2.2 STANDBY BATTERIES

A. Provide sufficiently sized batteries to permit normal system monitoring for a continuous period of 24 hours, and transmit an alarm signal through the communications dialer to the central station at the end of the 24 hour period.

B. Provide a battery charger sufficiently sized to fully charge the standby batteries within 8 hours after a complete discharge.

C. Provide maintenance-free sealed gel cell or lead acid batteries.

2.3 DETECTION DEVICES

A. Motion sensors

1. Provide motion sensors with the following specifications:
    a. Dual technology: Passive infrared and ultrasonic detection modes
    b. Powered from the main control panel.
    c. Integral LED for walk-through testing.
    d. Tamper alarm if front cover is removed.
    e. End of line resistor for supervision of wiring
    f. Replaceable lens for different detection coverage requirements.
    g. Adjustable wall or ceiling mounting hardware.
2. Provide motion sensors designed for use in the particular area (i.e. corridors, open area, etc.).
3. Provide C&K 8100S series or Dual Tec motion detectors or pre-approved equal manufacturer.

B. Door contacts

1. Provide recessed magnetic door contacts at each leaf of each monitored door shown on the plans and scheduled herein.
2. Provide concealed wiring throughout. Devices that mount to the exterior of door frames are not acceptable
3. Provide door contacts rated for an air gap of up to 1 ¾”
4. Provide Sentrol 1076C series magnetic door contacts or Senitrol 3005 door bug or approved equal.

C. Glass Break contacts

1. Provide recessed glass break contacts at each leaf of each monitored door shown on the plans and scheduled herein.
2. Provide concealed wiring throughout. Devices that mount to the exterior of door frames are not acceptable
3. Provide contacts rated for an air gap of up to 1 ¾”
4. Provide Sentrol 1076C series magnetic door contacts.
5. Provide intellisense FG-830 flush mounted glass break monitor or approvded equal.

2.4 EXTERIOR HORNS

A. Provide and install Ameseco #SSX-51 exterior horn or approved equal.

B. Provide plenum rated cable when allowed in ceiling plenum spaces.

2.5 WIRING

A. Provide wiring types as recommended by the manufacturer.

B. Provide plenum rated cable when allowed in ceiling plenum spaces.

C. Use 22 gauge AWG minimum conductors. Verify maximum wiring distances allowed by the manufacturer.

D. Provide Belden, West Penn, Alpha wire or pre-approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide a complete and fully operational security monitoring system as described herein and as shown on the drawings.

B. Equipment shall be installed and wired in accordance with this specification, project drawings and approved shop drawings.

C. Configure each motion sensor as a unique zone regardless of whether or not there are multiple devices in a specific room or area.

D. Verify the exact location of the detection devices with the Owner and Engineer prior to installation to provide the maximum coverage of the intended area.

E. Install all cable in conduit. Conceal all conduit.

F. Route system wiring in surface mounted wireway in existing areas or in other areas where noted on the plans. Provide conduit sleeves with fireproofing when routing cables through fire rated partitions.

G. Provide supervision of all wiring to all devices. Wire trouble alarm wiring through each device's tamper switch.

H. Coordinate termination of telephone wiring to main control panel with the Owner.

I. Provide all programming, system setup, calibration/aiming and testing.

3.2 TESTS AND ADJUSTMENTS

A. Upon completion of the installation phase, test and adjust the system to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

3.3 TRAINING

A. Provide a minimum of four (4) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.4 AS-BUILT DOCUMENTATION

A. Provide to the Engineer two (2) complete as-built manuals assembled in loose-leaf binders containing the following:

1. As-built system functional block diagrams.

2. Corrected copies of approved shop drawings

3. As-built system wiring diagram.
4. System operation manuals.
5. System maintenance manuals.
6. Name, address and phone number of the responsible service organization.

3.5 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Engineer and to the Owner's representatives.

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.
2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.6 SYSTEM GUARANTEE

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.7 MAINTENANCE

A. Maintain a local service organization which is available to perform testing, inspection, repair and maintenance service on the system.

3.8 SPARE PARTS

A. Provide the following spare parts for the system:

1. Two spare motion sensors and mounting hardware
2. One magnetic door contact sets
3. One magnetic door contact sets
4. Three glass break contact sets
5. 5 keys for the main control panel cabinet.

END OF SECTION

SECTION 28 31 00

FIRE ALARM SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 SUMMARY (EDIT)

A. Fire Alarm System

B. Interface to HVAC Systems

C. Interface to Automatic Closing and Self-Closing devices

D. Interface to Fire Protection System

E. Interface to Owner Telephone system

F. Interface to Elevator Controllers

G. Interface to Elevator smoke hatches

H. Interface to Kitchen Equipment under exhaust hood

I. Interface to Card Access System

J. Interface to Security System

1.3 REFERENCES

A. Section 26 01 00: General Provisions – Electrical.

B. Section 28 01 00: Common Work Results for Electronic Safety and Security

C. Section 28 01 05: Submittals, Closeout Documents, Training and Spare Parts

D. Section 28 01 50: Testing and Fire Alarm Systems

E. Section 26 05 29: Supporting Devices

F. This section is subject to all of the applicable provisions of the above indicated sections.

1.4 UNIT PRICES *(SELECT/DELETE/EDIT)*

A. Provide unit prices for the following items. Include all material, labor, programming, setup and testing required to incorporate the unit as a fully operational addition to the fire alarm system.

1. UNIT PRICE #__: Provide one intelligent photoelectronic smoke detector with addressable base installed in an existing lay-in ceiling, with 50 feet of twisted pair system wiring installed in conduit.

2. UNIT PRICE #__: Provide one intelligent duct smoke detector with addressable base and addressable control module wired to motor starter, installed in an existing accessible HVAC duct, and 50 feet of twisted pair system wiring installed in conduit.

3. UNIT PRICE #__: Provide one horn/strobe unit installed surface mounted to a block wall with surface mounted wireway to accessible ceiling and 50 feet of system wiring installed in conduit above a lay-in ceiling.

1.5 SYSTEM DESCRIPTION

A. Provide a complete operational intelligent addressable fire alarm system including the following components: Main control panel complete with central processing unit, communications cards, initiating loop cards, indicating zone cards, power supplies and backup batteries; remote annunciators with alarm silence and reset capability; remote intelligent detectors; interfaces to HVAC fans, combination smoke/fire dampers and sprinkler systems; audible and visual indicating devices; monitor and control modules; communication devices; raceway system, boxes, wiring, grounding and the associated labor, programming, setup and testing.

B. Provide a multiplexed, fully addressable system whereby all system components communicate with the main control panel for alarm, trouble, supervisory, monitoring and control functions over supervised twisted pair wiring.

1.6 SUBMITTALS

A. For general requirements see Section 26 01 00 and 28 01 00.

B. Submit qualifications of the system installer as specified in this section.

C. Submit a complete shop drawing package of the proposed system.

D. Provide clearly legible shop drawings.

E. Submit shop drawings in a neatly bound comb or three ring binder with protective covers. Indicate on the front cover the date submitted, project name, specification section number, electrical contractor's name, address, telephone number and the submitting equipment supplier’s address and telephone number. Allow enough clear area on the title sheet for shop drawing review stamps.

F. Submit 1/8” scale reproducible sepia floor plans showing all rooms, stairways, corridors, horizontal exits, controlled HVAC units, sprinkler flow and control valves, and all fire alarm system components. The drawings shall include exact wire counts and types, and point address information for each device. Single line for walls may be used.

G. Submit the following riser/wiring/connection diagrams:

1. Single line riser drawing indicating all system components and the vertical wiring necessary to connect the components. Indicate conduit sizes and wire counts and a legend indicating the type of wiring.

2. Functional block diagram showing initiating device wiring, loop communications wiring, annunciator wiring, power supply wiring, indicating device wiring, power supply wiring, battery wiring, communications/modem wiring, etc. It is not necessary to show every initiating and indicating device on the riser diagram, but illustrate the wiring and connection of each type of device on each addressable loop. Indicate on the diagram the quantity of devices on each loop and the maximum allowable quantity of devices on each loop (to determine the number of spare addresses for future expansion).

3. Wiring diagrams showing wiring and terminations between HVAC fan units and the fire alarm system.

4. Wiring diagrams showing wiring and terminations between combination fire/smoke dampers and the fire alarm system.

5. Wiring diagrams showing wiring and terminations between self closing and automatically closing devices and the fire alarm system.

6. Wiring diagrams showing wiring and terminations between sprinkler system flow switches, valve position switches, dry pipe low pressure monitoring switches, etc., and the fire alarm system.
7. (SELECT/DELETE)Wiring diagrams showing wiring and terminations to elevator controllers for primary and secondary recall functions.
8. Branch circuit wiring to the main control panel, sub-panels, and other devices in the system requiring 120 volt power.

H. Submit original drawings produced by the supplier/manufacturer. Submitting reproductions of the Contract Documents is not acceptable.

I. Submit a material list showing quantity, manufacturer, type and description of each item being furnished. Indicate in a separate list, the quantity and description of all spare parts to be turned over to the Owner at the end of the project.

J. Submit original prints of the manufacturer product sheets with complete technical data for each item being provided. Circle, arrow or provide other permanent marking on each data sheet to clearly indicate the specific product included in the submittal. Remove or crosshatch out any product on the data sheets not applicable to the project or not being submitted for review.

K. Submit physical and schematic drawings of special and custom components or hardware.

L. Submit power supply sizing and battery sizing calculations showing total fire alarm system power draw in the supervisory and alarm conditions.

M. Submit complete description of system operating sequence.

N. Submit voltage drop calculations for indicating devices.

O. Submit complete mounting details and instructions for all equipment to be installed.

P. Submit complete description of system operating sequence.

Q. Shop drawings not containing all the information listed above will be rejected without review.

1.7 QUALITY ASSURANCE

A. Only manufacturers that provide complete engineering, technical and support services to properly complete the project as designed are allowed.

B. Provide the following, prepared by the manufacturer and supplier:

1. Certification of project and drawings.
2. Project management as required by Engineer and Owner.
3. Complete project testing and training to Engineers and Owners satisfaction.
4. Underwriters Laboratories (U.L.) Certification.
5. Service personnel to be NICET Level II Certified.
6. Maintained inventory levels to provide service parts as required by the specification.

C. Provide fire alarm and detection systems conforming to the requirements of the latest edition of the following National Fire Protection Association (NFPA) publications including all amendments to these publications:

1. 13: Standard for the Installation of Sprinkler Systems.
2. 70: National Electrical Code, including Article 760.

3. 71: Protective Signaling Systems.
4. 72: National Fire Alarm Code.
5. 101: Life Safety Code.

D. Construct and install all fire alarm and fire detection equipment in accordance with the following publications:

1. Underwriters Laboratories Inc. (UL): ***(SELECT/EDIT)***
   a. 38 Manually Activated Signaling Boxes for Use with Fire Protection Signaling Systems.
   b. 268 and 268A Smoke Detectors for Fire Protective Signaling Systems.
   c. 346 Waterflow Indicators for Fire Protective Signaling Systems.
   d. 464 Audible Signal Appliances.
   e. 864 Control Units for Fire Protective Signaling Systems.
   f. 1481 Power Supplies for Fire Protective Signaling Systems.
   g. 1971 Visual Signaling Appliances for the Hearing Impaired.
2. Americans with Disabilities Act.
3. International Fire Code (IFC).
4. International Mechanical Code (UMC).
5. International Building Code (IBC).
6. State Building Code
7. State Amendments to the IBC, IMC and IFC.
8. Local (City) Codes

E. Provide components that are listed and cross listed as a product of a single fire alarm system manufacturer by Underwriter's Laboratory, Inc. (U.L.) and bear the "U.L." label. Provide control equipment listed under U.L. category UOJZ as a single control unit.

F. Qualifications of the Installer:

1. Before commencing work, submit data showing that the contractor/subcontractor has successfully installed fire alarm systems of the same type and design as specified. Include the names, locations, and the contact name and telephone number of at least six (6) such installations completed by the installer. Specify type and design for each system and furnish documentation that the system has performed satisfactorily for the preceding eighteen (18) months.
2. Provide evidence of completion of the required manufacturers' training and experience by the contractor or have NICET Level II (or higher), Certified Fire Alarm or Special Hazard Associate Engineering Technician(s), as applicable, in their employ.
3. Installed system to be certified by Underwriter's Laboratories for a period of five (5) years. The system must be covered by a maintenance contract, during this five (5) year term, by a U.L. certified service company. Installing contractor/subcontractor to furnish proof of qualification and listing to perform this service.

4. Experience of Installer: Accomplish installation by a Contractor with a minimum of five years experience in the installation of the specified fire alarm system. Any proposed installer who cannot show evidence of such qualifications will be rejected.

G. Manufacturer's Representative

1. Provide the services of a representative or technician licensed in the State of Minnesota from the manufacturer of the system, or a factory trained technician of the manufacturer of the system, experienced in the installation and operation of the type of system provided. Supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. Provide the required instruction to the Owner's personnel in the system operation, maintenance and programming.

1.8 ZONING

A. Initiating zones

1. Provide one initiating zone for each initiating device.
2. Provide a fire alarm control panel that supports at least 1000 automatic intelligent detectors. Provide loading of each loop card adhering to the following specifications:
   a. Load each loop card with the equal quantity of initiating points (e.g. if three loop cards are required for the system, load each loop card with 33% of the total number of system points, and homerun back to the main panel with the loop wiring).
   b. Load each loop card to a maximum of 80% of the total number of initiating points possible for the loop card.

B. Indicating zones

1. Provide one indicating zone for the interior indicating devices, and one indicating zone for the exterior sprinkler waterflow indicating device.
2. Provide 25% spare capacity on each interior indicating circuit for future indicating devices.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Equipment supplied by manufacturers as listed herein are considered approved for bidding on this project. Where specific models are referred to, the intent is to establish a minimum level of features and performance.

B. Systems manufactured by the following are approved for bidding purposes on this project. Approval for installation is subject to review and approval of shop drawings.

1. GE / Edwards System Technology EST-3 series
2. Gamewell 650 series
3. Notifier Onyx 3030 series (SELECT/EDIT) for 1000 points
4. Notifier Onyx 512 series (SELECT/EDIT) for 500 points
5. Siemens MXL series
6. Simplex 4100ES series (SELECT EDIT) for 512 points for more)
7. Simplex 4020xxx series (SELECT EDIT) for less than 512 points
8. Pre-approved equal

2.2 MAIN CONTROL PANEL

A. Provide a microprocessor-based main control panel with the following features and modules:

1. Communications module for controlling and monitoring all input, output, and accessory modules; power supplies, batteries, supervision of wiring, etc.
2. 80 character LCD display for displaying system events and keypad for input and programming functions. Plain English description of the location of each device.
3. Password protection for programming and system settings.
4. Provide the required quantity of input and output cards within the main control panel enclosure required for the system zoning plus spare capacity as described elsewhere in this specification.
5. Communication between main control panel and remote devices via RS-485 data lines.
6. Provide adequately sized power supply to power all system devices.
7. Provide alarm, trouble and supervisory silence, reset and drill functions.
8. Lamp test switch.
9. Monitors each remote initiating device and compensate for long term drift. Initiates a unique alarm when a detector requires maintenance due to excessive dirt/dust buildup.
10. Adjustable programmable day/night and weekend sensitivity setting ability.
11. One person-walk through system test on a zoned basis.
12. Password protection for administration and maintenance purposes.
13. Provide a durable, baked enamel finish for the main control panel enclosure.
14. UL listed (864).

B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site, and off-site via dial-up service modem, programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory. Full flexibility for selective input/output control functions based on ANDing, ORing, NOTing, timing, and special coded operations shall also be incorporated in the resident software programming of the system.

C. Resident software shall allow for full configuration of initiating circuits so that additional hardware shall not be necessary to accommodate changes in, for instance, sensing of normally open contact devices to sensing of normally closed contact devices, or from sensing of normally open contact devices to sensing a combination of current limited and non-current limited devices on the same circuit and being able to differentiate between the two, or changing from a non-verification circuit to a verification circuit or vice-versa.

D. Resident software shall also allow for configuration of indicating appliance and control circuits so that additional hardware shall not be necessary to accommodate changes in, for instance changing a non-coded indicating appliance circuit to a coded circuit, or from a slow march time (20 BPM) to a fast march time (120 BPM).

E. Provide a system that records system events (in chronological order) including the following:

1. Supervisory alarms

2. Trouble alarms

3. Fire alarms.

F. Provide a digital alarm communication transmitter to allow alarms to be transmitted to a constantly attended off-site alarm monitoring company. Verify with the Owner the location, phone number and required protocol to provide communications between the panel and the off-site monitoring station. Provide individual point-by-point monitoring to the monitoring company for each point in the fire alarm system. **(DELETE/SELECT/EDIT) for data connections**

G. Provide power and control wiring to automatic closing and self closing devices (door holders, fire shutters, smoke dampers, etc.), relays, HVAC unit starters, and any other interfaces to equipment required to be interfaced to the fire alarm system.

H. Provide the required communications port in the main control panel to allow a future printer to be plugged into the system for printing hard copies of all system events and history logs.

2.3 REMOTE ANNUNCIATOR PANELS *(SELECT/DELETE)*

A. Provide remote annunciator panels with the following specifications:

1. Mounted in vandalproof enclosure (specified elsewhere herein).

2. Six (6) Status indicator LEDs:

   a. Fire Alarm & Priority 2 Alarm, red LED

   b. Supervisory & Trouble, yellow LED

   c. Alarm Silenced, yellow LED

   d. AC Power, green LED (on for normal)

3. Minimum of five (5) programmable function buttons (unless fire alarm sequence of operations requires more).

4. Minimum of three (3) programmable status LED's (unless fire alarm sequence of operations requires more).

5. (SELECT/DELETE) For ULC systems, program one (1) of the three programmable status LED's above for Ground Fault Indication.

6. All switches, buttons and indicators located behind a transparent faceplate.

7. Supervised wiring between annunciator and the main control panel.

8. 2 line x 40 character display (total of 80 characters).

9. Powered from the main control panel.

10. Unique alarm and trouble notification signal at panel. Acknowledge, reset, silence and scroll forward and back functions for viewing system event history log.

B. (SELECT/EDIT) Locate remote annunciator(s) as indicated on the drawings.

2.4 STANDBY BATTERIES

A. Provide standby batteries in accordance with the requirements of NFPA 72 that are appropriately sized to operate the fire alarm system for a minimum of twenty-four (24) hours and then operating all indicating units for at least five (5) minutes after the 24 hours, **plus an additional 10% spare capacity.**

B. Provide battery charger sized to fully charge all standby batteries within eight (8) hours after a full discharge cycle.

C. Provide maintenance-free, sealed gel cell or sealed lead-acid batteries. Batteries which vent gases are not acceptable.

D. Mount batteries inside the main control panel enclosure on the bottom. Separate battery enclosures are not acceptable.

E. Provide monitoring of batteries, charger and associated wiring from the main control panel.

F. Provide a voltmeter and ammeter to indicate battery voltage and charging current through the front LCD display on the fire alarm control panel.

2.5 MANUAL STATIONS

A. Provide manual pull stations with the following specifications:

1. Single action type (non-break glass type).
2. Die cast aluminum construction with baked red enamel finish.
3. Semi flush mounted to recessed backbox.
4. Pull lever locks in the protruding position when actuated.
5. Key lock switch for resetting handle and for testing purposes.
6. Fully enclosed silver plated contacts configured as normally open or normally closed.
7. UL listed.

B. Provide vandalproof shield over each manual pull station, to sound a local alarm when the shield is raised. Refer to "Vandal Equipment" specified elsewhere in this section.

C. Provide manual station with addressable communications module or provide addressable communications module immediately adjacent to manual station.

D. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.6 VANDAL EQUIPMENT

A. Manual pull station vandal shields

1. Provide a UL listed clear polycarbonate hinged shield with integral peizo alarm to sound a local alarm when the shield is raised. Provide batteries for each.
   a. Safety Technology International #1100/#6600 Series or pre-approved equal.

B. Wire guards

1. Provide heavy gauge (16 Ga. minimum), white steel guard for smoke or heat detectors where indicated on the drawing or specified herein.
   a. Shaw Perkins model SDG, Pro-Tec model 2000 series or pre-approved equal.
2. Provide manufacturer-approved wire guards for horns, strobes and horn/strobe units where indicated on the drawings or specified herein.
3. Provide wire guards over horn/strobe units in the gymnasium.

C. Clear Plastic Guard.

1. Provide clear plastic cover guard where indicated on the drawing or specified herein.

D. Vandal proof enclosures

1. Where vandalproof equipment enclosures are noted in this specification and on the plans, provide enclosures with the following specifications:

   a. Heavy duty sheet metal with piano hinge

   b. Minimum ¼" thick clear lexan faceplate.

   c. BEST/SCHLAGE lock, keyed to the Owner's master.

   d. Secured to the wall with approved anchoring hardware.

   e. Verify color with Owner.

2.7 INTELLIGENT AUTOMATIC PHOTOELECTRONIC SMOKE DETECTORS

A. Provide automatic photoelectronic smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.

2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via the main control panel)

3. Operates +14 to +120 degree F temperature, 10% to 93% humidity range.

4. Operates on single twisted pair cable.

5. Self-compensating drift compensation for maximum stability (set via the main control panel).

6. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.

7. Mounts to base by twist locking motion.

8. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.8 INTELLIGENT AUTOMATIC HEAT DETECTORS

A. Provide automatic heat detectors with the following specifications:

1. Utilizes a combination of fixed temperature and rate of rise compensation (temperature exceeds 15 degree per minute rise, set via the main control panel).

2. Operates at +14 to +122 degree F temperature, with relative humidity less than 93%.

3. Integral red LED visible to the eye from below the detector to indicate an alarm condition and to indicate the polling pulse from the main control panel.

4. Mounts to base by twist locking motion.

5. U.L. 521 listed.

B. Provide detector base with addressable communications module.

C. Provide ordinary rated (135 degree F) detectors in normal spaces. Provide intermediate rated (175 degree F) in unconditioned spaces such as boiler rooms or other areas with a high ambient temperature.

D. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

2.9 INTELLIGENT PHOTOELECTRONIC DUCT SMOKE DETECTORS

A. Provide automatic photoelectronic duct smoke sensors with the following specifications:

1. Utilizes light scattering principle from an internal infrared LED light source and reports the percent obscuration to the main control panel.
2. Factory set threshold at a nominal 1.5% light obscuration per foot (set via main control panel)
3. Self-compensating drift compensation for maximum stability (set via main control panel).
4. Operates at air velocities from 300-4000 ft/min, +32 to +120 degree F operating temperature, 10%-93% humidity range.
5. Operates on single twisted pair cable.
6. Smoke chamber blocks particles larger than 200 microns.
7. Integral red LED visible to the eye from outside the detector housing to indicate an alarm condition and to indicate the polling pulse from the main control panel.
8. Mounts to housing/base by twist locking motion.
9. U.L. 268 listed.

B. Provide detector base with addressable communications module.

C. Provide unique address assignment for each detector, either through DIP switches located in the communication module or assigned by the main control panel.

D. Provide HVAC duct-mounted housing and sampling tubes of the proper length to sample the entire width of the HVAC duct. Provide additional duct smoke detectors as required for ducts wider than the longest sampling tube recommended by the fire alarm manufacturer.

E. Provide addressable control module and associated relay rated at 10 amps for connection to HVAC unit starter circuit for fan motor shutdown. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

F. Provide addressable control module and associated relay for connection to combination smoke/fire dampers. Provide unique address assignment for each control module, either through DIP switches located in the control module or assigned by the main control panel.

G. Provide remote test station for each duct detector in a readily accessible location near the unit. Provide engraved label on remote test station denoting the location, HVAC unit number, “RETURN”, damper location, etc. as required to identify the detector’s location and function.

2.10 BEAM SMOKE DETECTORS (SELECT/DELETE/EDIT)

A. Provide beam smoke detector with the following specifications:

1. Utilizes percent obscuration from a light source in the transmitter reported at the receiver to determine alarm and trouble.
2. Self-compensating drift compensation for maximum stability.
3. Operates at +32 to +130 degree F operating temperature and up 95% humidity range (noncondensing).

4. Operates on a 4-wire cable between the transmitter and receiver pair, and one twisted pair cable between the communications module and the main control panel.
5. Integral LEDs visible to the eye from outside the detector housing to indicate an alarm or trouble condition, and to indicate the polling pulse from the main control panel.
6. Mounts to wall or ceiling.
7. U.L. listed.

B. Provide addressable communications module with each transmitter/receiver pair to communicate alarm and trouble signals to the main control panel.

C. Provide unique address assignment for each beam detector transmitter/receiver pair, either through DIP switches located in the communication module or assigned by the main control panel.

2.11 AUTOMATIC-CLOSING AND SELF-CLOSING DEVICES (SELECT/DELETE/EDIT) WHO PROVIDES AND WHO INSTALLS?

A. Includes magnetic door holders, automatic doors and rolling fire shutters (provided by others)

B. Provide magnetic door holder with the following specifications:

1. Minimum holding force of 25 lbs.
2. Surface, wall mounted.
3. Operates at 24 VDC from the fire alarm panel.
4. U.L. listed.

C. Provide interface wiring between each closing device and the fire alarm system.

D. Provide power to 24 VDC and 120 VAC closing devices.

E. Provide Firemark FM 996 in surface mounted applications, Firemark FM 998 elsewhere.

F. Provide addressable control module at each closing device to allow the main control panel to actuate each closing device independently.

G. Provide unique address assignment for each self closing device, either through DIP switches located in the control module or assigned by the main control panel.

H. Provide addressable control module wiring between each closing device and the fire alarm system to allow the main control panel (through software) to operate the devices in either of two ways:

a. Any alarm in the building closes all automatic closing and self-closing devices.
b. Only the detectors adjacent to the automatic closing and self-closing devices close the devices.

2.12 COMBINATION FIRE/SMOKE DAMPERS

A. Provided by Mechanical Contractor. Verify damper type and locations with Mechanical Contractor.

B. Unless noted otherwise, provide intelligent duct detector located upstream of damper.

C. Provide addressable control module at each damper to allow the main control panel to actuate each damper independently.

D. Provide unique address assignment for each damper, either through DIP switches located in the control module or assigned by the main control panel.

E. Provide power wiring from fire alarm system through the control module to the damper's associated EP (electric-pneumatic) switch. EP switch by Mechanical Contractor. (SELECT/DELETE/EDIT).

F. Provide power wiring from fire alarm system through the control module to the damper's associated DDC (damper control).

2.13 AUTOMATIC SPRINKLER WATERFLOW SWITCHES

A. Provided by Mechanical Contractor.

B. Provide addressable communications module for each waterflow switch to communicate alarm and trouble signals to the main control panel.

C. Provide unique address assignment for each waterflow switch, either through DIP switches located in the communication module or assigned by the main control panel.

2.14 AUTOMATIC SPRINKLER VALVE POSITION (TAMPER) SWITCHES

A. Provided by Mechanical Contactor

B. Provide addressable communications module for each valve position switch to communicate trouble and supervisory signals to the main control panel.

C. Provide unique address assignment for each valve position switch, either through DIP switches located in the communication module or assigned by the main control panel.

2.15 DOMESTIC WATER SHUTOFF SOLENOIDS

A. Solenoids provided by Mechanical Contractor. Provide 120 volt power wiring to the solenoid.

B. Provide addressable control module to allow the fire alarm system to control the state of the solenoid. Provide control wiring between the solenoid and the control module.

C. Provide unique address assignment for the control module, either through DIP switches located in the control module or assigned by the main control panel.

D. Provide system programming to shut the solenoids (remove power to the solenoid) if water flow is detected by any sprinkler flowswitch.

2.16 ALARM INDICATING HORNS

A. Provide alarm indicating horns with the following specifications:

1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less that 180 seconds.
2. Semi-flush mounting to 4-inch square electrical box
3. 24 VDC operation powered from the main control panel.
4. A minimum 90 dB output at 10 feet on axis.
5. Red with white "Fire" lettering.
6. Supervised wiring.
7. U.L. listed, ADA compliant

2.17 ALARM INDICATING STROBES

A. Provide alarm indicating strobes with the following specifications:

1. Semi-flush mounting to 4-inch square electrical box

2. 24 VDC operation powered from the main control panel.
3. In rooms larger than 1600 square feet
   a. Minimum 120 candela when measured on axis
   b. Rated for wall mount applications per UL 1971 at a minimum of 110 candela effective intensity.
4. Non-assembly rooms and corridors
   a. Minimum 75 candela when measured on axis
   b. Rated for wall mount applications per UL 1971 at a minimum of 15 candela effective intensity.
5. One to three flashes per second with a one (1) hertz synchronous flash pattern in accordance with ADA.
6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
7. Supervised wiring
8. U.L. 1971 listed, ADA compliant

2.18 ALARM INDICATING HORN/STROBE UNIT

A. Provide horn/strobe units with the following specifications:
   1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less than 180 seconds.
   2. Semi-flush mounting to 4-inch square electrical box
   3. 24 VDC operation powered from the main control panel.
   4. A minimum 90 dB output at 10 feet on axis.
   5. Strobe light with the specifications of the strobe unit specified elsewhere in this section.
   6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
   7. Supervised wiring
   8. U.L. 1971 listed, ADA compliant

2.19 SPEAKER NOTIFICATION APPLIANCES

A. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.

B. Communication transducers multi-tapped 1/4W to 2 W, with moisture-resistant, sealed compression driver.

C. Sensitivity: 87 – 96 dBA on-axis at 10' or higher if required for vendor-supplied layout drawings.

D. Frequency response: 400-4000 Hz for tonal signaling and 125- 12,000 Hz for general signaling.

E. Matching Transformers: Tap range matched to acoustical environment of speaker location.

F. Mounting Faceplate: Factory finished, red.

2.20 ALARM INDICATING SPEAKER/STROBE UNIT

A. Provide speaker/strobe units with the following specifications:

1. Temporal sounding pattern of ½ to 1 sec ON, followed by ½ to 1 second OFF for three cycles, followed by a 1½ to 2 second OFF period for no less than 180 seconds.
2. Semi-flush mounting to 4-inch square electrical box
3. 24 VDC operation powered from the main control panel.
4. A minimum 90 dB output at 10 feet on axis.
5. Strobe light with the specifications of the strobe unit specified elsewhere in this section.
6. Red with white "Fire" lettering. Vandal-proof polycarbonate lens.
7. Supervised wiring
8. U.L. 1971 listed, ADA compliant

2.21 (SELECT/DELETE) TEXTUAL READER BOARDS (TEXT MESSAGING APPLIANCE)

A. Nominal 30" x 18" LED high visibility reader board for notification of fire alarm and alternate events.

B. Minimum viewing distance of 100 feet.

C. UL listed to Standard 1638, Textual Visible Appliance.

D. UL listed for use in a fire alarm system.

E. Powered and controlled by Main Fire Alarm Panel.

F. Text messages to be selected by Owner in the field and programmed into the system as directed.

2.22 *(SELECT/DELETE)* NOTIFICATION DEVICE (LIGHTED PANEL)

A. Nominal 7-1/2" H x 12" W x 2-1/2" D lighted LED Panel with "ANNOUNCEMENT" and "EVACUATE" selectable messages.

B. Manufacturer: Notifier SP-series lighted panel or approved equal.

C. This system will be provided as a "supplemental notification" to the private mode function of the fire alarm system and Owner's program.

D. Configure such that a general fire alarm condition will light "EVACUATE" message. Configure input causing "ANNOUNCEMENT" message as directed in the field by Owner.

E. Supervise all wiring to each unit. Provide additional monitor modules as required.

2.23 ADDRESSABLE MONITOR MODULE

A. Provide addressable monitor modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to monitor devices with normally-open (NO) contacts.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

D. Provide enclosures for modules where not part of factory equipment.

2.24 ADDRESSABLE CONTROL MODULE

A. Provide addressable control modules to serve as interfaces between the fire alarm system and ancillary systems where indicated on the drawings.

B. Provide with ability to provide a contact closure for control of devices. Provide with both normally-open (NO) and normally-closed contacts. Contacts on control module shall be rated for the proper voltage and current of the control circuits to which they are interfaced. Additional interfaces, if required to meet amperage or voltage requirements of the control system, are the responsibility of the contractor.

C. Match style and configuration of existing wiring. Provide with integral EOL resistor if required.

2.25 SYSTEM WIRE AND CABLE

A. Provide all conductors and cables in conformance with the National Electrical Code Section 760-30.

B. Size all initiating and indicating circuit wiring as recommended by the system manufacturer. Provide minimum 14 AWG size for indicating and control circuits, and 18 AWG for initiating circuits.

C. Provide shielded cable to minimize RFI if recommended by the manufacturer.

D. Provide maximum individual circuit voltage drop of 15% at the most distant device; or less if necessary to meet the manufacturer's operating voltage range for all devices.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATIONS

A. Remote station monitoring

1. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:
   a. Sprinkler waterflow alarm.
   b. Any fire alarm condition initiated by a manual pull station.
   c. Any verified automatic detector alarm.
2. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic release of fire doors.
   c. Detectors required for the automatic release of combination fire/smoke dampers.
   d. Detectors used for kitchen equipment power shutoff.
3. Automatic detectors at the following locations shall initiate a supervisory signal, not a general alarm:
   a. Smoke duct detectors required for HVAC unit shutdown.
   b. Detectors required for the automatic closure of fire doors and fire shutters.
   c. Detectors required for the automatic closure of fire/smoke dampers.

B. Walk test mode

1. The actuation of the "enable walk test" program at the control panel shall activate the "Walk Test" mode of the system which shall cause the following to occur:
   a. The city circuit connection shall be bypassed.

b. Control relay functions shall be bypassed.

c. The control panel shall show trouble condition.

d. The alarm activation of any initiation device shall cause the audible signals to code a number of pulses to match the zone number.

e. The panel shall automatically reset itself after signaling is complete.

f. Any momentary opening of an initiating or indicating appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating a trouble condition.

g. The system shall have the capacity of 8 distinctive walk test groups, such that only a portion of the system need be disabled during testing.

C. (SELECT/DELETE: CONFIRM WITH AHJ) Provide an adjustable alarm verification feature (as allowed in NFPA 72) to reduce the number of false alarms. Provide a system with programmable acknowledge time delay and reset time periods, within the allowable limits set by UL for the system. The activation of any system smoke detector shall initiate an alarm verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute, the system shall resume normal operation. The alarm verification shall operate only on smoke detector alarms. Other activated initiating device shall be processed immediately. The alarm verification operation shall be selectable by zone or addressable point. Each time a detector initiates an alarm verification operation, it shall be recorded into the alarm verification historical log.

D. The control panel shall have the capability to display the number of times (tally) a zone, or addressable point, has gone into a verification mode. Should this smoke verification tally reach a pre-programmed number, a trouble condition shall occur.

E. Alarm verification zones shall be able to be divided into eight separate groups whereby only verification zones from the same group will confirm the first activation and cause the alarm sequence to occur.

F. Provide the following sequence of events after the main control panel has determined that an alarm condition exists within the building, and the alarm has been verified:

1. Sound the alarm notification signal at the main control panel and all remote annunciators.

2. Display in plain English the description of the location of the device in alarm at the main control panel and each remote annunciator.

3. Activate all audible and visual indicating devices in the associated indicating zone within the building. Activate all audible alarm indicating devices in a synchronous temporal pattern and all visual indicating devices in a one (1) hertz synchronous flash pattern until silenced by the alarm silence switch at the control panel or remote annunciator.

4. Close the domestic water shutoff solenoids at the sprinkler service(s) if water flow is detected by any sprinkler flow switch.

5. Release all self-closing and automatically closing devices powered by the fire alarm system within the building.

6. Shut off any monitored HVAC system if smoke is detected by the associated HVAC unit duct detector.

7. Initiate the communication/modem device to transmit the point-specific information to the off-site monitoring station.
8. Recall the elevator cab if any elevator lobby, elevator equipment room, or top of hoistway smoke detector goes into alarm according to the following sequence:
    a. If the alarmed detector is in the elevator equipment room, top of hoistway, or in the elevator lobby on any floor other than the main level of egress, the elevator cab shall be recalled to the main level of egress.
    b. If the alarmed detector is in the elevator lobby on the main egress level, the elevator cab shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.
9. Store the event in the history log.

G. Provide the following sequence of events after the main control panel has determined that a trouble condition exists within the building:
    1. Sound the trouble notification signal in the main control panel and all remote annunciators.
    2. Display in plain English the description of the location of the device in trouble at the main control panel and each remote annunciator.
    3. Store the event in the history log.

H. Provide the following sequence of events after the main control panel determined that a supervisory condition exists within the building:
    1. Sound the trouble notification signal in the main control panel and all remote annunciators.
    2. Display in plain English the description of the location of the supervisory signal at the main control panel and each remote annunciator.
    3. Store the event in the history log.

I. Provide an interface to the building sprinkler system siamese connection indicating device on a separate indicating circuit. Provide alarm indication at the indicating circuit whenever water flow is detected. Provide a separate key switch at the main control panel to silence the indicating device.

J. If sprinkler water flow is detected by the kitchen hood water flow switch, the system shall shutoff electric power to the following:
    1. Electric appliances located under the hood.
    2. The exhaust fans serving the hood.
    3. The electric gas solenoid valve. A general building alarm shall not initiate equipment shutoff.

K. The following system conditions shall initiate the communicator to transmit the point-specific information to the remote monitoring location:
    1. Sprinkler water flow alarm.
    2. Sprinkler valve position switch supervisory alarm.
    3. Any fire pump supervisory, trouble or alarm condition.
    4. Any fire alarm condition initiated by a manual pull station.
    5. Any verified automatic detector alarm.

L. The following system conditions shall **not** initiate the communicator to transmit the alarm information to the remote monitoring location:

1. Smoke duct detectors required for HVAC unit shutdown.
2. Detectors required for the automatic release of fire doors.
3. Detectors required for the automatic release of combination fire/smoke dampers.
4. Detectors located within each dwelling unit.
5. Detectors used for elevator recall.
6. Detectors used for elevator power shutoff.
7. Detectors used for kitchen equipment power shutoff.

M. Automatic detectors at the following locations shall initiate a trouble signal, not a general alarm:

1. Smoke duct detectors required for HVAC unit shutdown.
2. Detectors required for the automatic closure of fire doors and fire shutters.
3. Detectors required for the automatic closure of fire/smoke dampers.
4. Detectors located in elevator lobbies and machine rooms required for the recall of elevators.

N. Provide green LED and the word NORMAL on the LCD display if the system is in its normal operating mode, and no alarms or faults exist in the system.

O. A manual evacuation (drill) switch shall be provided to operate the alarm indicating appliances without causing other control circuits to be activated. However, should a true alarm occur, alarm functions would occur as described previously.

P. The control panel shall maintain a moving average of the sensor's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Photoelectric smoke detector smoke obscuration sensitivity shall be adjustable to within 0.2% of either limit of the UL window (0.2% to 4.0%) to compensate for any environment.

Q. The system shall automatically indicate when an individual sensor needs cleaning. When a sensor's average value reaches a predetermined level, a "DIRTY SENSOR" trouble condition shall be audibly and visibly indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. If a "DIRTY SENSOR" is left unattended, and its average value increases to a second predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel for the individual sensor. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate an "ALMOST DIRTY" indication for any sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensor approaching a "DIRTY" trouble condition. This report shall generate a list of sensors requiring cleaning in advance of any trouble indication.

R. The control panel shall continuously perform an automatic self-test routine on each sensor which will functionally check sensor electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition with the sensor location at the control panel.

S. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each sensor:

1. Primary status
2. Device type
3. Present average value
4. Present sensitivity selected
5. Peak detection values
6. Sensor range (normal, dirty, etc.)

T. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1. Clear peak detection values
2. Enable or disable the point
3. Clear verification tally
4. Establish alarm sensitivity
5. Control a sensor's relay driver output

U. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week. There shall be five (5) sensitivity settings available for each sensor.

V. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3% sensor reaches a threshold of 1.5% smoke obscuration.

W. Adjust the sensitivity of the elevator lobby smoke detectors to maximum sensitivity.

3.2 INSTALLATION

A. Provide a complete and fully operational fire alarm and detection system as described herein and as shown on the drawings.

B. Provide a two wire Class B, low voltage, power limited, ADA compliant, addressable, closed circuit, electrically supervised, non-coded, temporal sounding type system as described in NFPA 72.

C. Provide individual alarm and trouble indication for each initiating device.

D. Provide supervisory signal indication for the sprinkler valve position switches (provided by others). Provide separate and unique monitoring of each valve position switch.

E. Provide supervision of the following circuits and devices:

1. Each individual initiating device and associated wiring
2. Each individual indicating device and associated wiring
3. Fire pump and fire pump wiring status.
4. Standby battery voltage.
5. Battery wiring.
6. Power supply voltage

7. CPU operation
8. Communications/Modem
9. Error Memory
10. Software Configuration
11. Hardware Configuration
12. Remote sub-panels, power supplies and associated wiring between the sub-panel and the main control panel.

F. Provide a clear distinction (at the main control panel and remote annunciators) between the alarm notification signal and the trouble notification signal.

G. Provide automatic HVAC system shut down for air handling units that move an air volume in excess of 2000 cfm. Provide duct detectors in the return ducts, and addressable control modules at each motor starter.

H. Install and wire all equipment in accordance with this specification, project drawings and shop drawings.

I. Provide all wiring, conduit, junction boxes and outlet boxes required for the system, including terminations to initiating, indicating and control devices furnished by others.

J. Install all wiring in concealed conduit in new construction. Provide surface raceway and boxes in finished areas of existing construction. Reuse existing conduit and boxes wherever possible.

K. Paint all junction boxes red and label “Fire Alarm”.

L. Provide plain English description of the location of each initiating device (zone). Coordinate wording of each device with the Owner.

M. Provide a laminated floor plan showing all device locations, addresses and plain-English description of the location. Mount the plan adjacent to the annunciator panel in the building Engineer’s office.

N. Provide color coded wiring throughout. Test all wiring for opens, shorts and grounds before system startup.

O. Terminate all fire alarm wiring at terminal strips at the main control panel and all annunciator panels. Identify each cable with a number corresponding to a wiring diagram to be submitted in the O&M manuals. Neatly arrange of cabling around the sides of the cabinets to facilitate servicing of equipment and modules.

P. Provide the required system programming. Coordinate with the Owner all plain English address points, alarm verification presets, passwords, communication dialer protocol information, etc.

Q. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of sprinkler waterflow switches and valve position switch locations with mechanical contractor. Provide wiring and make terminations to sprinkler waterflow devices and valve position switches being installed by mechanical contractor.

R. Coordinate the installation of the fire alarm system with mechanical contractor. Verify locations of smoke damper and EP switch locations with mechanical contractor. Provide wiring and make terminations to EP switches being installed by mechanical contractor.

S. Provide and install power to magnetic door holders, including wiring and connections through the associated smoke detector. Wire existing magnetic door holder wiring through the associated smoke detector base for automatic closure if the smoke detector senses smoke.

T. Mount end-of-line resistors in separate junction box located near the last device in the circuit or in last device. Clearly and permanently label "EOL RESISTOR" at each junction box cover plates and/or devices containing EOL resistors.

U. Provide one 3/4 inch conduit and telephone cable from main fire alarm control panel to the telephone terminal board for tie-in to remote monitoring company. Verify location with Owner.

V. Provide and connect wiring from the duct smoke detector control modules to associated motor controllers.

W. Install smoke detectors after the site is free from abnormal dust and dirt conditions, or provide manufacturer-approved protective cover over the device until the site is clean.

X. Provide permanent labels for controls and indicators.

Y. Provide Form C relays where required to control line voltage equipment.

Z. Mount fire alarm devices to electrical boxes.

AA. Locate automatic detectors a minimum of 36 inches away from supply air diffusers.

3.3 PLENUM CABLE INSTALLATION *(SELECT/DELETE/EDIT)*

A. Plenum rated conductors are to be installed above accessible, suspended ceilings. Provide conduit for all exposed areas. Where provided utilize cable trays. Do not utilize cable trays provided for voice/data cabling.

B. Provide bushings on all conduit drops to outlet boxes for devices installed in walls.

C. Route all cables to avoid access panels on equipment and in ceiling.

D. Support all cable at 5' intervals using "J" hooks. Fasten "J" hooks to building structure. Adhere to the manufacturer's maximum fill for the cable support hardware. Bundle cables to eliminate sagging between "J" hooks. Install "J" hooks to eliminate sagging on ceilings, ducts, pipes, etc.

E. Install cables without violating the minimum bend radius recommended by the cable manufacturer.

F. Maintain at least a 12" spacing from fluorescent light fixtures and other EMI/RFI noise sources.

G. No splices are allowed in individual runs of cables. If splices are required due to the construction schedule then splices are to be made within junction boxes. Notify engineer for inspection of junction boxes prior to installation of ceiling tiles.

H. Maintain conductor shields at each connection point and tie to ground. Conductor shields are to be continuous throughout the entire run of cable.

I. Provide test results indicating continuity of conductor shields. Replace all cables where shields have become nicked or cut.

J. Terminate all conductors in flush outlet boxes behind devices. Provide stress relief. Provide grommets where cables enter HVAC equipment.

K. Provide red plenum cable for fire alarm systems.

L. (SELECT/DELETE)Continuous, enclosed raceway and box systems are required for all smoke control system components-no free-air cable is allowed.

3.4 TESTS AND ADJUSTMENTS

A. Upon completion of the installation phase, test and adjust the system to insure proper operation.

B. Test all operational features of the system at this time.

C. Where required, make appropriate correction(s) and adjustments.

D. Make an inspection of the fire alarm system with the manufacturer's representative of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal detectors, smoke detectors, flow switches and controls, whether or not manufactured by the manufacturer. The inspection to comprise examination and certification of such equipment for the following:

1. The system functions properly;
2. The type of equipment installed is that designated by the Engineer's specifications;
3. The wiring connections to all equipment components have been installed in accordance with UL requirements;
4. Equipment of the manufacturer has been installed in accordance with the manufacturer's recommendation and that all signaling devices of whatever manufacturer have been operated or tested to verify their operation: The supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of inspecting officials.

E. Inspection Certification: Upon completion of the inspection and when all of the above conditions have been complied with, the manufacturer is to issue to the Engineer:

1. A copy of the inspecting technician's report showing location of each device and certifying the test results of each device.
2. A certificate of verification confirming that the inspection has been completed and accepted by the authority having jurisdiction and showing the conditions upon which such inspection and certification have been rendered.

F. Owners Instruction: The manufacturer to provide the services of a competent alarm system technician for the period of two working days, at a time convenient to the Owner, to instruct the staff in the operation and maintenance of the system.

G. Provide a letter to the Owner and Fire Marshal certifying that the installed system is UL certified.

H. ***(DELETE/EDIT)*** Provide UL certification of complete fire alarm system (including all new and existing devices) for a period of five years.

I. ***(DELETE/EDIT)*** Provide complete UL testing of the entire fire alarm system (including all new and existing devices). Field verify exact mounting locations of all fire alarm devices.

Provide a UL certified maintenance and monitoring contract for the complete fire alarm system (including all new and existing devices) ***(EDIT)*** for a five year period, beginning on the date of final completion. Provide all required on-site maintenance and testing during this period performed by a UL certified service company.

3.5 TRAINING

A. Provide a minimum of eight (8) hours of on-site instruction and training to the person or persons so designated by the Owner.

3.6 AS-BUILT DOCUMENTATION

A. Provide to the Engineer two (2) complete as-built manuals assembled in loose-leaf binders containing the following:

1. As-built system functional block diagrams.
2. Corrected copies of approved shop drawings

3. As-built system wiring diagram.
4. List indicating each device, location, address, label, etc.
5. Final operating sequence (step by step) for the system as tested and accepted by the Fire Marshal.
6. **Hard copy printout of the complete fire alarm operating program, and a CD-ROM disk with programming software as written and customized for this project.**
7. System operation manuals.
8. System maintenance manuals.
9. Name, address and phone number of the responsible service organization.

3.7 FINAL CHECKOUT AND ACCEPTANCE

A. Demonstrate the operation and use of the system to the Architect/Engineer, to the Owner's representative(s) and the Fire Marshal.

B. Verify the following before scheduling the system demonstration:

1. System installation is complete.
2. System is fully operational.

C. Verify the following before requesting final approval:

1. Owner training is complete.
2. As-built documentation is complete and turned over to the Engineer.

D. Provide a letter to the Owner certifying that the installation is complete, fully operational and successfully tested.

E. Final acceptance of the system will be given upon completion of all of the above requirements.

3.8 SYSTEM GUARANTEE

A. Provide a complete parts and labor warranty for the system, commencing on the date of final acceptance and continuing for a period of one (1) year. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse or misuse) at no charge to the Owner during this time period.

3.9 MAINTENANCE

A. Maintain a local service organization which is available to perform testing, inspection, repair and maintenance service on the system.

B. Make available to the Owner a maintenance contract proposal, from the system supplier to provide a minimum of two (2) inspections and test per year in compliance with NFPA-72 guidelines.

3.10 SPARE PARTS *(EDIT)*

A. Provide the following spare parts for the system:

1. Five intelligent smoke detectors with bases.
2. Five intelligent heat detectors with bases
3. One duct smoke detector housing and sampling tubes
4. Five manual pull stations.

5. Two addressable control modules.
6. Two addressable monitor module.
7. 15 keys for fire alarm cabinets.

B. Turn spare parts over to Owner at the completion of the project. Provide written documentation signed by the Owner that the spare parts were turned over at the completion of the project.

END OF SECTION

INDEX TO SPECIFICATIONS

END OF INDEX

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 WORK INCLUDES

A. Furnishing labor, materials, equipment and services required for the complete installation of new plumbing systems shown on the Drawings and specified in Division 22.

B. All work to be complete and to be left in operating condition.

C. Include all parts and labor, which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents.

D. Some equipment and materials provided under Division 22, 23, 25 or Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 22, 23, 25 and Division 26 Contract Documents to determine where these composite crews are required.

E. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project. Pay all fees and costs charged by utility companies for utility services.

F. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.

G. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.

H. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.

I. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

J. Furnish labor, equipment, and materials required for cutting, demolition, removal, patching, and restoration work necessary to accomplish and complete all demolition, including any relocation or reuse of existing materials, equipment, systems, as well as the disposition of salvaged materials or debris.

1.2 RELATED SECTIONS:

A. General Provisions are specifically applicable to all Division 22 Sections.

B. Divisions 0 and 1 apply to all work of Division 22 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 22 05 00 takes precedence. Section 22 05 00 specifies conditions, procedures, equipment and material particular to the mechanical work and applies to all mechanical work of the Contract Documents.

C. Division 0 and 1 and Section 22 05 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 22 work. Copy these documents to all Sub-contractors receiving other Sections of Division 22.

D. Where a Specification Section refers to other Sections under the Article on "Related Sections", this is done for Contractor's convenience only. It in no way relieves the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division's Specifications as well as for information contained in all other Divisions.

1.3 WORK SEQUENCE

A. Coordinate all work of this Section with General Contractor and all subcontractors so the work will progress without interruption and without delays.

B. Coordinate and schedule the work with the Owner and Construction Manager where possible disturbance may occur or where relocations or other potential disruptions of the Owner's functions and services are required. Perform all work affecting the Owner's functions and services at times acceptable to the Owner, even if this requires the Contractor to do the work in stages as directed by the Owner and Construction Manager.

1.4 ALTERNATES

A. Alternates: Refer to Bid Form and Instruction to Bidders.

1.5 REGULATORY REQUIREMENTS

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

Americans with Disabilities Act
Municipal Water and Sewer Regulations
National Electric Code
NFPA 101 Life Safety Code
Occupational Safety and Health Administration Regulations
State and Local Building Codes
State and Local Electrical Codes
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State and Local Plumbing Codes
State Industrial Commission Regulations
State Elevator Code
State Energy Code
Uniform Federal Accessibility Standards
AIA Guidelines
NFPA 99 Health Care Facilities

1.6 REFERENCES

A. Use the Standard where referenced in the specifications by the following abbreviations:

AIA - American Institute of Architects
ANSI - American National Standards Institute
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society of Testing and Materials
AWWA - American Water Works Association
EPA - Environmental Protection Agency
FM - Factory Mutual
IEEE - Institute of Electrical and Electronic Engineers

IES - Illuminating Engineering Society of North America
ICEA - International Cable Engineers Association
IRI - Industrial Risk Insurance
NEBB - National Environmental Balancing Bureau
NBFU - National Bureau of Fire Underwriters
NBS - National Bureau of Standards
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSC - National Safety Council
OSHA - Occupational Safety and Health Administration
PDI - Plumbing and Drainage Institute
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
UL - Underwriter's Laboratories

1.7 DEFINITIONS

A. Contract Documents: References to Contract Documents refers to a complete set of Drawings and Specifications for the entire Project. Drawings and Specifications are intended to supplement one another. Provide items shown on the Drawings but not mentioned in the Specifications and items mentioned but not shown the same as if they were both mentioned and shown. Bid the most expensive interpretation of a conflict between Drawings and Specifications so the conflict can be resolved with a deduct rather than an add to the contract amount.

B. Dimensions: Arrangement of equipment, accessories, piping and ductwork on the Drawings is generally diagrammatic unless the Drawings include dimensions. Do not scale the Drawings. Field verify all dimensions at the site to locate new and existing work.

C. Furnish: To obtain, coordinate, submit the necessary drawings, deliver to the job site in new condition ready for installation, unload and unpack, and guarantee.

D. Install: To receive at the job site, store, assemble, erect, set in place, anchor, apply, finish, protect, clean, test, start-up, and make ready for Owner’s use.

E. Provide: To furnish and install.

F. Responsibility: Where verbs such as “furnish”, “provide”, “install”, or “use” appear in the Contract Documents, they mean, “The Mechanical Contractor to furnish, provide, install, or use…..” unless the requirement is introduced by a phrase, sentence or heading specifically identifying the requirement as the responsibility of someone else.

1.8 SUBMITTALS

A. Substitutions

1. Submit written requests to use products not listed in the Specifications to the Engineer no later than ten (10) calendar days prior to the bid opening. Requests must be submitted by a bidding Contractor. Submit detailed information for proposed material or equipment.

2. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.

3. Contractor is responsible for dimensional differences, weights, electrical requirements and any other resulting changes, when using equipment other than that scheduled on the Drawings. Contractor is responsible for any additional costs incurred as a result of substitutions, including other Contractors and Architect/Engineer fees.

4. Material and equipment not listed in the Specifications or accepted in an Addendum shall be removed and replaced at no cost or inconvenience to the Owner.

B. List of Materials, Equipment and Sub-Contractors

1. Submit a complete list of all materials, equipment, and sub-contractors, proposed to be used on this project, to the Engineer within seven (7) calendar days of the award of contract or written notice to proceed.
2. Acceptance of items on the list are considered final, unless additional information or submissions are required by the Engineer. Unacceptable items will be rejected and resubmitted.

C. Pay Request Cost Breakdown

1. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.
2. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or as requested by the Engineer.
   a. Basic Materials and Methods
   b. Building Service Piping
   c. Plumbing Fixtures and Equipment
   d. Testing, Adjusting and Balancing

D. Submittals for Review

1. Submit in accordance with Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.
2. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacturer, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned without review.
3. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.
4. Submit PDF of each set of shop drawings based off of specification sections to the Architect & Engineer. Red lined PDF shall be returned to the Architect, Construction Manager or General Contractor - (two copies to be incorporated into the O&M Manuals.
5. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.
6. Submittals will be reviewed with the following actions:
   a. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.
   b. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.

c. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.

d. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.

7. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.

8. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.

9. Submit shop drawings for the following equipment and systems:

Section	Description
22 05 16	Common Motor Requirements for Plumbing Equipment
22 05 19	Gages and Meters for Plumbing Piping
22 05 23	General Duty Valves for Plumbing and Natural Gas Piping
22 05 29	Hangers and Supports for Plumbing Piping and Equipment
22 05 48	Vibration and Seismic Controls for Plumbing Piping and Equipment
22 05 53	Identification for Plumbing Piping and Equipment
22 07 19	Plumbing Piping Insulation
22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
22 13 16	Sanitary Waste and Vent Piping
22 13 19	Sanitary Waste Piping Specialties
22 14 29	Sump Pumps
22 42 00	Commercial Plumbing Fixtures

1.9 CAD/REVIT DRAWING FILES

A. The mechanical CAD/Revit drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD/Revit drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.10 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

C. Accomplish all work of cutting, removal, demolition, relocation, patching, and restoration by using only mechanics skilled in the trade required. Provide for the safety of the existing building and personnel, as well as for new construction as a result of work, procedures, operations or activities under this Contract.

D. Where the work of removals, demolition, cutting and similar work involves structural considerations, consult with Engineer. Exercise extreme care to avoid damage and preserve the safety of the structure and of all personnel. Particular care must be taken where the demolition or removals occur adjacent to occupied areas.

E. Utilize competent and qualified technical assistance to develop safe methods and techniques to accomplish the work, including temporary shoring and supports, methods of removal and other considerations. Design and place all permanent or temporary supports to carry all loads down to sound bearing.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.

2. Mechanical equipment and systems shown on the drawings as existing, have been based on existing plans, and may not be installed as originally shown. It is the Contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of Division 26 and other trades for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that can not be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.

2. Drawings may not show every rise and offset required for the work. Install piping and ductwork to accommodate the building structure and the work of other trades, with all required offsets and without extra cost to the Owner.

3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.

4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor to make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.

5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.

6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and Specifications are complementary and what is called for in either is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the Drawings and Specifications.

1.12 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specified in other Sections.

1.13 ELECTRICAL

A. Magnetic starters, disconnects, and power wiring provided by the Electrical Contractor, unless otherwise specified.

B. Control and interlock wiring provided by the Mechanical Contractor, unless otherwise specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S, VENDORS, SUPPLIERS OR AGENTS

A. Provide only products and services from manufacturers, vendors, suppliers or agencies with local representation and listed in these specifications that can provide complete coverage, parts and labor, for replacement and service of their products and listed in these specifications. Provide only equipment that will fit in the space available and be completely serviceable. Bring any conflicts to the Engineer's attention prior to ordering the equipment. Wholesale suppliers are not considered manufacturer representative unless they can provide the services listed in these specifications.

2.2 DEMOLITION

A. Remove salvageable materials and other items designated for reuse or relocation by the applicable trades and relocated to the new location.

B. If the new location is not ready to receive the relocated materials, store and protect from damage until they can be incorporated into the new work.

C. If the Owner is unable to forego the use of any existing items at the normal time for relocation, make all preparations for that work and then delay relocation until a time approved by the Owner or until other facilities are available to the Owner.

D. Carefully remove, clean, salvage and preserve all materials indicated to be reused, or which will be needed for reuse to match existing work.

E. Exercise extreme care in removals to prevent damage which would make materials unsuitable for reuse.

F. Replace all damaged materials, which were shown, tagged or needed for reuse, with equivalent.

2.3 SALVAGEABLE MATERIALS TO BE STORED BY OWNER

A. The Owner will mark or tag existing materials, equipment or other items he wishes to retain.

B. Carefully remove salvageable materials and items designated or marked to remain the property of the Owner. Protected from damage and store adjacent to the removal area as directed.

C. Consult the Owner about any salvage he may wish to retain and about the salvageability of all items. Carefully remove and salvage any materials the Owner wishes to retain.

D. Cleaning or restoration of the Owner's salvaged materials is not a part of this contract.

E. Relocate salvage material from the area and the site to the Owner's storage.

2.4 UNSALVAGEABLE MATERIALS

A. Remove all unsalvageable materials in a manner that will avoid damage to materials or equipment which will remain. Completely remove from the site as approved by and scheduled with the Owner.

B. Legally dispose of all unsalvageable materials away from the site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Continuity of Service:

1. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

2. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

3. No fire sprinkler or fire alarm systems are to remain inactive at the end of the work day. Assure that the fire sprinkler or fire alarm system is operational at the end of each work day. Coordinate with the Owner.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 DEMOLITION

A. The Drawings generally indicate the extent of demolition, removals, relocations and cutting.

B. The Drawings are not to be construed as indicating all required work, nor indicating all conditions or details which might be encountered during progress of the work of this Contract.

C. Examine all areas where demolition is to occur to determine the actual conditions and requirements.

D. Provide temporary bracing, shoring, and support for the execution of the work and the protection of persons and property during demolition, cutting, remodeling and all related new construction under this Contract. Perform all work with appropriate supports, protection and methods to prevent collapse, settling or damage to property or persons. Provide adequate supports for the loads to be carried, properly distributed, to lower levels or to sound bearing, if necessary.

E. Provide all protective coverings and enclosures necessary to prevent damage to existing spaces and materials which are to remain. Protect openings in exterior walls and roofs to prevent damage from water and weather and to prevent excessive heat loss from the existing buildings. Maintain a watertight installation by scheduling the work and removals at the exterior according to weather conditions. Temporarily seal unfinished areas to the existing roof or to other exterior surfaces of the existing building.

F. Provide dustproof temporary enclosures (including above ceilings) to separate the areas under demolition and remodeling from the remainder of the building. Also provide temporary air filters and ductwork to keep construction dust contained within the construction area. Provide temporary hinged doors in temporary enclosures where necessary. Temporary and permanent doors to be completely sealed with tape or other suitable materials during demolition work and to remain sealed until the dust has settled.

G. Demolish and remove existing construction as shown or indicated or as required to accomplish the work.

H. Where new work is to be installed in or adjacent to existing construction or when existing work is to be replaced, remove or cut the existing construction as necessary to complete the work under the Contract.

I. Execute the work with care. Remove and replace existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced, or is rendered unsuitable for its intended use, as a result of the work at no additional cost to the Owner.

J. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in a manner that prevents the spread of dust. Do not store or permit debris storage at the site. Do not burn or permit the burning of debris, rubbish or waste at the site. Keep adjacent areas unencumbered and clean. Keep all construction areas essentially broom clean.

K. Abandoned services may be left in place where they will be concealed inside floors or walls, providing they are disconnected from their sources and capped in place. No abandoned services, including piping, ductwork, tubing, etc., in ceilings or exposed.

L. Assure no "dead end" water, sewer, or vent piping is left in the completed work.

M. Based on a site inspection and the Contract Documents, the Contractor is responsible for the removal or rerouting of all anticipated mechanical work, exposed and concealed.

N. Where unanticipated mechanical work is exposed during the removal of partitions, walls, floors or ceilings, the removal or rerouting of this work to be accomplished by the Contractor under the direction of the Engineer.

O. Patch or otherwise restore disturbed existing construction and surfaces. Patching or restoration to be carried to natural breaks. Where existing construction is removed, cut or otherwise disturbed, patch all such disturbed and damaged surfaces.

P. Perform patching work by skilled mechanics experienced in the particular type of work involved. Conform to the standards of the Specifications where applicable, and where not specified, conform to the highest standards of the trade.

Q. Patch existing construction to match existing work, but always provide new materials and accomplish the work according to current standards. Examine existing surfaces before proceeding with the work. Report all conditions to the engineer, architect or owner, where existing materials, colors and finishes cannot be matched, but do not proceed until receiving instructions.

R. Repair existing construction that has been damaged as a result of the work to the extent required to match existing, undamaged construction.

S. All holes created by removal of existing systems, piping, ductwork, control wiring, tubing, etc., to be patched and fire caulked.

3.3 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.

2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current standards.

3. The Engineer reserves the right to reject material or workmanship not in accordance with the Contract Documents, before or after installation.

B. Piping

1. All piping to be run in the most direct and straight manner possible maintaining proper grading.

2. It is the intent of these plans and specifications that most piping be concealed. Where exposed, run as close to ceiling and/or wall as possible parallel with adjacent structural or architectural elements.

3. Do not install piping in any switchgear, transformer, elevator equipment, telephone, or electrical equipment room, unless it is a branch serving that room.

4. Do not install piping above switchboards, panelboards, control panels, motor control centers, etc.

5. Arrange work to facilitate maintenance, repair or replacement of equipment. Provide access for devices that require maintenance. For concealed devices, verify that access panels are properly located and labeled.

C. Equipment:

1. Install material and equipment in accordance with the Manufacturer's written instructions.

D. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to the General Contractor. Obtain special permission from the engineer before cutting structural members or finished material. Perform all patching in such a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.

2. Patch all holes left as a result of demolition of mechanical equipment and devices.

3. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for mechanical penetrations. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
4. Prevent the spread of dust, debris, and other material into adjacent areas.
5. Replace all ceiling tiles damaged during installation of work, with new tile.

E. Painting:

1. Refinish all mechanical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.

F. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of Division 0 and Division 1.
2. Maintain a complete set of Record Drawings showing all modifications to the Contract Documents. Drawings will be stamped “Record Drawings” and used only for that purpose.
3. As work progresses, record all changes or deviations from the contract drawings in a neat and legible manner as follows:
   a. Record exact location and elevation of underground mechanical systems including changes in direction, cleanouts etc., by reference to building lines, curbs, walks, and other permanent reference points.
   b. Record routing of concealed and exposed above ground mechanical systems where it varies from the Contract Documents.
4. The Engineer may recommend withholding payment if Record Drawings are not being maintained.
5. Submit Record Drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

3.4 PROTECTION

A. Protect openings and equipment from obstruction, breakage, misuse, damage or blemishes. Protect materials and equipment immediately upon receipt at the job site or immediately after they have been removed from their shipping containers. Unless noted otherwise, keep them clean and undamaged until final acceptance of the entire Project by the Owner. When a portion of the building is occupied by the Owner before substantial completion of the entire Project, make arrangements to transfer responsibility for protection and housekeeping for the occupied portion.

B. Protect pipe and equipment openings with temporary plugs or caps. Keep openings covered until permanent connections are complete.

C. Contractor is responsible for any damage to mechanical equipment, materials or work until final acceptance of the entire project by the Owner.

3.5 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean mechanical equipment and remove temporary identification.

B. In case of dispute, the Owner will remove the rubbish and charge the cost to the Contractor.

3.6 START-UP

A. Before start-up, lubricate, charge, and fill systems as specified and according to Manufacturer's instructions.

B. Test plumbing systems as specified in Sections governing their installation.

C. Perform testing, adjusting and balancing in accordance with that Section.

D. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final field observation and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

3.7 TESTING, ADJUSTING & BALANCING

A. Attend pre-testing conference as scheduled by Testing, Adjusting and Balancing Contractor.

B. Provide assistance to Test, Adjusting and Balancing Contractor by making adjustments to system and system components required for achieving design performance.

C. If acceptable performance of any test is not achieved, make the necessary corrections and the test to be repeated until acceptable performance is achieved.

3.8 FINAL FIELD OBSERVATION

A. A final field observation of the mechanical systems will be required before Contract Closeout. Request a final observation by the Engineer after all systems are fully completed and operational. The Engineer will schedule a field observation and generate a list of items to be corrected or completed before Contract Closeout.

B. If the Engineer is requested to make a final field observation by the Contractor, and the Engineer finds the work is not complete enough to perform that observation, the Contractor will compensate the Engineer for their time. The Contractor will then perform the necessary work to complete the project and again request a Final Field Observation.

3.9 TRAINING

A. Fully instruct the Owner's designated personnel in the operation of each mechanical system at the time it is put into service. Provide instruction using competent instructors and factory trained personnel.

B. Include documentation of instructions in the Operation and Maintenance Manuals.

C. Obtain a written statement from the Owner that his designated personnel have been instructed.

3.10 UTILITY REBATES

A. This Contractor to secure on behalf of the Owner all utility rebates associated with the design. This includes all submittals to the utility companies including substantiation where required and making all necessary arrangements on behalf of the Owner.

3.11 PROJECT CLOSEOUT

A. Operating and Maintenance Manuals: Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data to be appropriately marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer’s warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.
5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Local equipment suppliers/reps names, addresses, and telephone numbers.
10. Equipment manufacturers names, addresses, and telephone numbers.
11. Sub-contractors names, addresses, and telephone numbers.
12. Test reports.
13. Certifications.
14. Test and balance reports.
15. System validation reports.
16. Statement from Contractor that all incomplete items noted in Engineer’s Final Field Observation Report have been completed.
17. Statement from Owner confirming completion of Training.
18. Refer to individual Sections in Division 22 for additional requirements.

B. Record Drawings: Submit Record Drawings.

C. Extra Materials: Refer to individual Specification Sections for extra materials to be provided to the Owner.

D. System Startup: Refer to individual Specification Sections for system startup requirements.

3.12 JOB CLOSEOUT AND DOCUMENT TURNOVER

A. Construction Documents CD’s, Owner and Operation Manuals (O&M’s), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Record Drawings (As-Builts)

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document. Include all approved PR’s, Change Order, CCD’s, field changes, etc. in closeout documents.

1) Scanning:

i) 200DPI Grayscale

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Owners and Operation Manuals

a. O & M's shall be turned over by the Contractor.

b. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

ii) Bookmarking: Bookmarking of O & M Manuals shall be extensive.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Division 22 Sections, including single phase and three phase electric motors.

B. Power factor correction.

C. Drives.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. NEMA MG 1 - Motors and Generators.

D. NEMA MG 30 & 31.

E. NFPA 70 - National Electrical Code.

F. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

G. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

1.5 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Shop Drawings:

1. Include manufacturers product and nameplate data.
2. Include physical and performance data.
3. When used with variable frequency drive; certification that motor is compatible.
4. Include selection data for power factor correction capacitors.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 WARRANTY

A. Section 22 05 00 - Warranties.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

A. Manufacturers:

1. Baldor.
2. General Electric.
3. Marathon.
4. Reliance.
5. Substitutions: Refer to Section 22 05 00.

B. General:

1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Single Phase Motors:
   a. PSC for low starting torque, direct drive applications. Capacitor start for high starting torque applications.
   b. Single Phase Motors: Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used.
3. Electrical Service (unless noted otherwise):
   a. Motors Smaller than 1/2 HP: single phase, 60 Hz.
   b. Motors 1/2 HP and Larger: three phase, 60 Hz.
   c. Refer to the Schedules on Drawings for voltage.
4. Motors to be started across-the-line, unless noted otherwise, or as noted below:
   a. 208-240 Volt: Part winding start for motors 25 HP and above.
   b. 480 Volt: Part winding start for motors 50 HP and above.
5. Open drip-proof (ODP) type except where specifically noted otherwise.
6. Totally enclosed fan cooled (TEFC), TEAO or TENV motors when exposed to the weather.
7. Design for continuous operation in 40 degrees C environment.
8. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
9. Explosion-Proof Motors: Class 1, Group D; and Class II, Group E, F and G.
10. 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.
11. Wiring Terminations:
    a. 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.

b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

12. Motor Efficiencies

a. Efficiency: NEMA Premium Efficiency (1 hp and larger). Follow NEMA Standards Publication MG 1-2003, in Tables 12-12 and 12-13.

b. Exception: Motors on sump pumps, sewage ejectors, fire pumps, smoke exhaust fans and stairway pressurization.

13. Motors for use with Variable Frequency Drives

a. NEMA Standard MG1 definite purpose inverter duty rated motors to be used for all IGBT Pulse Width Modulated drive installations. Inverter duty motors to be designed and manufactured to meet NEMA Standard MG1 for definite purpose inverter duty motors. The inverter duty motors to be able to withstand voltages greater than 1600 volts peak and rise times of 0.1 microsecond.

b. Insulated of isolated bearings to be used for the inverter duty rated motors.

c. The inverter duty motor insulation class to be class F insulation and a class B temperature rise based on 40 degrees C.

d. The inverter duty motor name plate to indicate that the motor is an inverter duty motor.

e. Provide factory mounted shaft ground rings.

C. Single Phase Power – Electronically Commutated Motors:

1. Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used.

D. Single Phase Power - Permanent Split Capacitor Motors:

1. Starting Torque: Exceeding one fourth of full load torque.

2. Starting Current: Up to six times full load current.

3. Multiple Speed: Through tapped windings.

4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single Phase Power - Capacitor Start Motors:

1. Starting Torque: Three times full load torque.

2. Starting Current: Less than five times full load current.

3. Pull-up Torque: Up to 350 percent of full load torque.

4. Breakdown Torque: Approximately 250 percent of full load torque.

5. 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.

6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

F. Three Phase Power - Squirrel Cage Motors:

1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class F with Class B rise.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Weatherproof TEFC Motors: Epoxy seal windings using vacuum and pressure or coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.2 POWER FACTOR CORRECTION

A. Manufacturers:

1. Cornell-Dubelier.
2. General Electric.
3. Ronk Electrical Industries.
4. Sprague.
5. Westinghouse.
6. Zucker.

B. Provide power factor correction capacitors for motors 3 horsepower or larger in accordance with the following requirements. Capacitors to be selected so that they do not overcorrect the power factor beyond 99.99% throughout the range of operation of the motor. Reference to "full load" means the rated motor horsepower not including the service factor.

1. Motors with Constant Load: Correct to a minimum 95% power factor when operating at 65% of full load.
2. Two Speed Motors: Correct to a minimum of 95% power factor when operating at 65% of full load at low speed.

C. Motors that operate during emergency situations only, such as fire pumps, may be excluded from power factor correction. In addition, motors connected to variable speed drives to be excluded from the power factor correction requirements.

D. If equipment is furnished with a control panel, that panel to come with power factor correction capacitors factory installed and wired.

E. For equipment that does not have a control panel, the equipment supplier to be responsible for furnishing the capacitors and installing them at either the motor disconnect or motor control center.

F. Individual capacitors to be dry electrolytic type and enclosed in integrated dust tight enclosure.

2.3 MOTOR CONTROLLERS

A. In general, motor controllers will be furnished and installed under Division 26 unless the motor controller is an integral part of a piece of equipment, or noted otherwise.

B. Where control components are factory furnished, a control transformer with fused secondary to be provided to reduce voltage to 120 volts to operate control and safety devices.

2.4 BELT DRIVES

A. V-belt drives for equipment with motors smaller than 3 horsepower to be rated for 150% of rated horsepower of the driven equipment with matched pulleys and belts. V-belt drives for equipment with motors 3 horsepower and larger to be rated for 200%.

B. Variable pitch drives to be selected so that the fan speed at the specified operating conditions is approximately centered on the sheave adjustment range.

C. Exposed belt drives to have OSHA approved guards to completely enclose sheaves and belts. Guards to be constructed of expanded metal and reinforced with angle iron and securely fastened to floor or base. Provide openings at motor and driven equipment shafts for taking tachometer readings.

D. Except as specified otherwise, provide variable sheaves for motors 15 HP and smaller and fixed sheaves for motors 20 HP and larger.

E. Where motors are used with variable frequency drive systems, provide fixed sheaves. Select sheaves at an RPM which will provide 15 percent greater capacity that called out on drawings. Final capacity adjustments will be made with the variable frequency drive system.

F. Belt driven equipment to include an adjustable motor base for adjusting belt tension.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motors, power factor correction capacitors, and drives in accordance with manufacturer’s instructions.

B. Power factor correction capacitors to motor starters by Division 26.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Check rotation of motor driven equipment and lubricate as recommended by manufacturer.

F. Align all drive systems and adjust belt tension. Remove pulley set screws, install thread locking substance on threads, and reinstall screws, torquing to manufacturer's specifications.

G. Check and adjust belt guards so that no parts are in contact with rotating equipment.

END OF SECTION

SECTION 22 05 16

EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.4 SUBMITTALS

A. Submit under provisions of Section 22 05 00.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 22 05 00.

B. Record actual locations of flexible pipe connectors.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 22 05 00.

B. Maintenance Data: Include adjustment instructions.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Provide year warranty under provisions of Section 22 05 00.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Adsco.
2. Flexonics.
3. Keflex.
4. Metra-Flex.
5. Minnesota Flexible Corp.
6. Substitutions: Refer to Section 22 05 00.

B. Copper Piping:

1. Manufacturers:
   a. Flexonics Series 201.
2. Inner Hose: Bronze
3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 700 psig WSP @ 70 degrees F for 1/2" pipe. 470 psig WSP @ 70 degrees F for 1" pipe. 475 psig WSP @ 70 degrees F for 2" pipe.
5. Joint: Flanged, threaded or welded as specified for pipe joints.
6. Size: Use pipe sized units.
7. Maximum offset: 3/4 inch on each side of installed center line.
8. Length: Flange size plus 10 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 FLEXIBLE PIPE CONNECTORS

A. Construct spool pieces to exact size of flexible connection for future insertion.

B. Provide flexible connectors on pipes connected to equipment supported by vibration isolation. [Provide on pumps, chillers, cooling towers, generators, air compressors.]

C. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION

SECTION 22 05 19

GAGES AND THERMOMETERS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

C. Test plugs.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Standard Specification for ASTM Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

D. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00: Submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.7 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturer: Trerice No.750 Series.

B. Other acceptable Manufacturers:

1. Ashcroft.
2. Crosby.
3. Marsh.

4. U.S. Gauge
5. Weiss
6. Substitutions: Refer to Section 22 05 00.

C. Gage: ASME B40.1, UL 404 with bourdon tube, liquid filled, rotary brass movement, brass socket, front recalibration adjustment, black scale on white background.

1. Case: Stainless Steel.
2. Fill: Glycerin.
3. Bourdon Tube: Brass.
4. Dial Size: 4-1/2 inch diameter.
5. Mid-Scale Accuracy: One percent.
6. Scale: Psig.

2.2 STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model BX93000.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 22 05 00.

C. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.3 SOLAR POWERED STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model SX.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 22 05 00.

C. Thermometer: ASTM E1, adjustable angle, LED Solar activated, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Test Plug:

1. Manufacturers:
   a. Pete's Plug.
   b. Sisco.
   c. Substitutions: Refer to Section 22 05 00.
2. 1/4 inch fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   a. Neoprene core for temperatures up to 200 degrees F.
   b. Nordel core for temperatures up to 350 degrees F.
   c. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 3-1/2 inch diameter pressure gages.
      1) Scaled for each range required
   b. Two gage adapters with 1/8 inch probes.
   c. Two 1-1/2 inch dial thermometers.
      1) Scale range: 25 to 125 degrees F.
      2) Scale range: 50 to 500 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping.

C. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

D. Coil and conceal excess capillary on remote element instruments.

E. Provide the following thermometer temperature ranges unless noted otherwise:

1. Domestic cold water; 0-100 degrees F.
2. Domestic hot water (140 degrees F maximum); 0-160 degrees F.
3. Domestic hot water (180 degrees F maximum); 30-240 degrees F.

F. Provide instruments with scale ranges selected according to service with largest appropriate scale.

G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

I. Locate test plugs where indicated on drawings.

3.2 SCHEDULES

A. Pressure Gages.

1. Water service (near meter).
2. Elsewhere as indicated on drawings.

B. Solar Type Thermometers:

1. Domestic hot water supply and recirculation.
2. Inlet and outlet pipes to water heaters.
3. Water service (near meter).
4. Elsewhere as indicated on drawings.

C. Stem Type Thermometers:

1. Domestic hot and cold water supply and circulation.
2. Inlet and outlet pipes to water heaters.
3. Water service (near meter)
4. Elsewhere as indicated on drawings.

D. Test Plugs:

1. Where indicated on drawings.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valves for plumbing piping systems.

1. Globe.
2. Ball.
3. Check.
4. Ball (fuel).
5. Plug (fuel).

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 22 05 00.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 GLOBE VALVES - (150 PSIG)

A. 2-1/2 inches and Larger:

1. Manufacturers: Stockham Model D-512, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts Regulator.
    f. Substitutions: Refer to Section 22 05 00.
2. Class 150, 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.

2.2 BALL VALVES - (150 PSIG)

A. Up to and including 2 inches:

1. Manufacturer: Apollo 77FLF-100/77FLF-200 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: Refer to Section 22 05 00.
2. Construction: Class 150, 600 psig wog, certified lead free, bronze, two piece body, brass ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle, solder or threaded ends, suitable for domestic water. Extended stems for use on insulated pipe.

B. Up to and including 2 inches:

1. Manufacturer: Apollo 82-100/82-200 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Substitutions: Refer to Section 22 05 00.
2. Construction: Class 150, 600 psig wog, bronze, three piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle [with balancing stops], solder or threaded ends [with union]. Extended stems for use on insulated pipe.]

2.3 SWING CHECK VALVES - (150 PSIG)

A. Up To and including 2 1/2 inches:

1. Manufacturers: Watts UP1509, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Stockham.
    f. Victaulic (Alternate #8).
    g. Substitutions: Refer to Section 22 05 00.
2. Class 125, bronze body and cap, certified lead free, bronze swing disc with rubber seat, solder or threaded ends.

2.4 BALL VALVES - NATURAL GAS

A. Manufacturer:

1. Apollo.
2. Hammond.
3. Kitz.
4. Milwaukee.
5. Nibco.
6. Watts.
7. Substitutions: Refer to Section 22 05 00.

B. Construction 3/8" to 3": UL Listed for valves, Class 150, 600 wog for valves installed on systems over 5 psi. AGA Standard 3-88, ANSI Z21.15, CGA9.1 and CR91-002 for valves installed on systems 5 psi and less. Bronze body, chrome plated brass ball, Virgin PTFE (Teflon) seats and stem bearing, reinforced PTFE (15% glass Teflon) stem packing, lever handle, threaded ends, one quarter turn on/off and blow-out proof stem.

2.5 PLUG VALVES - NATURAL GAS

A. Manufacturer: DeZurick Series 400:

1. Substitutions: Refer to Section 22 05 00.
2. Construction 2-1/2 inches and Larger: UL Listed, 175 psig wog, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access where valves and fittings are not exposed.

C. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

A. Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

B. Use globe valves for throttling, bypass, or manual flow control services.

C. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

D. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

E. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide ball valves or plug valves in [natural] [propane] gas systems for shut-off service.

END OF SECTION

SECTION 22 05 29

HANGERS & SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 07 19 – Plumbing Piping Insulation.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping.

1.3 REFERENCES

A. ASME B31.9 - Building Services Piping

1.4 SUBMITTALS

A. Product Data: Provide manufacturers catalog data including load capacity.

B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of plumbing piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Anvil.
2. B-Line Systems.
3. Michigan.
4. Tolco.
5. Substitutions: Under provisions of Section 22 05 00.

B. Plumbing Piping - DWV:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and 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.
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.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: 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.
9. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
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.
11. Vertical Support: Steel riser clamp.
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 Pipe 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.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Stainless steel in areas of high humidity.

2.3 INSERTS

A. Manufacturers: Anvil Figure 282 (8 inches and smaller). Anvil Figure 282 with Figure 66 attachment (larger than 8 inches). Other acceptable manufacturers offering equivalent products.

1. B-Line Systems.
2. Michigan.

B. Inserts: 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 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing: Waterproofing: 5 lb/sq ft sheet lead

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage 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.

D. Sleeves for Pipes in building walls below grade: modular wall seal.

E. Stuffing and Fire stopping Insulation: Glass fiber type, non-combustible.

F. Sealant: Acrylic.

2.6 FIRESTOP SYSTEMS

A. Manufacturer:

1. 3M (Minnesota Mining and Manufacturing Co.).

2. Hilti.

3. Substitutions: Under provisions of Section 22 05 00.

B. Firestop systems that are produced and installed to resist the spread of fire according to requirements indicated, resist passage of smoke and other gasses, and maintain original fire-resistance rating of construction assembly.

C. Certificate of conformance for through-penetration requirements of ASTM E814 and UL1479.

D. Systems or devices listed in the UL Fire Resistance Directory under category XHCR (firestop devices) and XHEZ (firestop systems) may be used, providing that they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system in symmetrical for wall applications.

E. Accessories include, but are not limited to; permanent forming/damming/backing materials, temporary forming materials, substrate primers, and collars and steel sleeves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

L. Hangers for insulated pipe to be large enough to encompass the insulation and the metal protective shield, except that hangers may be applied directly to the pipe for domestic hot water and rainwater piping.

M. For glass pipe, provide pads or cushions on bearing surfaces of hangers to prevent scratching of pipe. Follow manufacturers instructions.

N. Support piping from building structure. Do not support piping from other mechanical or electrical components.

O. Do not support piping with wire or metal stripping hangers.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Provide for all floor mounted mechanical equipment.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal counterflashing where piping penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.

D. Seal [floor] [shower] [mop sink] drains watertight to adjacent materials.

E. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

F. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Sleeves in mechanical room floor slabs to extend 6 inches above finished floor level. Calk sleeves.

D. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIRE STOP SYSTEMS

A. Provide firestop systems for pipe through-penetrations of the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items: floor and ceilings, walls and partitions, smoke barriers, and construction enclosed compartmentalized areas.

B. Install through-penetration firestop systems to comply with manufacturer’s written installation instructions.

3.8 SCHEDULES

A. Piping:

PIPE SIZE Inches	MAX. HANGER SPACING (**) Feet	HANGER ROD DIAMETER Inches
Copper:		
1/2 to 1-1/4	6	3/8
1-1/2 to 4	10	3/8
5 and larger	10	1/2
Steel:		
1/2 to 3/4	10	3/8

1 to 4	12	3/8
5 to 8	12	1/2
10 to 12	12	5/8
PVC		
2 to 4	4	3/8
5 to 8	4	1/2
10 to 12	4	5/8
PP, PPFR, PVDF		
PEX-A		
1 and smaller	32”	3/8
1-1/4 to 4	4	3/8
5 to 8	4	1/2
10 to 12	4	5/8
C.I. No-Hub and at Joints	5*	3/4

(*) Support cast iron at every other joint unless over 4 feet, then support each joint not to exceed 10 feet.
(**) Per Minnesota Mechanical Code.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling Tacks.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

1.3 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Submit list of wording, symbols, letter size, and color coding proposed for plumbing identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two tags, 1-1/2 inches in size.

F. Samples: Submit two labels, 1.9 x 0.75 inches in size.

G. Manufacturer's Instructions: Indicate installation instructions, special procedures, and installation.

H. Samples: Submit two (2) signs each, 9” x 7” and 6” x 2” size.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

C. Valve Tag Chart.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/OSHA.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton.

2. Brady.

3. Substitutions: Refer to Section 22 05 00.

B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 22 05 00.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 22 05 00.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

C. Tag Chart: Typewritten letter size list plastic laminated.

2.3 STENCILS

A. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Pipe Markers:

1. Manufacturers:

a. Brady.

b. Seton.

c. Substitutions: Refer to Section 22 05 00.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. No tape or adhesive necessary. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Markline.

b. Substitutions: Refer to Section 22 05 00.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS.

A. Manufacturer: Moore.

B. Other acceptable manufacturers offering equivalent products.

1. Substitutions: Refer to Section 22 05 00.

C. Description: Steel with ¾ inch diameter color coded head.

D. Color code as follows:

1. Plumbing (valves): Green.

2. Gases (valves): Blue.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags and signs using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify piping, concealed or exposed, with plastic pipe markers . Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

K. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Identification:

1. Piping: Use pipe service description and color schemes that are standard to the manufacturer.

2. Equipment: Use nomenclature as noted on the drawings.

3. Underground Utilities: Use nomenclature as noted on the drawings.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

C. Section 22 11 16 – Domestic Water and Natural Gas Piping: Placement of hangers.

1.3 REFERENCES

A. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

B. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. NAIMA National Insulation Standards.

E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

A. Manufacturer: Johns Manville Micro-Lok HP (with integral vapor barrier).

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 22 05 00.

C. Insulation: ASTM C547; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket:

1. All service vapor retarder (ASJ).
2. Moisture vapor transmission: 0.02 perm-inches.

E. Vapor Barrier Lap Adhesive:

1. Compatible with insulation.

2.2 CELLULAR FOAM

A. Manufacturer: AP Armaflex by Armacell.

B. Other acceptable manufacturers offering equivalent products:

1. Halstead.
2. IMCOA/Nomaco.
3. Rubatex.
4. Substitutions: Refer to Section 22 05 00.

C. Insulation: ASTM C534; flexible, cellular elastomeric (or unicellular polyolefin), molded or sheet.

1. 'K' Value: 0.28 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Maximum Moisture Absorption: 0.2 percent by weight.
5. Moisture Vapor Transmission: 0.05 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.

7. Flame spread/smoke developed: Materials shall have a flame spread index of less than 25 and a smoke developed index of less than 50 when tested in accordance with ASTM E 84, latest revision.

D. Adhesive: Air dried, contact adhesive, compatible with insulation.

2.3 JACKETS

A. PVC Plastic:

1. Manufacturers:
   a. Zeston.
   b. Substitutions: Refer to Section 22 05 00.
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Transmission: 0.002 perm-inches.
   d. Thickness: 10 mil minimum (use standard stock dimensions).
   e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic:
   a. Compatible with insulation.

B. Canvas Jacket: UL listed.

1. Fabric: 6 oz/sq yd, plain weave cotton treated with dilute fire retardant lagging adhesive.
2. Lagging Adhesive:
   a. Compatible with insulation.

C. Aluminum Jacket:

1. Thickness: .025 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

3. Insulation thickness on runouts, 2 inch and smaller, to individual terminal units may be reduced to 1/2 inch, within 12 feet of the unit.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 22 05 29.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

K. Exterior Applications: Increase scheduled insulation thickness by 1/2 inch. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES – BASED ON MINNESOTA ENERGY CODE

A. Plumbing Systems:

1. Domestic Hot Water Supply and Recirculation
    a. Glass Fiber Insulation:
        1) Pipe Size Range: 2 inch and less, 2-1/2 inch and larger.
        2) Thickness: 1 inch, 1-1/2 inch.
    b. Cellular Foam:
        1) Pipe Size Range: All sizes.
        2) Thickness: 1-1/2 inch.
2. Domestic Cold Water:
    a. Glass Fiber Insulation:
        1) Pipe Size Range: all sizes.
        2) Thickness: 1 inch.
    b. Cellular Foam:
        1) Pipe Size Range: all sizes.
        2) Thickness: 1 inch.
3. Roof Drain Bodies:
    a. Cellular Foam:
        1) Thickness: 1 inch.
4. Rainwater Piping Above Grade – Horizontal Only:
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch. (where electrical heat taping occurs, use 1 inch thick).
5. Plumbing Vents Within 10 feet of the Exterior:
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch.
6. Drains from Electric Water Coolers: (minimum of 10 feet)
    a. Glass Fiber Insulation:
        1) Thickness: 1/2 inch.
    b. Cellular Foam:
        1) Pipe Size Range: 2 inches and less.
        2) Thickness: 3/4 inch.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER AND NATURAL GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, connections, and testing for piping systems.

1. Domestic water.
2. Natural gas.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 – Plumbing Piping Insulation.

E. Section 22 05 23 – General Duty Valves for Plumbing and Natural Gas Piping.

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

B. ASTM B88 - Seamless Copper Water Tube.

C. ASTM C1540 – Heavy Duty Shielded Couplings for Hubless Cast Iron.

D. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

E. UL 723 – Molded Plastic Surface Burning Characteristics.

F. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalog information.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual routing of piping.

C. Piping system cleaning reports.

D. Piping system testing reports.

1.6 QUALITY ASSURANCE

A. Testing of all piping systems.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 WATER PIPING (EXTERIOR OF BUILDING)

A. Ductile Iron Pipe: AWWA C151.

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: Rubber gasket with ¾ inch diameter rods.

B. Copper Tubing: ASTM B88, type "K" soft copper, 2-1/2 inch and smaller.

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: BCuP silver braze.

2.2 WATER PIPING (BELOW GRADE)

A. Copper Tubing: ASTM B88, type K" soft copper, 2-1/2" and smaller.

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: BCuP silver braze.

B. Ductile Iron Pipe: AWWA C151.

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: Rubber gasket with ¾ inch diameter rods.

2.3 WATER PIPING (ABOVE GRADE)

A. Copper Tubing: ASTM B88, Type L, hard drawn, ½" to 4".

1. Fittings: Cast copper alloy or wrought copper and bronze.
2. Joints: 95/5 solder, except joints to be BCuP silver brazed at expansion loops.
3. Press fittings:
   a. Manufacturers:
      1) Viega ProPress.

2) Substitutions: None.

b. Material:

1) Tubing Standard: Copper tubing shall conform to ASTM B88.

2) Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME, B16.22, or ASME B16.26.

3) Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect®) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

4) Threaded Fittings: Pipe Threads shall conform to ASME B1.20.1.

5) Hanger Standard: Hangers and supports shall conform to MSS-SP-58.

2.4 NATURAL GAS PIPING (BURIED EXTERIOR OF BUILDING)

A. Steel Pipe: ASTM A53 Schedule 40 black.

1. Fittings: Forged steel welding type, with polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: Welded.

B. Polyethylene Pipe: ASTM D2513, SDR 11.5.

1. Fittings: Socket type.

2. Joints: Fusion welded.

2.5 NATURAL GAS PIPING (ABOVE GRADE)

A. Steel Pipe: ASTM A53 Schedule 40 black. 2 inch and smaller exposed.

1. Fittings: Malleable iron.

2. Joints: Threaded.

B. Steel Pipe: ASTM A53 Schedule 40 black. 2 inch and smaller concealed, and 2 ½ inch and larger.

1. Fittings: Forged steel welding type.

2. Joints: Welded.

2.6 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 3 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 1 inch:

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.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, or Victaulic Clearflow dielectric waterway, water impervious isolation barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify that excavations are to required grade, dry, and not over-excavated.

C. ProPress piping system:

1. Examine the copper tubing and fittings for defects, sand holes or cracks. There shall be no defects of the tubing or fittings. Any damaged tubing or fittings shall be rejected.

2. Ensure that sealing elements are properly in place and free from damage. For Sizes 2-1/2" to 4", ensure that the stainless steel grip ring is in place.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. ProPress piping system:

1. Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.

2. Remove scale, slag, dirt and debris from inside and outside of tubing and fittings before assembly. The tubing end shall be wiped clean and dry. The burrs on the tubing shall be reamed with a deburring or reaming tool.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

H. Provide access where fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than [8] ft of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Prime and paint all exterior natural gas pipe with two (2) coats of safety yellow epoxy paint.

N. Pipe relief valves full size to 12 inches above floor, run to floor drain if within 20 feet.

O. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

P. Install water piping to ASME B31.9.

Q. Sleeve pipes passing through partitions, walls and floors.

R. Pipe Hangers and Supports: Refer to Section 22 05 29.

S. ProPress piping system:

1. Pressure Rating: Install components having a pressure rating equal to or greater than the system operating pressure.
2. Install piping free of sags, bends and kinks.
3. Change in Direction: Install fittings for changes in direction and branch connections. Where approved, changes in direction may also be made by bending of Types K and L tube.
4. Solder Joints: Solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
5. Threaded Joints: Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
6. Flared Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose.
7. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
8. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
9. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve. Penetrations for fire resistant rated assemblies shall maintain the rating of the assembly.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Provide unions downstream of valves and at equipment or apparatus connections.

C. Provide brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

D. Provide flow controls in all branches of water recirculating systems.

3.5 ERECTION TOLERANCES

A. Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.6 TESTING OF PLUMBING SYSTEMS

A. Provide final test with fixtures in place with 1 inch water column air pressure.

B. Test domestic water piping, tanks, etc. with hydraulic pressure of 125 psig for a period of 2 hours.

3.7 TESTING OF GAS PIPING

A. Test gas piping at 50 psig for 24 hours with no drop in pressure as dictated by local codes or Gas Co. if greater. Soap test all joints.

3.8 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.9 SERVICE CONNECTIONS

A. Provide new water service complete with approved double check backflow preventer, water meter and pressure reducing valve.

1. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

B. Provide new gas service from house side of gas meter and regulator. Gas Utility Company to provide gas meter and regulator. Gas service distribution piping to have initial minimum pressure of 2 psig. Provide regulators on each pipe serving equipment and appliances, sized in accordance with equipment.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.

B. Water hammer arrestors.

C. Water pressure reducing valves.

D. Relief valves.

E. Strainers.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

C. Section 22 11 23 – Domestic Water Pumps.

D. Section 22 42 00 – Commercial Plumbing Fixtures.

1.3 REFERENCES

A. ASME A112.26.1 - Water Hammer Arrestors.

B. ASSE 1011 - Hose Connection Vacuum Breakers.

C. ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.

D. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

E. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

G. PDI WH-201 - Water Hammer Arrestors.

1.4 SUBMITTALS FOR REVIEW

A. Submit under the provisions of Section 22 05 00.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Warranties.

B. Project Record Documents: Record actual locations of all water piping specialties.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers:

1. Manufacturers:

   a. 900 Watts, Model 009QT.

   b. Substitutions: Refer to Section 22 05 00.

2. ANSI/ASSE 1013; 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.

2.2 WATER HAMMER ARRESTORS

A. Manufacturer: Sioux Chief, Model 650 series.

B. Other acceptable manufacturers offering equivalent products.

1. PPP, Inc.; SC Series.

2. Watts Regulator.

3. Substitutions: Refer to Section 22 05 00.

C. ANSI A112.26.1; stainless steel, copper construction, piston type sized in accordance with PDI WH-201, precharged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.

2.3 WATER PRESSURE REDUCING VALVES

A. Up to 2 inches:

1. Manufacturers: Watts Series U5, or equivalent by:

   a. Amtrol.

   b. Honeywell-Braukmann

   c. Substitutions: Refer to Section 22 05 00.

2. Construction: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded double union ends, with integral stainless steel strainer.

B. Over 2 inches:

1. Manufacturers:

   a. Watts.

   b. Amtrol.

c. Honeywell-Brackman.

d. Substitutions: Refer to Section 22 05 00.

2. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.4 TEMPERATURE AND RELIEF VALVES

A. Temperature and Pressure Relief:

1. Manufacturers: Watts Type LF40L, or equivalent by:

a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 22 05 00.

2. AGA Z21.22 certified, lead free, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME SEC IV certified and labeled.

2.5 STRAINERS

A. Manufacturers:

1. Armstrong.

2. Hayward.

3. Metra-Flex.

4. Mueller.

5. Sarco.

6. Titan.

7. Watts.

8. Substitutions: Refer to Section 22 05 00.

B. Size 2 inch and Under: Threaded brass body for 200 psig wog, lead free, Y pattern with 20 mesh stainless steel perforated screen. Application: Bronze body with copper or brass pipe.

C. Size 2 inch to 4 inch: Class 125, flanged or grooved iron body, lead free, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Class 125, flanged or grooved iron body, lead free, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs an elsewhere as noted on drawings..

C. Pipe relief from backflow preventer to nearest drain.

D. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets water closets, dishwasher, hose stations and elsewhere as noted on drawings.

E. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

F. Install pressure reducing valves on dishwasher booster heater and elsewhere as noted on drawings.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, connections, and testing for system.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 – Plumbing Piping Insulation.

1.3 REFERENCES

A. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

B. ASTM A74 - Cast Iron Soil Pipe and Fittings.

C. ASTM C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

D. ASTM C1540 – Heavy Duty Shielded Couplings for Hubless Cast Iron.

E. ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

F. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

G. UL 723 – Molded Plastic Surface Burning Characteristics.

H. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 22 05 00.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalog information.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 22 05 00.

B. Project Record Documents: Record actual routing of piping.

C. Piping system cleaning reports.

D. Piping system testing reports.

1.6 QUALITY ASSURANCE

A. Testing of all piping systems.

B. Identify pipe with marking including size, ASTM material classification, ASTM specification, water pressure rating.

1.7 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State and Municipal plumbing code.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING (EXTERIOR OF BUILDING)

A. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

A. PVC Pipe: Schedule 40, ASTM D2665

1. Fittings: Schedule 40, PVC.
2. Joints: Solvent weld with solvent cement.
3. Install per ASTM D2321.

2.2 SANITARY WASTE AND VENT PIPING (BELOW GRADE)

A. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

B. PVC Pipe: Schedule 40, ASTM D2665

1. Fittings: Schedule 40, PVC.
2. Joints: Solvent weld with solvent cement.
3. Install per ASTM D2321.

2.3 SANITARY WASTE AND VENT PIPING (ABOVE GRADE)

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Heavy duty joints: Neoprene gasket and stainless steel clamp and shield assemblies conforming to ASTM C1540.
    a. Manufacturers: Husky SD 4000, Clamp-All 125 or MG Coupling.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.

H. Provide access where fittings are not exposed.

I. Establish elevations of buried piping outside the building to ensure not less than 8 feet of cover wherever possible. All pipe exterior of the building with less than 8 feet of cover shall be cast iron. Install two (2) layers of 1" thick, 4'x8' closed cell foam insulation for the length of the pipe. Stagger joints. Insulation shall extend 4' out from centerline of pipe.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Sleeve pipes passing through partitions, walls and floors.

N. Pipe Hangers and Supports: Refer to Section 22 05 29.

O. All PVC pipes to have expansion joints every 35 feet as approved by applicable codes.

P. Install underground PVC per ASTM D2321.

3.4 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/4 inch per foot (smaller than 3 inch pipe), and 1/8 inch per foot (3 inches and larger) minimum. Maintain gradients.

3.5 TESTING OF PLUMBING SYSTEMS

A. Test sanitary and vent piping with air pressure of 5 psig for a period of 15 minutes.

B. Provide final test with fixtures in place with 1 inch water column air pressure.

3.6 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Floor drains.

B. Cleanouts.

C. Backwater valves.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 13 16 – Sanitary Waste and Vent Piping.

C. Section 22 13 29 – Sanitary Sewage Pumps.

D. Section 22 42 00 – Commercial Plumbing Fixtures.

1.3 REFERENCES

A. ASME A112.14.1 – Backwater Valves.

B. ASME A112.21.1 - Floor Drains.

1.4 SUBMITTALS FOR REVIEW

A. Submit under the provisions of Section 22 05 00.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Warranties.

B. Project Record Documents: Record actual locations of all sanitary specialties.

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

A. Manufacturers: Josam Model (Refer to Schedule on Drawings), or equivalent by:

1. J.R. Smith.

2. Mifab.

3. Wade.
4. Watts Drainage Products.
5. Zurn.
6. Substitutions: Refer to Section 22 05 00.

B. ANSI A112.21.1; lacquered cast-iron two-piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.2 CLEANOUTS

A. Manufacturer; Josam Series 56000 for floors and Series 58600 for walls, or equivalent by:

a. J.R. Smith.
b. Mifab.
c. Wade.
d. Watts Drainage Products.
e. Zurn.
f. Substitutions: None.

B. Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange and nikaloy top, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

C. Interior Unfinished Floor Areas:

1. Lacquered cast iron body with anchor flange and bronze top, reversible clamping collar, threaded top assembly, and round gasketed scored cover.

D. Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Interior Unfinished Accessible Areas:

1. Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.3 BACK WATER VALVES W/ SHEAR GATE VALVE

A. Manufacturer: Josam Model 67360.

B. Other acceptable manufacturers offering equivalent products.

1. J. R. Smith.
2. Mifab.
3. Wade.
4. Zurn.

C. Construction: ANSI A112.14.1; coated cast iron combination backwater valve, straight-through type, bronze swing-check assembly, bronze manually operated shear-gate with non-rising stem and hub and spigot connections. Removable handle.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

END OF SECTION

SECTION 22 14 29

SUMP PUMP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sump pumps.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work results for Plumbing.

B. Section 22 00 48 – Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

1.3 REFERENCES

A. ASHRAE 90A - Energy Conservation in New Building Design.

B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals.

B. Product Data:

1. Indicate pump type, capacity, power requirements.
2. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
3. Provide electrical characteristics and connection requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components.

C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Electrical Manufacturers' Association (NEMA).
4. Underwriters Laboratories (UL).

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 WARRANTY

A. Section 22 05 00 - Warranties.

B. Provide five year manufacturer warranty for submersible sump pumps.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Manufacturer:

1. Bell & Gossett.
2. Flygt.
3. Hydromatic.
4. Metropolitan.
5. Peerless.
6. Weil.
7. Zoeller.
8. Substitutions: Refer to Section 22 05 00.

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Strainer: Stainless steel.

E. Impeller: Cast iron shaft.

F. Bearings: Ball bearings.

G. Sump: Fiberglass basin with steel cover plate; 30 inches diameter, 84 inches deep.

H. Accessories: Oil resistant 15-foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

I. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

J. Controls: UL listed, single phase panel with motor starter relay, high water level sensor, operating water level sensor, seal fail fault and high temperature controls, NEMA 4X enclosure, dry contacts. Provide manual/off/auto switch, pump reset switch, test button, and silence button. Provide wiring suitable for sump basin depth.

K. Performance: Refer to schedule on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate with plumbing piping and related electrical work to achieve operating system.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mop sinks.

B. Hose bibbs.

C. Hydrants.

1.2 RELATED SECTIONS

A. Section 22 05 00 – Common Work Results for Plumbing.

B. Section 22 11 16 – Domestic Water and Natural Gas Piping.

C. Section 22 13 16 – Sanitary Waste and Vent Piping.

1.3 REFERENCES

A. ANSI A117.1 – Accessible and Usable Buildings and Facilities.

B. ANSI Z124.1 - Gel-Coated Glass-Fiber Reinforced Polyester Resin Bathtub Units.

C. ANSI Z124.2 - Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor and Shower Stall Units.

D. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.

E. ARI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

F. ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

G. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

H. ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

I. ASME A112.19.2 - Vitreous China Plumbing Fixtures.

J. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

K. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

L. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.

M. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 22 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 22 05 00 - Project Closeout.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Fixtures shall be free from flaws and blemishes, with finished surfaces clear, smooth and bright. Surfaces coming into contact with walls, floors or surfaces of other fixtures shall be ground true.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

A. Section 22 05 00 - Warranties.

1.10 EXTRA MATERIALS

A. Section 22 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mop sinks; Fiat, Mustee, Stern-Williams, Swan, Zurn..

1. Faucets; Chicago Faucet, Zurn.

B. Hose bibbs: Chicago Faucet, T&S, Woodford, Zurn.

C. Hydrants; Josam, Jonespec, J.R. Smith, Wade, Woodford, Zurn.

D. Substitutions; Refer to Section 22 05 00.

2.2 MOP SINKS

A. P-1 Mop Sink: Fiat Model MSB-2424, "Molded Stone" mop basin 24 inches x 24 inches x 10 inches high with rim guard, 3 inch drain and stainless steel or brass strainer, and caulked deep seal "P" trap.

1. Trim: Chicago Faucet No. 897-CP chrome plated service sink fitting with 3/4 inch hose connection, vacuum breaker, wall brace and pail hook. Install 36 inches above floor. Also provide Fiat No. 832-AA hose and stainless steel hose bracket.

2.3 HOSE BIBBS

A. P-2 Interior Hose Bibb: Chicago Faucet No. 998-RCF rough chrome finish inside sill fitting, for exposed piping, 3/4 inch male hose threaded outlet. Furnished with 893 vacuum breaker and 293-6 loose key handle.

2.4 HYDRANTS

A. P-3 Wall Hydrant: Woodford 3/4 inch Model B67 Series automatic draining freezeless wall faucet with vacuum breaker and locking door. All internal parts shall be renewable from the outside face of the hydrant. Hydrant vacuum breaker shall be field testable per ASSE 1052.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in Plumbing Fixture Schedule on Drawings.

B. Provide brackets, braces or reinforcing angles as required in all partitions not sufficient in themselves to support plumbing fixtures or other wall-hung equipment.

3.3 INSTALLATION

A. Connect fixture waste to waste line with iron ferrule and threaded pipe, other than water closets and trap standard fixtures.

B. Install each fixture with chrome plated, 17 gauge tubing trap with cleanout, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.

D. Install components level, plumb and secure.

E. Install and secure fixtures in place with wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

G. Mount lever control for handicapped water closets on wide side of toilet stall.

H. Insulate waste and supplies for all handicapped fixtures.

I. Connect floor mounted water closets with cast iron floor flange with ring putty or gaskets.

J. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

K. Provide carriers with full baffle plates for back-to-back blowout water closets.

L. Provide stop and waste valve on branch piping to all wall hydrants.

M. Provide locking style stop valves in branch lines serving safety equipment.

3.4 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean plumbing fixtures and equipment.

3.6 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures during construction.

3.7 SCHEDULES

A. Fixture Heights: Refer to Architectural Drawings.

B. Fixture Rough-In: Refer to Plumbing Fixture Schedule on Drawings.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDES

A. Furnishing labor, materials, equipment and services required for the complete installation of new heating, ventilating and air conditioning systems as shown on the Drawings and specified in Division 23.

B. All work shall be complete and shall be left in operating condition.

C. Include all parts and labor, which are incidental and necessary for a complete and operable installation even though not specifically mentioned in the Contract Documents.

D. Some equipment and materials provided under Division 22, 23, 25 or Division 26 may require composite work crews because of trade jurisdiction. Where this occurs, include in the bid this portion of the composite crew labor costs. It is the Contractor's responsibility to review Division 22, 23, 25 and Division 26 Contract Documents to determine where these composite crews are required.

E. Arrange with appropriate utility companies to provide temporary and permanent utility services as required and coordinate their installation with construction progress of this project. Pay all fees and costs charged by utility companies for utility services.

F. Obtain all temporary and permanent permits and licenses required in connection with this Division's work. Pay all fees and expenses required for such permits and licenses.

G. Request inspections as required by regulating agencies and/or regulations. Pay all charges for inspections by regulating agencies of installations of plans specifications.

H. Include State and Local sales taxes in the bid. Keep accurate records of these taxes and furnish such records to the Owner upon request.

I. Provide the Owner with a certificate of final inspection and approval by enforcement authorities.

J. Furnish labor, equipment, and materials required for cutting, demolition, removal, patching, and restoration work necessary to accomplish and complete all demolition, including any relocation or reuse of existing materials, equipment, systems, as well as the disposition of salvaged materials or debris.

1.2 RELATED SECTIONS

A. General Provisions are specifically applicable to all Division 23 Sections.

B. Divisions 0 and 1 apply to all work of Division 23 and are an integral part of this Section. Where the conditions specified are at variance with other Divisions, Section 23 05 00 takes precedence. Section 23 05 00 specifies conditions, procedures, equipment and material particular to the mechanical work and applies to all mechanical work of the Contract Documents.

C. Division 0 and 1 and Section 23 05 00 and all Addenda form a part of and apply to all contracts or sub-contracts relating to Division 23 work. Copy these documents to all Sub-contractors receiving other Sections of Division 23.

D. Where a Specification Section refers to other Sections under the Article on “Related Sections”, this is done for Contractor’s convenience only. It shall in no way relieve the Contractor of responsibilities stated in other Sections of the Specifications, even though these Sections are not specifically referenced. The Contractor is responsible for all information contained in this Division’s Specifications as well as for information contained in all other Divisions.

1.3 WORK SEQUENCE

A. Coordinate all work of this Section with all subcontractors so the work will progress without interruption and without delays.

B. Coordinate and schedule the work with the Owner and Construction Manager where possible disturbance may occur or where relocations or other potential disruptions of the Owner's functions and services are required. Perform all work affecting the Owner's functions and services at times acceptable to the Owner, even if this requires the Contractor to do the work in stages as directed by the Owner and Construction Manager.

1.4 ALTERNATES

A. Alternates: Refer to Bid Form and Instruction to Bidders.

1.5 REGULATORY REQUIREMENTS

A. Meet or exceed all current applicable codes, ordinances and regulations for all installations. Promptly notify the Engineer, in writing, if the contract documents appear to conflict with governing codes and regulations. Contractor assumes all responsibility and costs for correcting non-complying work installed without notifying the Engineer.

B. Higher quality of workmanship and materials indicated in the Contract Documents takes precedence over that allowed in referenced codes and standards.

C. Perform all work in compliance with the currently adopted version of the following codes and standards for this project:

Americans with Disabilities Act
Municipal Water and Sewer Regulations
National Electric Code
NFPA 90A Air Conditioning and Ventilating Systems
NFPA 101 Life Safety Code
Occupational Safety and Health Administration Regulations
State and Local Building Codes
State and Local Electrical Codes
State and Local Fire Codes and Regulations
State and Local Mechanical Codes
State and Local Plumbing Codes
State Industrial Commission Regulations
State Elevator Code
State Energy Code
Uniform Federal Accessibility Standards
AIA Guidelines
NFPA 99 Health Care Facilities

1.6 REFERENCES

A. Use the Standard where referenced in the specifications by the following abbreviations:

AABC - Associated Air Balance Council
ADC - Air Diffusion Council

AGA - American Gas Association
AIA - American Institute of Architects
AMCA - Air Moving and Conditioning Association, Inc.
ANSI - American National Standards Institute
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society of Testing and Materials
AWWA - American Water Works Association
EPA - Environmental Protection Agency
FM - Factory Mutual
IEEE - Institute of Electrical and Electronic Engineers
IES - Illuminating Engineering Society of North America
ICEA - International Cable Engineers Association
IRI - Industrial Risk Insurance
NEBB - National Environmental Balancing Bureau
NBFU - National Bureau of Fire Underwriters
NBS - National Bureau of Standards
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSC - National Safety Council
OSHA - Occupational Safety and Health Administration
PDI - Plumbing and Drainage Institute
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
UL - Underwriter's Laboratories

1.7 DEFINITIONS

A. Contract Documents: References to Contract Documents refers to a complete set of Drawings and Specifications for the entire Project. Drawings and Specifications are intended to supplement one another. Provide items shown on the Drawings but not mentioned in the Specifications and items mentioned but not shown the same as if they were both mentioned and shown. Bid the most expensive interpretation of a conflict between Drawings and Specifications so the conflict can be resolved with a deduct rather than an add to the contract amount.

B. Dimensions: Arrangement of equipment, accessories, piping and ductwork on the Drawings is generally diagrammatic unless the Drawings include dimensions. Do not scale the Drawings. Field verify all dimensions at the site to locate new and existing work.

C. Furnish: To obtain, coordinate, submit the necessary drawings, deliver to the job site in new condition ready for installation, unload and unpack, and guarantee.

D. Install: To receive at the job site, store, assemble, erect, set in place, anchor, apply, finish, protect, clean, test, start-up, and make ready for Owner’s use.

E. Provide: To furnish and install.

F. Responsibility: Where verbs such as “furnish”, “provide”, “install”, or “use” appear in the Contract Documents, they mean, “The Mechanical Contractor shall furnish, provide, install, or use…..” unless the requirement is introduced by a phrase, sentence or heading specifically identifying the requirement as the responsibility of someone else.

1.8 SUBMITTALS

A. Substitutions

1. Submit written requests to use products not listed in the Specifications to the Engineer no later than ten (10) calendar days prior to the bid opening. Requests must be submitted by a bidding Contractor. Submit detailed information for proposed material or equipment.
2. Accepted substitutions will be incorporated in an Addendum to the Contract Documents.
3. Contractor is responsible for dimensional differences, weights, electrical requirements and any other resulting changes, when using equipment other than that scheduled on the Drawings. Contractor is responsible for any additional costs incurred as a result of substitutions, including other Contractors and Architect/Engineer fees.
4. Material and equipment not listed in the Specifications or accepted in an Addendum will be removed and replaced at no cost or inconvenience to the Owner.

B. List of Materials, Equipment and Sub-Contractors

1. Submit a complete list of all materials, equipment, and sub-contractors, proposed to be used on this project, to the Engineer within seven (7) calendar days of the award of contract or written notice to proceed.
2. Acceptance of items on the list are considered final, unless additional information or submissions are required by the Engineer. Unacceptable items will be rejected and resubmitted.

C. Pay Request Cost Breakdown

1. Provide Schedule of Values for the utilization of submitting a "Pay Request". Allocate appropriate share of overhead and profit to each item. Separate each item into labor and material.
2. Submit cost breakdown on AIA document G703. Provide minimum breakdown as indicated below. Provide additional breakdown as required for clarity or as requested by the Engineer.
    a. Basic Materials and Methods
    b. Building Service Piping
    c. Process Piping
    d. Heat Generation Equipment
    e. Heating, Ventilating and Air Conditioning Equipment
    f. Air Distribution
    g. HVAC Instrumentation and Controls
    h. Testing, Adjusting and Balancing

D. Submittals for Review

1. Submit in accordance with Division 0 and Division 1. Submit drawings to the Engineer for review within 30 calendar days after award of Contract.
2. Include project name, name of Architect, name of Engineer, contractor, sub-contractor, manufacturer, supplier and sales representative, include name, address, and phone number for the sales representative. Clearly identify section number and description of equipment submitted. Shop drawings not including all of this information will be returned <u>without</u> review.

3. Examine all shop drawings noting capacity, arrangement and physical dimensions. Clearly mark all relevant items on catalog data and cross-out unrelated information. Review and stamp shop drawing prior to submitting to the Engineer.
4. Submit PDF of each set of shop drawings based off of specification sections to the Architect & Engineer. Red lined PDF shall be returned to the Architect, Construction Manager or General Contractor - (two copies to be incorporated into the O&M Manuals.
5. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.
6. Submittals will be reviewed with the following actions:
   a. NO EXCEPTIONS TAKEN—Indicates the Submittal appears to conform to the design concept of the Work and that the Contractor at his discretion, may proceed with fabrication and/or procurement and installation.
   b. MAKE CORRECTIONS NOTED—Indicates that the Submittals, after noted corrections are made, would appear to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.
   c. REJECTED—Indicates that the Submittal does not appear to conform to the specifications, and that a complete resubmittal is required. The Contractor shall not proceed with fabrication or procurement.
   d. NO ENGINEER ACTION REQUIRED—Indicates the Contractor may proceed without review of the Submittal based on provisions of the Contract Documents.
7. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.
8. If the Engineer rejects (Make corrections noted/Submit corrected copy, Rejected/Submit specified item) two (2) times for the same section the Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process.
9. Submit shop drawings for the following equipment and systems:

Section	**Description**
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters and Gages for HVAC Piping
23 05 23	General Duty Valves for HVAC Piping
23 05 29	Hanger and Supports for HVAC Piping, Ductwork and Equipment
23 05 48	Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53	Identification for HVAC Piping, Ductwork and Equipment
23 05 93	Testing, Adjusting and Balancing for HVAC
23 07 13	Duct Insulation
23 07 19	HVAC Piping Insulation
23 20 13	Hydronic Piping
23 20 19	Hydronic Specialties
23 21 23	Hydronic Pumps

23 23 13	Refrigerant Piping, Valves and Specialties
23 25 31	Water Treatment for Heating Systems
23 31 13	Metal and Non-Metal Ductwork, Casings and Plenums
23 33 13	Ductwork Accessories
23 37 13	Air Outlets and Inlets
23 52 38	Condensing Boilers
23 74 13	Packaged Outdoor Roof Top Units
23 74 33	Packaged Outdoor Roof Top Heating and Cooling Make-Up Air Units
23 82 36	Finned-Tube Radiation Heaters
23 82 39	Unit Heaters

1.9 CAD DRAWING FILES

A. The mechanical CAD drawing files prepared by Hallberg Engineering, Inc. for this project are Instruments of Service of Hallberg Engineering, Inc. for use solely with respect to this project and will not be made available to the Contractor.

B. Request CAD drawing files of Architectural floor plans, elevations, sections, etc directly from the Architect.

1.10 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Initiate, maintain and supervise all safety precautions required with this work in accordance with the regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

B. Environmental Requirements:

1. Do not remove or disturb any asbestos containing materials from the project. Immediately stop work and notify the Owner if asbestos containing materials are suspected.

C. Accomplish all work of cutting, removal, demolition, relocation, patching, and restoration by using only mechanics skilled in the trade required. Provide for the safety of the existing building and personnel, as well as for new construction as a result of work, procedures, operations or activities under this Contract.

D. Where the work of removals, demolition, cutting and similar work involves structural considerations, consult with Engineer. Exercise extreme care to avoid damage and preserve the safety of the structure and of all personnel. Particular care must be taken where the demolition or removals occur adjacent to occupied areas.

E. Utilize competent and qualified technical assistance to develop safe methods and techniques to accomplish the work, including temporary shoring and supports, methods of removal and other considerations. Design and place all permanent or temporary supports to carry all loads down to sound bearing.

1.11 PROJECT/SITE CONDITIONS

A. Site Inspections:

1. Before submitting a proposal on the work contemplated, examine the site of the proposed work and become thoroughly familiar with existing conditions and limitations. No extra compensation will be allowed because of misunderstanding as to the amount of work involved nor bidders lack of knowledge of existing conditions which could have been discovered or reasonably anticipated prior to bidding.
2. Mechanical equipment and systems shown on the drawings as existing, have been based on existing plans, and may not be installed as originally shown. It is the contractor's responsibility to visit the site and make exact determination of the existence, location and condition of such facilities prior to submitting a bid.

B. Correlation of Work:

1. Consult the drawings and specifications of Division 26 and other trades for correlating information and lay out work so that it will coordinate with other trades. Verify dimensions and conditions (i.e., finished ceiling heights, footing and foundation elevations, beam depths, etc.) with the Architectural and Structural drawings. Notify the Architect/Engineer of any conflicts that can not be resolved, in the field, by affected trades. Replacement of work due to lack of coordination and failure to verify existing conditions will be completed at no cost to the Owner.
2. Drawings may not show every rise and offset required for the work. Install piping and ductwork to accommodate the building structure and the work of other trades, with all required offsets and without extra cost to the Owner.
3. Where work must be replaced due to the failure of the Contractor to verify the conditions existing on the job, such replacement must be accomplished at no cost to the Owner. This applies to shop fabricated work as well as to work fabricated in place.
4. Throughout the course of the work, minor changes and adjustments to the installation may be requested by the Engineer. The Contractor shall make adjustments without additional cost to the Owner, where such adjustments are necessary to the proper installation and operation within the intent of the Contract Documents. This does not include work already completed.
5. Equipment outlines shown on detail plans of 1/4"=1'-0" scale or larger and/or dimensions indicated on the plans are limiting dimensions. Do not install any equipment that exceeds the equipment outlines shown or reduces indicated clearances.
6. Obtain exact location of connection to equipment, furnished by others, from the person furnishing the equipment.
7. Drawings and Specifications are complementary and what is called for in either is as binding as if called for in both.
8. Include the better quality, greater quantity or higher cost for an item or arrangement where a disagreement exists in the Drawings and Specifications.

1.12 WARRANTY

A. Guarantee and maintain the stability of work and materials and keep same in perfect repair and condition for the period of one (1) year after the final completion of the work as evidenced by issuance of the final certificate by the Architect.

B. Defects of any kind due to faulty work or materials appearing during the above mentioned period must be immediately made good by the Contractor at his own expense to the entire satisfaction of the Owner and Architect and Engineer. Include damage to the finish or the building resulting from the original defect or repairs.

C. Guarantee does not apply to injuries occurring after final acceptance and due to wind, fire, violence, abuse or carelessness or other Contractors or their employees or the agents of the Owner.

D. Guarantee does not apply where other guarantees for different lengths of time are specified in other Sections.

1.13 ELECTRICAL

A. Magnetic starters, disconnects, and power wiring provided by the Electrical Contractor, unless otherwise specified.

B. Control and interlock wiring provided by the Mechanical Contractor, unless otherwise specified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER'S, VENDORS, SUPPLIERS OR AGENTS

A. Provide only products and services from manufacturers, vendors, suppliers or agencies with local representation and listed in these specifications that can provide complete coverage, parts and labor, for replacement and service of their products and listed in these specifications. Provide only equipment that will fit in the space available and be completely serviceable. Bring any conflicts to the Engineer's attention prior to ordering the equipment. Wholesale suppliers are not considered manufacturer representative unless they can provide the services listed in these specifications.

2.2 DEMOLITION

A. Remove salvageable materials and other items designated for reuse or relocation by the applicable trades and relocated to the new location.

B. If the new location is not ready to receive the relocated materials, store and protect from damage until they can be incorporated into the new work.

C. If the Owner is unable to forego the use of any existing items at the normal time for relocation, make all preparations for that work and then delay relocation until a time approved by the Owner or until other facilities are available to the Owner.

D. Carefully remove, clean, salvage and preserve all materials indicated to be reused, or which will be needed for reuse to match existing work.

E. Exercise extreme care in removals to prevent damage which would make materials unsuitable for reuse.

F. Replace all damaged materials, which were shown, tagged or needed for reuse, with equivalent.

2.3 SALVAGEABLE MATERIALS TO BE STORED BY OWNER

A. The Owner will mark or tag existing materials, equipment or other items he wishes to retain.

B. Carefully remove salvageable materials and items designated or marked to remain the property of the Owner. Protected from damage and store adjacent to the removal area as directed.

C. Consult the Owner about any salvage he may wish to retain and about the salvageability of all items. Carefully remove and salvage any materials the Owner wishes to retain.

D. Cleaning or restoration of the Owner's salvaged materials is not a part of this contract.

E. Relocate salvage material from the area and the site to the Owner's storage.

2.4 UNSALVAGEABLE MATERIALS

A. Remove all unsalvageable materials in a manner that will avoid damage to materials or equipment which will remain. Completely remove from the site as approved by and scheduled with the Owner.

B. Legally dispose of all unsalvageable materials away from the site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Continuity of Service:

1. Coordinate/schedule all work with the Owner to minimize any disruptions. Confine all interruptions to the smallest possible area. Provide temporary connections if required to provide continuity of service.

2. Inspect all areas affected by the interruptions and return all automatically controlled equipment, electrically operated equipment to the same operating condition prior to the interruption.

3. No fire sprinkler or fire alarm systems are to remain inactive at the end of the work day. Assure that the fire sprinkler or fire alarm system is operational at the end of each work day. Coordinate with the Owner.

B. Use of Facility:

1. Do not disturb normal use of the facility, except within the immediate construction area. Keep walks, driveways, entrances, etc. free and clear of equipment, material and debris.

2. Store all equipment and material in a place and manner that minimizes congestion and is approved by the Owner.

3.2 DEMOLITION

A. The Drawings generally indicate the extent of demolition, removals, relocations and cutting.

B. The Drawings are not to be construed as indicating all required work, nor indicating all conditions or details which might be encountered during progress of the work of this Contract.

C. Examine all areas where demolition is to occur to determine the actual conditions and requirements.

D. Provide temporary bracing, shoring, and support for the execution of the work and the protection of persons and property during demolition, cutting, remodeling and all related new construction under this Contract. Perform all work with appropriate supports, protection and methods to prevent collapse, settling or damage to property or persons. Provide adequate supports for the loads to be carried, properly distributed, to lower levels or to sound bearing, if necessary.

E. Provide all protective coverings and enclosures necessary to prevent damage to existing spaces and materials which are to remain. Protect openings in exterior walls and roofs to prevent damage from water and weather and to prevent excessive heat loss from the existing buildings. Maintain a watertight installation by scheduling the work and removals at the exterior according to weather conditions. Temporarily seal unfinished areas to the existing roof or to other exterior surfaces of the existing building.

F. Provide dustproof temporary enclosures (including above ceilings) to separate the areas under demolition and remodeling from the remainder of the building. Also provide temporary air filters and ductwork to keep construction dust contained within the construction area. Provide temporary hinged doors in temporary enclosures where necessary. Temporary and permanent doors shall be completely sealed with tape or other suitable materials during demolition work and shall remain sealed until the dust has settled.

G. Demolish and remove existing construction as shown or indicated or as required to accomplish the work.

H. Where new work is to be installed in or adjacent to existing construction or when existing work is to be replaced, remove or cut the existing construction as necessary to complete the work under the Contract.

I. Execute the work with care. Remove and replace existing construction that is to remain which is loosened, cracked, or otherwise damaged or defaced, or is rendered unsuitable for its intended use, as a result of the work at no additional cost to the Owner.

J. Clean demolition areas and remove debris, waste and rubbish from the building at the conclusion of each day's work. Transport debris and rubbish in a manner that prevents the spread of dust. Do not store or permit debris storage at the site. Do not burn or permit the burning of debris, rubbish or waste at the site. Keep adjacent areas unencumbered and clean. Keep all construction areas essentially broom clean.

K. [Abandoned services may be left in place where they will be concealed inside floors or walls, providing they are disconnected from their sources and capped in place.] [No abandoned services, including piping, ductwork, tubing, etc., in ceilings or exposed.]

L. Based on a site inspection and the Contract Documents, the Contractor is responsible for the removal or rerouting of all anticipated mechanical work, exposed and concealed.

M. Where unanticipated mechanical work is exposed during the removal of partitions, walls, floors or ceilings, the removal or rerouting of this work shall be accomplished by the Contractor under the direction of the Engineer.

N. Patch or otherwise restore disturbed existing construction and surfaces. Patching or restoration shall be carried to natural breaks. Where existing construction is removed, cut or otherwise disturbed, patch all such disturbed and damaged surfaces.

O. Perform patching work by skilled mechanics experienced in the particular type of work involved. Conform to the standards of the Specifications where applicable, and where not specified, conform to the highest standards of the trade.

P. Patch existing construction to match existing work, but always provide new materials and accomplish the work according to current standards. Examine existing surfaces before proceeding with the work. Report all conditions to the engineer, architect or owner, where existing materials, colors and finishes cannot be matched, but do not proceed until receiving instructions.

Q. Repair existing construction that has been damaged as a result of the work to the extent required to match existing, undamaged construction.

R. All holes created by removal of existing systems, piping, ductwork, control wiring, tubing, etc., shall be patched and fire caulked.

3.3 INSTALLATION

A. Material and Workmanship

1. Provide new material and equipment, unless noted otherwise. Protect equipment and material from damage, dirt and the weather.
2. Provide the highest quality workmanship and perform all work only by skilled mechanics. Install material and equipment in accordance with manufacturers' recommendations, instructions and current standards.
3. The Engineer reserves the right to reject material or workmanship not in accordance with the Contract Documents, before or after installation.

B. Piping and Ductwork

1. All piping and ductwork shall be run in the most direct and straight manner possible maintaining proper grading.
2. It is the intent of these plans and specifications that most piping and ductwork be concealed. Where exposed, run as close to ceiling and/or wall as possible parallel with adjacent structural or architectural elements.
3. Do not install piping or ductwork in any switchgear, transformer, elevator equipment, telephone, or electrical equipment room, unless it is a branch serving that room.
4. Do not install piping or ductwork above switchboards, panelboards, control panels, motor control centers, etc.
5. Arrange work to facilitate maintenance, repair or replacement of equipment. Provide access for devices that require maintenance. For concealed devices, verify that access panels are properly located and labeled.

C. Equipment:

1. Install material and equipment in accordance with the Manufacturer's written instructions.

D. Cutting and Patching:

1. Perform all cutting and patching necessary to work, unless specifically delegated to the General Contractor. Obtain special permission from the engineer before cutting structural members or finished material. Perform all patching in such a manner as to leave no visible trace and return the area affected to the condition of undisturbed work. Perform all patching by workers experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted.
2. Patch all holes left as a result of demolition of mechanical equipment and devices.
3. Drill all holes in masonry with rotary drill. Impact tools are not allowed. Core drill all holes in masonry and concrete for mechanical penetrations. Provide and dispose of all water required for core drilling. Coordinate with other trades to prevent damage from water.
4. Prevent the spread of dust, debris, and other material into adjacent areas.
5. Replace all ceiling tiles damaged during installation of work, with new tile.

E. Painting:

1. Refinish all mechanical equipment damaged during shipping and/or installation to its original condition. Remove all rust; prime, and paint per manufacturer's recommendations for finish equal to original.

F. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of Division 0 and Division 1.

2. Maintain a complete set of Record Drawings showing all modifications to the Contract Documents. Drawings will be stamped “Record Drawings” and used only for that purpose.
3. As work progresses, record all changes or deviations from the contract drawings in a neat and legible manner as follows:
    a. Record exact location and elevation of underground mechanical systems including changes in direction, cleanouts etc., by reference to building lines, curbs, walks, and other permanent reference points.
    b. Record routing of concealed and exposed above ground mechanical systems where it varies from the Contract Documents.
4. The Engineer may recommend withholding payment if Record Drawings are not being maintained.
5. Submit Record Drawings to the Engineer for review at completion of the Work. Submit final record drawings as part of the Operation and Maintenance Manual package after the completion of the project.

3.4 TEMPORARY UTILITIES

A. Do not use heating, ventilating and air conditioning systems provided in this scope of work for temporary heating, ventilating and air conditioning during construction.

3.5 PROTECTION

A. Protect openings and equipment from obstruction, breakage, misuse, damage or blemishes. Protect materials and equipment immediately upon receipt at the job site or immediately after they have been removed from their shipping containers. Unless noted otherwise, keep them clean and undamaged until final acceptance of the entire Project by the Owner. When a portion of the building is occupied by the Owner before substantial completion of the entire Project, make arrangements to transfer responsibility for protection and housekeeping for the occupied portion.

B. Protect pipe, duct and equipment openings with temporary plugs or caps. Keep openings covered until permanent connections are complete.

C. Contractor is responsible for any damage to mechanical equipment, materials or work until final acceptance of the entire project by the Owner.

3.6 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish, caused by his employees or work, at all times. Remove rubbish, tools, scaffolding, and surplus materials from and about the building, and leave work areas "broom clean" or its equivalent upon completion of the work. Clean mechanical equipment and remove temporary identification.

B. In case of dispute, the Owner will remove the rubbish and charge the cost to the Contractor.

3.7 START-UP

A. Before start-up, lubricate, charge, and fill systems as specified and according to Manufacturer’s instructions.

B. Test hydronic systems and air systems as specified in Sections governing their installation.

C. Perform testing, adjusting and balancing in accordance with that Section.

D. Operate equipment and systems in all their operating modes, to verify proper operation, prior to final field observation and Owner instructions. Notify the Engineer, in writing, that all systems have been tested and are functioning and operating properly.

3.8 TESTING, ADJUSTING & BALANCING

A. Attend pre-testing conference as scheduled by Testing, Adjusting and Balancing Contractor.

B. Provide assistance to Test, Adjusting and Balancing Contractor by making adjustments to system and system components required for achieving design performance.

C. If acceptable performance of any test is not achieved, make the necessary corrections and the test shall be repeated until acceptable performance is achieved.

3.9 FINAL FIELD OBSERVATION

A. A final field observation of the mechanical systems will be required before Contract Closeout. Request a final observation by the Engineer after all systems are fully completed and operational. The Engineer will schedule a field observation and generate a list of items to be corrected or completed before Contract Closeout.

B. If the Engineer is requested to make a final field observation by the Contractor, and the Engineer finds the work is not complete enough to perform that observation, the Contractor will compensate the Engineer for their time. The Contractor will then perform the necessary work to complete the project and again request a Final Field Observation.

3.10 TRAINING

A. Fully instruct the Owner's designated personnel in the operation of each mechanical system at the time it is put into service. Provide instruction using competent instructors and factory trained personnel.

B. Include documentation of instructions in the Operation and Maintenance Manuals.

C. Obtain a written statement from the Owner that his designated personnel have been instructed.

3.11 UTILITY REBATES

A. This Contractor shall secure on behalf of the Owner all utility rebates associated with the design. This shall include all submittals to the utility companies including substantiation where required and making all necessary arrangements on behalf of the Owner.

3.12 PROJECT CLOSEOUT

A. Operating and Maintenance Manuals: Submit to the Engineer two (2) Operating and Maintenance manuals. Submit in portfolio form neatly edited with similar equipment grouped, tabbed and indexed. Provide printed or typewritten materials. Provide the following in each manual:

1. Shop drawings, approved manufacturer's bulletins, and other appropriate data from specific manufacturer of each piece of equipment furnished and/or installed. Shop drawings, manufacturer's bulletin, and other data shall be appropriate marked to reflect the "as-built" condition. Cross out or delete all information shown on shop drawings or literature not applying to this specific project.
2. Copies of manufacturer’s warranties
3. Operating instruction for equipment.
4. Wiring and installation instructions for equipment.

5. Recommended maintenance schedules and procedures for equipment.
6. Recommended trouble shooting procedures for equipment.
7. Equipment parts list.
8. Settings/adjustments/calibrations for systems as required.
9. Local equipment suppliers/reps names, addresses, and telephone numbers.
10. Equipment manufacturers names, addresses, and telephone numbers.
11. Sub-contractors names, addresses, and telephone numbers.
12. Test reports.
13. Certifications.
14. Test and balance reports.
15. System validation reports.
16. Statement from Contractor that all incomplete items noted in Engineer's Final Field Observation Report have been completed.
17. Statement from Owner confirming completion of Training.
18. Refer to individual Sections in Division 23 for additional requirements.

B. Record Drawings: Submit Record Drawings.

C. Extra Materials: Refer to individual Specification Sections for extra materials to be provided to the Owner.

D. System Startup: Refer to individual Specification Sections for system startup requirements.

3.13 JOB CLOSEOUT AND DOCUMENT TURNOVER

A. Construction Documents CD's, Owner and Operation Manuals (O&M's), As-Builts, Specifications and other documents turned over at the completion of the projects shall be furnished to the Owner in both paper hard copy and digital Adobe PDF.

1. Record Drawings (As-Builts)

a. PDF Creation: Each roll of drawings shall be scanned or converted to PDF to one single PDF document. Include all approved PR's, Change Order, CCD's, field changes, etc. in closeout documents.

1) Scanning:

i) 200DPI Grayscale

ii) Cropped to original size

iii) Color corrected and despeckled

b. Bookmarking: Each page of the PDF shall be bookmarked with the number and name of the sheet.

c. Naming: The PDF shall be labeled: "Building Name_Year_Title_Spec_Type"

1) Name = Building Name

2) Year = Date of Documents

3) Title = "Addition" "Remodel," etc…

4) CD = Construction Document

5) Type = Arch, Mech, Electrical Communications or a combination of the above

2. Owners and Operation Manuals

a. O & M's shall be turned over by the Contractor.

b. PDF Creation: Each book of specifications shall be scanned or converted to PDF to one single PDF document.

1) Scanning:

i) 200 DPI Grayscale

ii) Bookmarking: Bookmarking of O & M Manuals shall be extensive.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common requirements for electric motors furnished on equipment specified in other Division 23 Sections, including single phase and three phase electric motors.

B. Power factor correction.

C. Drives.

1.2 RELATED SECTIONS

A. 23 05 00 – Common Work Results for HVAC Equipment.

B. 23-05 16 – Expansion Fittings and Loops for HVAC Piping.

C. 23 21 23 – Hydronic Pumps.

D. 23 34 13 – Fans.

E. 23 36 00 – Air Terminal Units.

F. 23 52 38 – Condensing Boilers.

G. 23 72 13 – Heat-Wheel Air-to-Air Energy Recovery.

H. 23 74 13 – Packaged, Outdoor Roof-Top Units.

I. 23 74 33 – Packaged Outdoor Roof-Top Heating and Cooling Make-Up Air Units.

J. 23 82 33 – Convectors.

K. 23 82 39 – Unit Heaters.

1.3 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. NEMA MG 1 - Motors and Generators.

D. NEMA MG 30 & 31.

E. NFPA 70 - National Electrical Code.

F. UL 674 - UL Standard for Safety Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

G. UL 1836 - UL Standard for Safety for Electric Motors for Use in Class I, Division 2 and Class II, Division 2 Hazardous (Classified) Locations.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL Component Recognition for appropriate sizes.

B. Conform to NFPA 70 and local energy code.

1.5 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Shop Drawings:

1. Include manufacturer's product and nameplate data.
2. Include physical and performance data.
3. When used with variable frequency drive; certification that motor is compatible.
4. Include selection data for power factor correction capacitors.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to the site.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry, environmentally-controlled space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.

D. Handle in accordance to the manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure and finish

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not store or install unless temperature in maintained between 32 degrees F and 104 degrees F, at a relative humidity less than 95 percent (non-condensing).

B. Maintain conditions during and after installation of Products.

1.9 WARRANTY

A. Section 23 05 00 - Warranties.

B. Provide a complete parts and labor warranty on the VFD system and all related accessories, commencing on the date of final acceptance and continue for a period of two (2) years. Provide all materials and labor required to correct any system malfunction or failure (determined not to be the result of negligence, abuse, or misuse) at no charge to the Owner during this time period

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

A. Manufacturers:

1. Baldor.
2. General Electric.
3. Marathon.
4. Reliance.
5. Substitutions: Refer to Section 23 05 00.

B. General:

1. Motors Less Than 250 Watts, for Intermittent Service: Equipment manufacturer's standard and need not conform to these specifications.
2. Single Phase Motors: PSC for low starting torque, direct drive applications. Capacitor start for high starting torque applications.
3. Electrical Service (unless noted otherwise):
    a. Motors Smaller than 1/2 HP: single phase, 60 Hz.
    b. Motors 1/2 HP and Larger: three phase, 60 Hz.
    c. Refer to the Schedules on Drawings for voltage.
4. Motors to be started across-the-line, unless noted otherwise, or as noted below:
    a. 208-240 Volt: Part winding start for motors 25 HP and above.
    b. 480 Volt: Part winding start for motors 50 HP and above.
5. Open drip-proof (ODP) type except where specifically noted otherwise.
6. Totally enclosed fan cooled (TEFC), TEAO or TENV motors when exposed to the weather.
7. Design for continuous operation in 40 degrees C environment.
8. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
9. Explosion-Proof Motors: Class 1, Group D; and Class II, Group E, F and G.
10. 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.
11. Wiring Terminations:
    a. 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.
    b. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.
12. Motor Efficiencies
    a. Efficiency: NEMA Premium Efficiency (1 hp and larger). Follow NEMA Standards Publication MG 1-2003, in Tables 12-12 and 12-13.
    b. Exception: Motors on sump pumps, sewage ejectors, fire pumps, smoke exhaust fans and stairway pressurization.
13. Motors for use with Variable Frequency Drives
    a. NEMA Standard MG1 definite purpose inverter duty rated motors shall be used for all IGBT Pulse Width Modulated drive installations. Inverter duty motors shall be designed and manufactured to meet NEMA Standard MG1 for definite purpose inverter duty motors. The inverter duty motors shall be able to withstand voltages greater than 1600 volts peak and rise times of 0.1 microsecond.
    b. Insulated of isolated bearings shall be used for the inverter duty rated motors.

c. The inverter duty motor insulation class shall be class F insulation and a class B temperature rise based on 40 degrees C.

d. The inverter duty motor name plate shall indicate that the motor is an inverter duty motor.

e. Provide factory installed shaft ground ring.

C. Single phase: Motor shall be an electronically commutated motor rated for continuous duty and furnished with internally mounted potentiometer speed controller suitable for speed control. Capacitor motors shall not be used when ECM is specified.

D. Single Phase Power - Permanent Split Capacitor Motors:

1. Starting Torque: Exceeding one fourth of full load torque.
2. Starting Current: Up to six times full load current.
3. Multiple Speed: Through tapped windings.
4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

E. Single Phase Power - Capacitor Start Motors:

1. Starting Torque: Three times full load torque.
2. Starting Current: Less than five times full load current.
3. Pull-up Torque: Up to 350 percent of full load torque.
4. Breakdown Torque: Approximately 250 percent of full load torque.
5. 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.
6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, pre-lubricated sleeve bearings.
7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, pre-lubricated ball bearings.

F. Three Phase Power - Squirrel Cage Motors:

1. Starting Torque: Between 1 and 1-1/2 times full load torque.
2. Starting Current: Six times full load current.
3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
5. Insulation System: NEMA Class F with Class B rise.
6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centre line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
8. Sound Power Levels: To NEMA MG 1.
9. Weatherproof TEFC Motors: Epoxy seal windings using vacuum and pressure or coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.2 POWER FACTOR CORRECTION

A. Manufacturers:
   1. Cornell-Dubelier.
   2. General Electric.
   3. Ronk Electrical Industries.
   4. Sprague.
   5. Westinghouse.
   6. Zucker.

B. Provide power factor correction capacitors for motors 3 horsepower or larger in accordance with the following requirements. Capacitors shall be selected so that they do not overcorrect the power factor beyond 99.99% throughout the range of operation of the motor. Reference to "full load" means the rated motor horsepower not including the service factor.
   1. Motors with Constant Load: Correct to a minimum 95% power factor when operating at 65% of full load.
   2. Direct Expansion Refrigeration Compressors: correct compressors to a minimum of 95% power factor when operating in its least loaded condition.

C. Motors that operate during emergency situations only, such as smoke exhaust fans and stairway pressurization fans, may be excluded from power factor correction. In addition, motors connected to variable speed drives shall be excluded from the power factor correction requirements.

D. If equipment is furnished with a control panel, that panel shall come with power factor correction capacitors factory installed and wired.

E. For equipment that does not have a control panel, the equipment supplier shall be responsible for furnishing the capacitors and installing them at either the motor disconnect or motor control center.

F. Individual capacitors shall be dry electrolytic type and enclosed in integrated dust tight enclosure.

2.3 MOTOR CONTROLLERS

A. In general, motor controllers will be furnished and installed under Division 26 unless the motor controller is an integral part of a piece of equipment, or noted otherwise.

B. Where control components are factory furnished, a control transformer with fused secondary shall be provided to reduce voltage to 120 volts to operate control and safety devices.

2.4 BELT DRIVES

A. V-belt drives for equipment with motors smaller than 3 horsepower shall be rated for 150% of rated horsepower of the driven equipment with matched pulleys and belts. V-belt drives for equipment with motors 3 horsepower and larger shall be rated for 200%.

B. Variable pitch drives shall be selected so that the fan speed at the specified operating conditions is approximately centered on the sheave adjustment range.

C. Exposed belt drives shall have OSHA approved guards to completely enclose sheaves and belts. Guards shall be constructed of expanded metal and reinforced with angle iron and securely fastened to floor or base. Provide openings at motor and driven equipment shafts for taking tachometer readings.

D. Except as specified otherwise, provide variable sheaves for motors 15 HP and smaller and fixed sheaves for motors 20 HP and larger.

E. Where motors are used with variable frequency drive systems, provide fixed sheaves. Select sheaves at an RPM which will provide 15 percent greater capacity that called out on drawings. Final capacity adjustments will be made with the variable frequency drive system.

F. Belt driven equipment shall include an adjustable motor base for adjusting belt tension.

PART 3 EXECUTION

3.1 COORDINATION

A. Provide the necessary control interface that will accept and understand the input from the controlling entity. Verify the interface requirements with the temperature control contractor.

3.2 INSTALLATION

A. Install motors, power factor correction capacitors, and drives in accordance with manufacturer’s instructions.

B. Power factor correction capacitors wired to motor starters by Division 26.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Check rotation of motor driven equipment and lubricate as recommended by manufacturer.

F. Align all drive systems and adjust belt tension. Remove pulley set screws, install thread locking substance on threads, and reinstall screws, torquing to manufacturer's specifications.

G. Check and adjust belt guards so that no parts are in contact with rotating equipment.

H. All motors on pumps shall be laser aligned by a factory authorized service technician.

3.3 DEMONSTRATION

A. Fully instruct the Owner's personnel as to the proper operation of the equipment.

END OF SECTION

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 23 13 - Refrigerant Piping, Valves and Specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data:

1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.

2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Design Data: Indicate selection calculations.

D. Manufacturer's Installation Instructions: Indicate special procedures, and external controls.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include adjustment instructions.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

A. Provide year warranty under provisions of Section 23 05 00.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Adsco.
2. Flexonics.
3. Keflex.
4. Metra-Flex.
5. Minnesota Flexible Corp.
6. Substitutions: Refer to Section 23 05 00.

B. Steel Piping:

1. Manufacturers: Flexonics [BSN] [PCS].
2. Inner Hose: Stainless Steel.
3. Exterior Sleeve: Braided stainless steel.
4. [Pressure Rating for Flexonics BSN, single braided: 390 psig WSP @ 70 degrees F for 2" pipe. 270 psig WSP @ 70 degrees F for 4" pipe.]
5. [Pressure Rating for Flexonics PCS, single braided: 450 psig WSP @ 70 degrees F for 2" pipe. 285 psig WSP @ 70 degrees F for 4" pipe. 165 psig WSP @ 70 degrees F for 10" pipe.]
6. Joint: Flanged, threaded or welded as specified for pipe joints.
7. Size: Use pipe sized units.
8. Maximum offset: 3/4 inch on each side of installed center line.
9. Length: Flange size plus 10 inches.

C. Copper Piping:

1. Manufacturers:
   a. Flexonics Series 301.
2. Inner Hose: Bronze
3. Exterior Sleeve: Braided bronze.
4. Pressure Rating: 735 psig WSP @ 70 degrees F for 1/2" pipe. 460 psig WSP @ 70 degrees F for 1" pipe. 280 psig WSP @ 70 degrees F for 2" pipe.]
5. Joint: Flanged, threaded or welded as specified for pipe joints.
6. Size: Use pipe sized units.
7. Maximum offset: 3/4 inch on each side of installed center line.
8. Length: Flange size plus 10 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 FLEXIBLE PIPE CONNECTORS

A. Construct spool pieces to exact size of flexible connection for future insertion.

B. Provide flexible connectors on pipes connected to equipment supported by vibration isolation. Provide on pumps.

C. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and Pressure gage taps.

B. Thermometers and thermometer wells.

C. Test plugs.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

1.3 REFERENCES

A. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. ASTM E1 - Standard Specification for ASTM Thermometers.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Product Data: Provide manufacturers data [and list] which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.7 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

PART 2 PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturer: Trerice No.750 Series.

B. Other acceptable Manufacturers:

1. Ashcroft.
2. Crosby.
3. Marsh.
4. U.S. Gauge

5. Weiss
6. Substitutions: Refer to Section 23 05 00.

C. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black scale on white background.

1. Case: Cast aluminum.
2. Bourdon Tube: Brass.
3. Dial Size: 4-1/2 inch diameter.
4. Mid-Scale Accuracy: One percent.
5. Scale: Psi.

2.2 STEM TYPE THERMOMETERS

A. Manufacturer: Trerice Model BX93000.

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 23 05 00.

C. Thermometer: ASTM E1, adjustable angle, red appearing mercury, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.
3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.3 SOLAR POWERED THERMOMETERS

A. Manufacturer: Trerice Model SX9 Series (Interior).

B. Other acceptable Manufacturers:

1. Palmer.
2. Taylor.
3. Weiss.
4. Wexler
5. Substitutions: Refer to Section 23 05 00.

C. Thermometer: ASTM E1, adjustable angle, LED Solar activated, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

1. Size: 9 inch scale.
2. Window: Clear glass.

3. Stem: Brass, 3/4 inch NPT long.
4. Accuracy: plus-minus one scale division.
5. Calibration: Degrees F.

2.4 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required[, and with cap and chain].

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.5 TEST PLUGS

A. Test Plug:

1. Manufacturers:
   a. Pete's Plug.
   b. Sisco.
   c. Substitutions: Refer to Section 23 05 00.
2. 1/4 inch fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
   a. Neoprene core for temperatures up to 200 degrees F.
   b. Nordel core for temperatures up to 350 degrees F.
   c. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 3-1/2 inch diameter pressure gages.
      1) Scaled for each range required
   b. Two gage adapters with 1/8 inch probes.
   c. Two 1-1/2 inch dial thermometers.
      1) Scale range: 25 to 125 degrees F.
      2) Scale range: 50 to 500 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install one pressure gage per pump, with taps before strainers and on suction and discharge of pump; pipe to gage.

B. Install gage taps in piping.

C. Install pressure gages with pulsation dampers. Provide ball valve to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide the following thermometer temperature ranges unless noted otherwise:

1. Heating hot water; 30-240 degrees F.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

K. Locate test plugs where indicated.

3.2 SCHEDULES

A. Pressure Gages.

1. Pumps - inlets and outlets.
2. Pressure reducing valves - inlet and outlet.
3. Other locations as shown on drawings.

B. Pressure Gage Tapping Location:

1. Control valves 3/4 inch & larger - inlets and outlets.
2. Boiler - inlets and outlets.
3. Other locations as shown on drawings.

C. Stem Type Thermometers:

1. Headers to central equipment.
2. Heat exchangers - inlets and outlets.
3. Boilers - inlets and outlets.
4. Water zone supply and return.
5. Other locations shown on drawings.

D. Thermometer Socket Location:

1. Control valves 1 inch & larger - inlets and outlets.

END OF SECTION

SECTION 23 05 23

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valves for hydronic and steam piping systems.

1. Ball.
2. Butterfly.
3. Swing Check.
4. Wafer Silent Check.
5. Drain (Same as Ball valves)

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 20 13 - Hydronic Piping.

1.3 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide data on valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 23 05 00.

B. Project Record Documents: Record actual locations of valves.

1.5 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME SEC IX and applicable state labor regulations.

C. Welders Certification: In accordance with ASME SEC IX.

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

1.7 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 BALL VALVES - (150 PSIG)

A. Up to and including 3 inches:

1. Manufacturer: Apollo 77-140/77-240 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Victaulic
    g. Substitutions: Refer to Section 23 05 00.
2. Construction: Class 150, 600 psig wog, bronze, two piece body, stainless steel ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union if next to control valve or equipment. Extended stems for use on insulated pipe.

B. Up to and including 3 inches:
1. Manufacturer: Apollo 82-140/82-240 Series, or equivalent by:
    a. Hammond.
    b. Kitz.
    c. Milwaukee.
    d. Nibco.
    e. Watts.
    f. Victaulic
    g. Substitutions: Refer to Section 23 05 00.
2. Construction: Class 150, 600 psig wog, bronze, three piece body, stainless steel ball, full port, teflon seats and stuffing box ring, brass blow-out proof stem, lever handle with balancing stops, solder or threaded ends with union if next to control valve or equipment. Extended stems for use on insulated pipe.

2.2 BUTTERFLY VALVES - (150 PSIG)

A. Manufacturer: Bray series 31:
1. Centerline.
2. Crane.
3. Hammond.
4. Kitz.
5. Milwaukee.
6. Nibco.
7. Victaulic.
8. Substitutions: Refer to Section 23 05 00.

B. Construction 1-1/2 inches and Larger: MSS SP-67, ANSI 150 rating, ductile iron body, flanged, lug or grooved ends, extended neck.

C. 316 Stainless steel disc.

D. Resilient EPDM seat, 100% bubble tight shut off to 150 psi.

E. Valves 5 inches and smaller, used for shut off service, shall have a latch-lock handle. When used for throttling or located above 8'-0" AFF, valves shall have worm screw enclosed operator with position indicator and adjustable stop.

F. Valves 6 inches and larger shall have worm screw enclosed operator with positive indicator, and adjustable stop.

G. Provide chain-wheel operators for valves mounted over 8 feet above floor.

2.3 SWING CHECK VALVES - (150 PSIG)

A. Up To and Including 2 inches:

1. Manufacturers: Stockham Model B-309/B-319, or equivalent by:
   a. Hammond.
   b. Bray.
   c. Kitz.
   d. Milwaukee.
   e. Nibco.
   f. Watts Regulator.
   g. Victaulic.
   h. Substitutions: Refer to Section 23 05 00.
2. Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded or grooved ends.

B. 2-1/2 inches and Larger:

1. Manufacturers: Stockham Model G-931, or equivalent by:
   a. Hammond.
   b. Bray.
   c. Kitz.
   d. Milwaukee.
   e. Nibco.
   f. Watts Regulator.
   g. Victaulic.
   h. Substitutions: Refer to Section 23 05 00.
2. Class 125, 3 percent nickel cast iron body and disc, stainless steel seat and pin, flanged or grooved connections.

2.4 WAFER STYLE SILENT CHECK VALVES - HYDRONIC (150 & 300 PSIG)

A. 3 inches and Larger:

1. Manufacturers: Crane Model Duo-Chek II
   a. Mueller.

b. Titan

c. Spence

d. Substitutions: Refer to Section 23 05 00.

2. ANSI Class 150 and 300, carbon steel wafer or flanged type body, 316 stainless steel plates and springs with Buna-N insert seat.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. All grooved products shall be of the same manufacturer.

C. Provide access where valves and fittings are not exposed.

D. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

A. Install all handles for valving overhead on the side of the pipe to allow access. Do not install on top of pipe or bottom of pipe. Verify handle has clearances for operating and replacement.

B. Hand wheels shall be a minimum of 6” diameter on valves 6” diameter and smaller, 10” diameter hand wheels on valves 8” thru 14”and 16” diameter hand wheels on valves 18” and larger.

C. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

D. Use butterfly valves on heating water systems.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

F. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

G. Provide wafer style silent check valves on discharge of base mounted water pumps if triple duty valve is not used.

H. Provide swing style check valves on discharge of inline water pumps.

I. Provide High Performance Butterfly valves on heating system.

END OF SECTION

SECTION 23 05 29

HANGERS & SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, ductwork, and equipment hangers and supports.

B. Equipment bases and supports.

C. Sleeves and seals.

D. Flashing and sealing equipment and pipe stacks.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 07 19 – HVAC Piping Insulation

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 23 13 - Refrigerant Piping, Valves and Specialties.

E. Section 23 22 13 - Section 23 31 13 – Metal and Non-Metal Ductwork Casing and Plenums.

1.3 REFERENCES

A. ASME B31.1 - Power Piping

B. ASME B31.5 - Refrigeration Piping

C. ASME B31.9 - Building Services Piping

1.4 SUBMITTALS

A. Shop Drawings: Indicate system layout with locations and details of all types of hangers.

B. Product Data: Provide manufacturers catalog data including load capacity.

C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable code for support of hydronic and refrigerant piping, and ductwork.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Anvil.
2. B-Line Systems.
3. Michigan.
4. Tolco.
5. Substitutions: Under provisions of Section 23 05 00.

B. Hydronic Piping:

1. Conform to ASME B31.9.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, and split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: 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.
9. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
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.
11. Vertical Support: Steel riser clamp.
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 Pipe 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. Refrigerant Piping:

1. Conform to ASME B31.5.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron 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.
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.

2.2 HANGER RODS

A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Stainless steel in areas of high humidity.

2.3 INSERTS

A. Manufacturers: Anvil Figure 282 (8 inches and smaller). Anvil Figure 282 with Figure 66 attachment (larger than 8 inches). Other acceptable manufacturers offering equivalent products.

1. B-Line Systems.

2. Michigan.

B. Inserts: 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 DUCT HANGERS AND SUPPORTS

A. Hangers: Galvanized steel band iron or rolled angle and 3/8 inch diameter rods. Fastenings and hardware to be cadmium plated or stainless steel.

B. Wall Supports: Galvanized steel band iron or fabricated angle bracket.

C. Vertical Supports: Rolled angles at floor.

D. High Humidity Areas: Aluminum or stainless steel hangers, wall supports, vertical wall supports, fastenings and hardware.

2.5 FLASHING

A. Metal Flashing: 26 gage thick galvanized steel.

B. Metal Counterflashing: 22 gage thick galvanized steel.

C. Lead Flashing:

1. Waterproofing: 5 lb/sq ft sheet lead

2. Soundproofing: 1 lb/sq ft sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage 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.

D. Sleeves for Pipes in building walls below grade: modular wall seal.

E. Sleeves for Round Ductwork: Galvanized steel.

F. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

G. Stuffing and Fire stopping Insulation: Glass fiber type, non-combustible.

H. Sealant: Acrylic.

2.7 FIRESTOP SYSTEMS

A. Manufacturer:

1. 3M (Minnesota Mining and Manufacturing Co.).

2. Hilti.

3. Substitutions: Under provisions of Section 23 05 00.

B. Firestop systems that are produced and installed to resist the spread of fire according to requirements indicated, resist passage of smoke and other gasses, and maintain original fire-resistance rating of construction assembly.

C. Certificate of conformance for through-penetration requirements of ASTM E814 and UL1479.

D. Systems or devices listed in the UL Fire Resistance Directory under category XHCR (firestop devices) and XHEZ (firestop systems) may be used, providing that they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system in symmetrical for wall applications.

E. Accessories include, but are not limited to; permanent forming/damming/backing materials, temporary forming materials, substrate primers, and collars and steel sleeves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 INSERTS

A. Provide inserts for placement in concrete formwork.

B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1-1/2 inch minimum vertical adjustment.

E. Support vertical piping at every floor.

F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Support riser piping independently of connected horizontal piping.

H. Provide copper plated hangers and supports for copper piping.

I. Design hangers for pipe movement without disengagement of supported pipe.

J. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Hangers for insulated pipe shall be large enough to encompass the insulation and the metal protective shield.

L. Support piping from building structure. Do not support piping from other mechanical or electrical components.

M. Do not support piping with wire or metal stripping hangers.

3.4 DUCT HANGERS AND SUPPORTS

A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, Chapter 4, Hangers and Supports.

3.5 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Provide for all floor mounted mechanical equipment.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.

C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.

D. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 SLEEVES

A. Set sleeves in position in formwork. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Sleeves in mechanical room floor slabs shall extend 6 inches above finished floor level. Calk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and calk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.8 FIRE STOP SYSTEMS

A. Provide firestop systems for pipe and duct through-penetrations of the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items: floor and ceilings, walls and partitions, smoke barriers, and construction enclosed compartmentalized areas.

B. Install through-penetration firestop systems to comply with manufacturer’s written installation instructions.

3.9 SCHEDULES

A. Piping:

PIPE SIZE Inches	MAX. HANGER SPACING (**) Feet	HANGER ROD DIAMETER Inches
Copper:		
1/2 to 1-1/4	6	3/8
1-1/2 to 4	10	3/8
5 and larger	10	1/2
Steel:		
1/2 to 3/4	10	3/8
1 to 4	12	3/8
5 to 8	12	1/2
10 to 12	12	5/8

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vibration isolators.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers & Supports for HVAC Piping, Ductwork and Equipment.

C. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

1.3 PERFORMANCE REQUIREMENTS

A. Provide vibration isolation on motor driven equipment over 0.5 HP, plus connected piping and ductwork.

B. Provide minimum static deflection of isolators for equipment as indicated in schedule.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Locate vibration isolators, with static and dynamic load on each.

C. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

D. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Vibration Isolation

1. Flexonics
2. Korfund
3. Mason Industries.
4. Vibration Eliminator Co.
5. Vibration Mountings and Controls.
6. Substitutions: Under provisions of Section 23 05 00.

2.2 VIBRATION ISOLATORS

A. Open Spring Isolators:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:

1. Spring Isolators:
   a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

E. Spring Hanger:

1. Spring Isolators:

a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

b. Code: Color code springs for load carrying capacity.

2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.

4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Neoprene Pad Isolators:

1. Rubber or neoprene waffle pads.

a. 30 durometer.

b. Minimum ½ inch thick.

c. Maximum loading 40 psi.

d. Height of ribs shall not exceed 0.7 times width.

2. Configuration: Single layer. 1/2 inch thick waffle pads bonded each side of ¼ inch thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

2.3 PUMP CONNECTORS:

A. Flexible metal hose.

B. 2 inches and smaller: threaded ends, braided phosphor bronze, annular correlations, 250 psig working pressure, 450 F operating temperature.

C. 2 1/2 inches and larger: flanged ends, braided stainless steel, annular correlations, 250 psig working pressure, 450 F operating temperature.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install isolation for motor driven equipment.

C. Install spring hangers without binding.

D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

F. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.

G. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector. as follows:

1. Up to 4 inch Diameter: First three points of support.
2. 5 to 8 inch Diameter: First four points of support.
3. 10 inch Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

H. Connect wiring to isolated equipment with flexible hanging loop.

3.2 MANUFACTURER'S FIELD SERVICES

A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.3 EQUIPMENT ISOLATION SCHEDULE

A. Floor mounted fans and factory assembled air handling units: open spring isolator with 1 1/2" deflection and thrust restraint. Use concrete inertia base for fans in excess of 3.5 inch WC or motors in excess of 40 HP.

B. Suspended fans 1 HP and smaller: rubber hanger.

C. Suspended fans and air handling units: open spring hanger with 1 1/2 inch deflection.

D. Roof mounted fans, condensers and condensing units: restrained closed spring isolators with 1 ½ inch deflection.

E. Base mounted pumps 10 HP and smaller: pump connectors.

F. Base mounted pumps greater than 10 HP, or on other than lowest level of building: pump connectors with inertia base.

G. Centrifugal chiller: restrained spring isolators (manufacturer's instructions for deflection).

H. Cooling tower: restrained closed spring isolators (manufacturer's instructions for deflection).

I. Isolated piping connected to equipment: spring hanger.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling Tacks.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

1.3 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Submit list of wording, symbols, letter size, and color coding proposed for mechanical identification.

C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Samples: Submit two tags, 1-1/2 inches in size.

F. Samples: Submit two labels, 1.9 x 0.75 inches in size.

G. Manufacturer's Instructions: Indicate installation instructions, special procedures, and installation.

H. Samples: Submit two (2) signs each, 9” x 7” and 6” x 2” size.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

C. Valve Tag Chart.

1.6 REGULATORY REQUIREMENTS

A. Conform to ANSI/OSHA.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Seton.

2. Brady.

3. Substitutions: Refer to Section 23 05 00.

B. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 23 05 00.

2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:

a. Seton.

b. Brady.

c. Substitutions: Refer to Section 23 05 00.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with smooth edges.

C. Tag Chart: Typewritten letter size list plastic laminated.

2.3 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Ductwork and Equipment: 2 inch high letters.

B. Stencil Paint: Semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Pipe Markers:

1. Manufacturers:

a. Brady.

b. Seton.

c. Substitutions: Refer to Section 23 05 00.

2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. No tape or adhesive necessary. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

a. Markline.

b. Substitutions: Refer to Section 23 05 00.

2. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS.

A. Manufacturer: Moore.

B. Other acceptable manufacturers offering equivalent products.

1. Substitutions: Refer to Section 23 05 00.

C. Description: Steel with ¾ inch diameter color coded head.

D. Color code as follows:

1. HVAC (equipment and valves): Yellow.

2. Fire dampers/smoke damper/sprinkler shut off valve/duct smoke detector: Red.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

C. Install labels with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

D. Install tags and signs using corrosion resistant chain. Number tags consecutively by location.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify air terminal units and radiator valves with numbered tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Identify piping, concealed or exposed, with plastic pipe markers . Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

A. Identification:

1. Piping: Use pipe service description and color schemes that are standard to the manufacturer.
2. Equipment: Use nomenclature as noted on the drawings.
3. Ductwork: Use description as noted on the drawings.
4. Underground Utilities: Use nomenclature as noted on the drawings.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of new air systems.

B. Testing, adjustment, and balancing of new hydronic systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Vibration measurement of equipment operating conditions.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance.

B. ADC - Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

D. Prior to commencing work, submit detailed procedures, agenda, sample report forms.

E. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Test Reports: Indicate data on AABC National Standards for Total System Balance forms, forms prepared following ASHRAE 111, NEBB forms, containing information indicated in Schedules.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of flow measuring stations, balancing valves and rough setting.

1.6 QUALITY ASSURANCE

A. Services provided by independent qualified Testing and Balancing Agency.

B. Provide services to Mechanical Contractor.

C. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.7 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience, certified by AABC or NEBB.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.8 SEQUENCING

A. Sequence work under the provisions of Section 23 05 00.

B. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 SCHEDULING

A. Schedule work under the provisions of Section 23 05 00.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable before commencing work.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems. Adjust outside air to within 0 to plus 10 percent of design.

B. Heat Recovery Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

C. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

D. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, outside air, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets with direct reading velocity meters or flow hoods in accordance with manufacturers instructions.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required, including belts and pulleys. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air, minimum outside air, return air, relief air and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Verify operation of temperature control dampers to assure shut-off and proper position with controller. Make adjustments if necessary.

M. Measure building static pressure and adjust supply, return, relief and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated circuit balancing valves, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

Air Coils
Air Cooled Refrigerant Condensing Units
Air Handling Units
Air Inlets and Outlets
Boilers - Packaged Steel Water Tube
Energy Recovery Equipment
Fans
Heat Exchangers
Packaged Roof Top Heating/Cooling Units
Pumps - HVAC
Terminal Heat Transfer Units

B. Report Forms

1. Title Page:
   a. Name, Address and Telephone Number of Testing, Adjusting, and Balancing Agency
   b. Project name
   c. Project location
   d. Project Architect
   e. Project Engineer
   f. Project Contractor
   g. Project altitude
   h. Report date
2. Summary Comments:
   a. Design versus final performance
   b. Notable characteristics of system
   c. Description of systems operation sequence
   d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
   e. Nomenclature used throughout report
   f. Test conditions

3. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Range
    f. Calibration date
4. Electric Motors:
    a. Manufacturer
    b. Model/Frame
    c. HP/BHP
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore
5. V-Belt Drive:
    a. Identification/location
    b. Required driven RPM
    c. Driven sheave, diameter and RPM
    d. Belt, size and quantity
    e. Motor sheave diameter and RPM
    f. Center to center distance, maximum, minimum, and actual
6. Pump Data:
    a. Identification/number
    b. Manufacturer
    c. Size/model
    d. Impeller
    e. Service
    f. Design flow rate, pressure drop, BHP
    g. Actual flow rate, pressure drop, BHP
    h. Discharge pressure
    i. Suction pressure
    j. Total operating head pressure
    k. Shut off, discharge and suction pressures

l. Shut off, total head pressure

m. Variable flow pumps: Flow rate, pressure drop, RPM, BHP, from design flow rate to VFD minimum in 10% increments.

7. Combustion Test:

a. Burner manufacturer

b. Model number

c. Serial number

d. Firing rate

e. Overfire draft

f. Gas meter timing dial size

g. Gas meter time per revolution

h. Gas pressure at meter outlet

i. Gas flow rate

j. Heat input

k. Burner manifold gas pressure

l. Percent carbon monoxide (CO)

m. Percent carbon dioxide (CO2)

n. Percent oxygen (O2)

o. Percent excess air

p. Flue gas temperature at outlet

q. Ambient temperature

r. Net stack temperature

s. Percent stack loss

t. Percent combustion efficiency

u. Heat output

8. Air Moving Equipment

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Arrangement/Class/Discharge

f. Air flow, specified and actual

g. Return air flow, specified and actual

h. Outside air flow, specified and actual

i. Total static pressure (total external), specified and actual

j. Inlet pressure

k. Discharge pressure

l. Sheave Make/Size/Bore

m. Number of Belts/Make/Size

n. Fan RPM

o. Variable flow fans: CFM, static pressure, RPM, BHP, from design cfm to VFD minimum in 10% increments.

9. Return Air/Outside Air Data:

a. Identification/location

b. Design air flow

c. Actual air flow

d. Design return air flow

e. Actual return air flow

f. Design outside air flow

g. Actual outside air flow

h. Return air temperature

i. Outside air temperature

j. Required mixed air temperature

k. Actual mixed air temperature

l. Design outside/return air ratio

m. Actual outside/return air ratio

n. Variable flow fans: Track supply fan cfm from maximum to minimum air flows maintaining building pressurization and minimum outside air.

10. Exhaust Fan Data:

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Air flow, specified and actual

f. Total static pressure (total external), specified and actual

g. Inlet pressure

h. Discharge pressure

i. Sheave Make/Size/Bore

j. Number of Belts/Make/Size

k. Fan RPM

11. Duct Traverse:
    a. System zone/branch
    b. Duct size
    c. Area
    d. Design velocity
    e. Design air flow
    f. Test velocity
    g. Test air flow
    h. Duct static pressure
    i. Air temperature
    j. Air correction factor
12. Duct Leak Test:
    a. Description of ductwork under test
    b. Duct design operating pressure
    c. Duct design test static pressure
    d. Duct capacity, air flow
    e. Maximum allowable leakage duct capacity times leak factor
    f. Test apparatus
        1) Blower
        2) Orifice, tube size
        3) Orifice size
        4) Calibrated
    g. Test static pressure
    h. Test orifice differential pressure
    i. Leakage
13. Flow Measuring Station (CBV, Venturi, etc.):
    a. Identification/number
    b. Location
    c. Size
    d. Manufacturer
    e. Model number
    f. Serial number
    g. Design Flow rate
    h. Design pressure drop
    i. Actual/final pressure drop

j. Actual/final flow rate

k. Station calibrated setting

14. Air Distribution Test Sheet:

a. Air terminal number

b. Room number/location

c. Terminal type

d. Terminal size

e. Area factor

f. Design velocity

g. Design air flow

h. Test (final) velocity

i. Test (final) air flow

j. Percent of design air flow

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ductwork insulation.

B. Duct Liner.

C. Insulation jackets.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork Casing and Plenums: Duct liner.

1.3 REFERENCES

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

C. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. NAIMA National Insulation Standards.

F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER, FLEXIBLE

A. Manufacturer: Johns-Manville 800 Series Spin-Glas

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C553; flexible, noncombustible blanket.

1. ‘K’ value: .24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F unfaced side, 150 degrees F faced side.
3. Maximum moisture absorption: less than 5 percent by weight.

D. Vapor Barrier Jacket:

1. FSK facing.
2. Moisture vapor transmission: 0.02 perm.
3. Secure with pressure sensitive tape.

E. Vapor Barrier Tape:

1. FSK facing, with pressure sensitive rubber based adhesive.

F. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

G. Tie Wire: Annealed steel, 16 gage.

2.2 GLASS FIBER, RIGID

A. Manufacturer: Johns-Manville 800 Series Spin-Glas.

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.

2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C612; rigid, noncombustible blanket.
1. 'K' value: 0.24 at 75 degrees F.
2. Maximum service temperature: 450 degrees F unfaced side, 150 degrees F faced side.
3. Maximum moisture absorption: less than 1% by volume.
4. Density: 3.0 lb/cu ft.

D. Vapor Barrier Jacket:
1. FSK facing.
2. Moisture vapor transmission: 0.02 perm.
3. Secure with pressure sensitive tape.

E. Vapor Barrier Tape:
1. FSK facing, with pressure sensitive rubber based adhesive.

2.3 GLASS FIBER DUCT LINER, FLEXIBLE

A. Manufacturer: Johns-Manville Permacote Linacoustic RC.

B. Other acceptable manufacturers offering equivalent products:
1. CertanTeed.
2. Knauf
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C1071; flexible, noncombustible blanket with acrylic polymer impregnated surface and edge coat.
1. 'K' Value: maximum 0.24 at 75 degrees F for 1" thickness.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Velocity on Coated Air Side: 5,000 fpm.
4. Minimum Noise Reduction Criteria: 0.55 for 1/2 inch thickness, 0.70 for 1 inch thickness, 0.85 for 1-1/2 inch thickness, 0.95 for 2 inch thickness.

D. Adhesive:
1. Waterproof, fire-retardant type.

E. Liner Fasteners: Galvanized steel, with press-on head.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ductwork has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Insulate ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulate ductwork conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces below 10 feet above finished floor: Finish with canvas jacket sized for finish painting.

E. Exterior Applications: Provide insulation with weatherproof vapor barrier jacket. Cover with caulked aluminum waterproof jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct Liner Application:

1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Exhaust and Relief Air Ducts Within 10 ft of Exterior Openings (except for kitchen range hood exhaust systems):

1. Flexible Glass Fiber Blanket – external (concealed areas only): 1-1/2 inches thick.
2. Rigid Glass Fiber - external: 1 inch thick.

3. Flexible Glass Fiber Duct Liner: 1-1/2 inches thick.

B. Mixed Air Ducts:
   1. Flexible Glass Fiber Blanket – external (concealed areas only): 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 1/2 inches thick.

C. Outside Air Intake Ducts:
   1. Flexible Glass Fiber Blanket – external (concealed areas only): 3 inches thick.
   2. Rigid Glass Fiber - external: 2 inches thick.

D. Relief Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.

E. Relief Ducts – Exposed (non-conditioned spaces):
   1. Rigid Glass Fiber - external: 1 inch thick.

F. Relief Ducts – Exposed (conditioned spaces):
   1. No insulation.

G. Return Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.
   3. Flexible Glass Fiber Duct Liner: 1 inch thick.

H. Return Ducts - Exposed:
   1. Rigid Glass Fiber - external: 1 inch thick.
   2. Flexible Glass Fiber Duct Liner: 1 inch thick.

I. Supply Ducts - Concealed:
   1. Flexible Glass Fiber Blanket - external: 1-1/2 inches thick.
   2. Rigid Glass Fiber - external: 1 inch thick.

J. Supply Ducts – Exposed (non-conditioned spaces):
   1. Rigid Glass Fiber - external: 1 inch thick.

K. Supply Ducts – Exposed (conditioned spaces):
   1. No insulation.

L. Transfer Ducts:
   1. Flexible Glass Fiber Duct Liner: 1/2 inch thick.

M. Ducts Exposed to Outdoors:
   1. Rigid Glass Fiber - external: 2 inches thick.
   2. Flexible Glass Fiber Duct Liner: 2 inch thick.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

C. Section 23 20 13 - Hydronic Piping: Placement of hangers and hanger inserts.

D. Section 23 23 13 - Refrigerant Piping, Valves and Specialties: Placement of inserts.

1.3 REFERENCES

A. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

B. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. NAIMA National Insulation Standards.

E. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.

B. Conform to ASTM Standards for “k” value, moisture vapor transmission, maximum moisture absorption, jacket, insulating cement, and adhesive.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 GLASS FIBER

A. Manufacturer: Johns Manville Micro-Lok HP.

B. Other acceptable manufacturers offering equivalent products:

1. CertainTeed.
2. Knauf.
3. Owens-Corning.
4. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.23 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

D. Vapor Barrier Jacket:

1. White kraft paper with glass fiber yarn, bonded to aluminized film.
2. Moisture vapor transmission: 0.02 perm-inches.

E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

F. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.2 CELLULAR FOAM

A. Manufacturer: Armacell AP Armaflex.

B. Other acceptable manufacturers offering equivalent products:

1. IMCOA/Nomaco.
2. Rubatex.
3. Substitutions: Refer to Section 23 05 00.

C. Insulation: ASTM C534; flexible, cellular elastomeric (or unicellular polyolefin), molded or sheet.

1. 'K' Value: 0.25 at 75 degrees F.
2. Minimum Service Temperature: -40 degrees F.
3. Maximum Service Temperature: 220 degrees F.
4. Maximum Moisture Absorption: 5 percent by weight.

5. Moisture Vapor Transmission: 0.10 perm-inches.
6. Connection: Waterproof vapor barrier adhesive.
7. Flame Spread: 25. Smoke Developed: 50.

D. Adhesive: Air dried, contact adhesive, compatible with insulation.

2.3 JACKETS

A. PVC Plastic:

1. Manufacturers:
   a. Zeston.
   b. Proto Corp.
   c. Substitutions: Refer to Section 23 05 00.
2. Jacket: Sheet material, off-white color.
   a. Minimum Service Temperature: -40 degrees F.
   b. Maximum Service Temperature: 150 degrees F.
   c. Moisture Vapor Transmission: 0.002 perm-inches.
   d. Thickness: 10 mil minimum (use standard stock dimensions).
   e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic:
   a. Compatible with insulation.

B. Aluminum Jacket:

1. Thickness: .025 inch sheet.
2. Finish: Stucco embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Metal Jacket Bands: 3/8-inch-wide; 0.015-inch-thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.

2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

3. Insert location: Between support shield and piping and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 23 05 29.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces less than 10 feet above finished floor: Finish with PVC jacket and fitting covers.

K. Exterior Applications: Increase scheduled insulation thickness by 1/2 inch. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES – BASED ON MINNESOTA ENERGY CODE

A. Heating Systems:

1. Hot Water (140 degrees F maximum):

a. Glass Fiber Insulation:

1) Pipe Size Range: 1-1/4 inch and less, 1-1/2 inch and larger.

2) Thickness: 1 inch, 1-1/2 inch.

2. Hot Water (141 to 200 degrees F):

a. Glass Fiber Insulation:

1) Pipe Size Range: 1-1/4 inch and less, 1-1/2 inch and larger.

2) Thickness: 1-1/2 inch, 2 inch.

B. Cooling Systems:

1. Condensate Drains from Cooling Coils:

a. Glass Fiber Insulation:

1) Thickness: 1/2 inch.

b. Cellular Foam: (not for use in air plenum ceilings).

1) Pipe Size Range: 2 inches and less.

2) Thickness: 3/4 inch.

2. Refrigerant Suction and Hot Gas:

a. Glass Fiber Insulation:

1) Pipe Size Range: all sizes.

2) Thickness: 1 inch.

b. Cellular Foam: (not for use in air plenum ceilings).

1) Pipe Size Range: 2 inches and less.

2) Thickness: 1 inch.

END OF SECTION

SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1-GENERAL

1.1 DEFINITION

A. The Commissioning Authority will be an independent agency (separate from this Contract) selected by the Owner to perform the Work outlined in the Contract Documents.

B. The Work shall include coordination and documentation of all Verification and Functional Performance Test procedures on new and modified mechanical ventilation equipment and systems to ensure operation and performance.

C. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions.

D. Commissioning work shall be a team effort to ensure that all mechanical equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine tuning of control sequences and operational procedures. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing and balancing, and Verification and Functional Performance Testing.

E. The commissioning team shall be made up of representatives from the Owner, design professionals, major equipment suppliers, and construction trades. The trades represented on the commissioning team shall include, but not be limited to, sheet metal, piping and fitting, controls, test and balance, and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team. Responsibility for various steps of the commissioning process shall be divided among the members of the commissioning team, as described in this section.

F. The Commissioning Authority shall have responsibility for coordinating and directing each step of the commissioning process.

G. Mechanical system installation, start-up, testing, balancing, preparation of O & M manuals, and operator training are the responsibility of the Division 23 Contractors (under this contract), with coordination, observation, verification and commissioning the responsibility of this commissioning authority. The Commissioning process does not relieve Division 23 from the obligations to complete all portions of work in a satisfactory and fully operational manner.

END OF SECTION

SECTION 23 20 13
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system.
2. Glycol water piping system.
3. Equipment drains and overflows.
4. Unions, flanges and couplings.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping, Ductwork and Equipment.

C. Section 23 05 53 – Identification for HVAC Piping, Ductwork and Equipment.

D. Section 23 07 19 – HVAC Piping Insulation.

E. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping.

F. Section 23 25 31 - Water Treatment for Heating Systems.

G. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. ASME B31.5 - Refrigeration Piping.

C. ASME B31.9 - Building Services Piping.

D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

E. ASTM B88 - Seamless Copper Water Tube.

F. ASTM D1785 - Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

G. ASTM D2241 - Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series).

H. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

I. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite-Sewer Piping.

J. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

K. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems.

L. ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.

M. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.

N. AWS D1.1 - Structural Welding Code.

O. AWWA C151 - Ductile-Iron Pipe,Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

1.4 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use grooved mechanical couplings and fasteners only in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals.

E. Provide pipe hangers and supports in accordance with Section 23 05 29.

1.5 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Include data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welder’s certification of compliance with ASME SEC 9.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual routing of piping.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

C. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.

1.9 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

A. Steel Pipe: ASTM A53, Schedule 40, [0.375 inch wall for sizes 12 inch and over,] black.

1. Fittings: Malleable iron or forged steel welding type fittings.
2. Joints: Threaded or welded.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: Cast brass, or solder wrought copper.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
3. Press fittings:
   a. Manufacturers:
      1) Viega ProPress.
      2) Substitutions: None.
   b. Material:
      1) Tubing Standard: Copper tubing shall conform to ASTM B88.
      2) Fitting Standard: Copper fittings shall conform to ASME B16.18, ASME, B16.22, or ASME B16.26.
      3) Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect®) feature design (leakage path). In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
      4) Threaded Fittings: Pipe Threads shall conform to ASME B1.20.1.
      5) Hanger Standard: Hangers and supports shall conform to MSS-SP-58.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron, or malleable iron.
2. Joints: Threaded, or grooved mechanical couplings.

B. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: Cast brass, or solder wrought copper.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.1 EXAMINATION

A. ProPress piping system:

1. Examine the copper tubing and fittings for defects, sand holes or cracks. There shall be no defects of the tubing or fittings. Any damaged tubing or fittings shall be rejected.
2. Ensure that sealing elements are properly in place and free from damage. For Sizes 2-1/2" to 4", ensure that the stainless steel grip ring is in place.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems.

F. ProPress piping system:

1. Copper tubing shall be cut with a wheeled tubing cutter or approved copper tubing cutting tool. The tubing shall be cut square to permit proper joining with the fittings.
2. Remove scale, slag, dirt and debris from inside and outside of tubing and fittings before assembly. The tubing end shall be wiped clean and dry. The burrs on the tubing shall be reamed with a deburring or reaming tool.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install piping to ASME B31.9.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide expansion loops where shown on Drawings. Anchor pipe with U-bolt or iron bar clamps secured to building structure. Provide guides to maintain position and alignment of piping. Where space does not allow space for expansion loop, provide expansion joints.

I. Install runouts from mains and risers with swing joints of sufficient length to absorb vertical expansion or contraction of risers and horizontal expansion or contraction of mains.

J. Provide access where valves and fittings are concealed.

K. Slope piping and arrange systems to drain at low points. Provide manual drain at low points and bottom of risers.

L. Use eccentric reducers to maintain top of pipe level.

M. Use non-conducting dielectric connections whenever jointing dissimilar metals.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

P. Install control valves. Run piping full size to valve, use concentric increasers at valves outlets and eccentric reducers at inlets.

Q. ProPress piping system:

1. Pressure Rating: Install components having a pressure rating equal to or greater than the system operating pressure.
2. Install piping free of sags, bends and kinks.
3. Change in Direction: Install fittings for changes in direction and branch connections. Where approved, changes in direction may also be made by bending of Types K and L tube.
4. Solder Joints: Solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
5. Threaded Joints: Threaded joints shall have pipe joint compound or Teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
6. Flared Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose.

7. Press connections: Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.
8. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
9. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation or by installing through an appropriately sized sleeve. Penetrations for fire resistant rated assemblies shall maintain the rating of the assembly.

3.4 TESTING OF PIPING SYSTEMS

A. Test under hydrostatic pressure of 100 psig or 1-1/2 times normal operating pressure, whichever is greater, for a period of four hours.

B. Apply tests to all piping and equipment which a part of these systems, including tanks, pumps, and valves, except for items that might be damaged because of excessive pressures.

C. Start systems following a procedure that will remove all air.

END OF SECTION

SECTION 23 20 19

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air vents.

B. Air separators.

C. Expansion tanks.

D. Expansion tanks - diaphragm type.

E. Circuit balancing valves.

F. Test plugs.

G. Relief valves.

H. Strainers.

I. Glycol specialties.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 25 31 - Water Treatment for Heating Systems.

C. Section 23 20 13 - Hydronic Piping.

1.3 REFERENCES

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model [and dimensions].

C. Submit inspection certificates for pressure vessels from [authority having jurisdiction.]

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of glycol system for one year from date of substantial completion.

B. Visit four times during the first year to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide one extra 10 gallon drum of propylene glycol.

PART 2 PRODUCTS

2.1 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:

1. Manufacturers:
    a. Armstrong.
    b. Bell and Gossett.
    c. Braukmann.
    d. Hoffman Specialty.
    e. Taco.
    f. Thrush/Amtrol.
    g. Substitutions: Refer to Section 23 05 00.
2. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.2 AIR SEPARATORS

A. In-line Air Separators:

1. Manufacturers:
    a. Armstrong.
    b. Bell & Gossett.
    c. Taco.
    d. Substitutions: Refer to Section 23 05 00.
2. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME SEC 8-D; for 125 psig operating pressure.

2.3 EXPANSION TANKS

A. Manufacturers:

1. Armstrong.
2. Bell and Gossett.
3. John Wood.
4. Taco.
5. Wessels.
6. Substitutions: Refer to Section 23 05 00.

B. Construction: Closed, welded steel, tested and stamped in accordance with ASME SEC 8-D; cleaned, prime coated, and supplied with steel support saddles; with tappings for installation of accessories.

1. Pressure rating: 100 psig.
2. Size: Refer to Drawings.

C. Gage Glass Set: Brass compression stops, guard, and 3/4 inch red line glass, maximum 24 inches length, long enough to cover tank for 2 inches above bottom to 2 inches below top.

D. Quick Connect Air Inlet:

1. Compressed Air: 75 inches of 1/4 inch diameter braided reinforced air hose, air chuck, check valve, and shut-off valve on supply from control air compressor.
2. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.

E. Automatic Cold Water Fill Assembly: Pressure reducing valve, [reduced pressure] double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

F. Size: Refer to drawings.

2.4 EXPANSION TANKS- DIAPHRAGM TYPE

A. Manufacturers:

1. Bell & Gossett.
2. Thrush/Amtrol.
3. Wessels.
4. Substitutions: Refer to Section 23 05 00.

B. Construction: Welded steel, tested and stamped in accordance with ASME SEC 8-D; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible [butyl] [EPDM] diaphragm sealed into tank [, and steel support stand].

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to [12] psig.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, [reduced pressure] double check back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

E. Size: Refer to Drawings.

2.5 CIRCUIT BALANCING VALVES

A. Manufacturers:

1. Armstrong.
2. Oventrop.
3. Nibco.
4. Tour Anderson.
5. Substitutions: Refer to Section 23 05 00.

B. General: Balancing valves with provision for connecting portable differential pressure meter. Each meter connection for pressure and temperature probes. Provide precise flow measurement, precise flow balancing, and positive shut-off with no drip seat. Solder, threaded, flanged or grooved end connections.

C. Construction: Nonferrous pressure diecast nonporous copper allow, or ductile iron conforming to ASTM Grade A535.

D. Calibration: Control flow within 2 percent of selected rating.

E. Control Mechanism: One, four, eight, twelve, or sixteen 360 degree adjustment turns with memory feature, locking feature tamper-proof setting, and digital readout.

F. Accessories:

1. Drain kit for field mounting.
2. Insulation kit - preformed rigid polyurethane insulation for complete enclosure of valve.
3. Portable meter: Carrying case containing one, 3 percent accuracy pressure gage with 0-60 feet pressure range for 500 psig maximum working pressure, color coded hoses for low and high pressure connections, and connectors suitable for connection to read-out valves.

2.6 TEST PLUGS

A. 1/4 inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:

1. Neoprene core for temperatures up to 200 degrees F.
2. Nordel core for temperatures up to 350 degrees F.
3. Viton core for temperatures up to 400 degrees F.

B. Test Kit:

1. Carrying case, internally padded and fitted containing:
   a. Two 2-1/2 inch diameter pressure gages.
      1) Two gage adapters with 1/8 inch probes.
      2) Scale to match system.
   b. Two 1-1/2 inch dial thermometers.
      1) Scale to match system.

2.7 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers: Watts Type 174A or 740, or equivalent by:
   a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 23 05 00.

2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, sized for application.

B. Temperature and Pressure Relief:

1. Manufacturers: Watts Type 40, or equivalent by:

a. Bell & Gossett.

b. Kunkle

c. Substitutions: Refer to Section 23 05 00.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME SEC IV certified and labelled.

2.8 STRAINERS

A. Manufacturers:

1. Armstrong.

2. Hayward.

3. Metra-Flex.

4. Mueller.

5. Sarco.

6. Titan.

7. Watts.

8. Substitutions: Refer to Section 23 05 00.

B. Size 2 inch and Under: Threaded cast iron body for 400 psig wog or Class 250, Y pattern with 20 mesh stainless steel perforated screen.

C. Size 2 inch to 4 inch: Class 125, flanged [or grooved] iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger: Class 125, flanged [or grooved] iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 GLYCOL SPECIALITES

A. Mixing Tank: 55 gallon steel drum with fittings suitable for filling and hand pump for charging, rubber hose for connection of hand pump to system.

B. Storage Tank: Closed type, welded steel constructed, tested and stamped in accordance with ASME SEC 8-D; 125 psi rating; cleaned, prime coated, and supplied with steel support saddles. Construct with tappings for installation of accessories.

C. Expansion Tank: Diaphragm type with vent fitting with air separator, and automatic air vent.

D. Glycol Solution: Refer to Section 23 25 31.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. Provide valved drain and hose connection on strainer blow down connection.

E. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

F. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

G. Pipe relief valve outlet to nearest floor drain.

H. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

I. Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 31.

J. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION

SECTION 23 20 20

HYDRONIC WATER FILTRATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Side Stream Filtration.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 20 19 – Hydronic Specialties.

D. Section 23 25 31 - Water Treatment for Heating Systems.

1.3 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 05 00.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

PART 2 PRODUCTS

2.1 FULL STREAM OR SIDE STREAM FILTERS

A. Manufacturers

1) Wessels – WesFlo.

2) Substitutions: None.

B. Provide a filter system with single or multi-bag filters made of 304 polished SS. Provide with swing bolt (quick opening) closure and internal positive pressure bag hold down device. Sizes range from 2" NPT or Flng up to 6" flange connection to meet indicated flow on schedule. Filter to be constructed of 304SS filter housing rated for 150psi at 300F. Provide standard EPDM O-ring, NPT drain valve and air vent. Filter to be 25 micron polypropylene bag with options for 10 and 5 micron bag filters.

2.2 SIDE STREAM BAG FILTERS OR CARTRIDGE

1. Provide a bypass filter system – system to be ¾" or 1" and shall include filter, sight flow indicator, ball valve, balancing valve, and nipples. Filter to be constructed of 304SS filter housing (10" minimum) with brass head and to include two EPDM O-rings, brass drain valve with barb fitting and cap, filter to be a 25 micron cotton wound filter cartridge with tin core. Sight flow indicator to have a brass body and include EPDM O-rings, two tempered borosilicate glass windows, 304SS cage, TPX ball, and cork washers. Ball valve to be of brass construction. Manual balancing valve to be of brass construction with an integral air vent, memory stop, and be able to provide flow metering, blow balancing and filter cartridge isolation.
2. Provide a filter system with single or multi-bag filters for flows from 30 to 960 GPM. Casing to be made of 304 polished stainless steel. Provide with swing bolt (quick opening) closure and internal positive pressure bag hold down device. Sizes range from 2" NPT or Flng. up to 6" flange connection to meet indicated flow on schedule. Filter to be constructed of 304SS filter housing rated for 150psi at 300F. Provide standard EPDM O-ring, NPT drain valve and air vent. Filter to be 25 micron polypropylene bag with options for 10 and 5 micron bag filters.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Install as indicated on the drawings.

C. Provide 10 extra cartridges or 5 bags based on the unit provided.

D. Install shut off valves on inlet and discharge side of filters.

E. Provide a shut off valve on filter drain and pipe as indicated on the drawings.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vertical in-line pumps.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Section 23 07 16 - Equipment Insulation.

E. Section 23 20 13 - Hydronic Piping.

F. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

1.4 PERFORMANCE REQUIREMENTS

A. Pumps shall operate at specified system fluid temperatures without vapor binding and cavitation.

B. Pumps shall be non-overloading in parallel or individual operation.

C. Pumps shall operate within 25 percent of midpoint of published maximum efficiency curve.

D. Pumps shall operate from zero flow to 50% above design flow without exceeding rated full load nameplate horsepower.

1.5 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories as suitable for the purpose specified and indicated.

1.8 EXTRA MATERIALS

A. Furnish under provisions of Section 23 05 00.

B. Provide 2 sets of cartridges or bags for each side-stream filter.

PART 2 PRODUCTS

2.1 VERTICAL IN-LINE PUMPS

A. Manufacturers:

1. Bell & Gossett Series 80.
2. Other acceptable manufacturers offering equivalent products.
    a. Armstrong.
    b. Peerless
    c. Taco
    d. Substitutions: Under provisions of Section 23 05 00.

B. Type: Vertical, single stage, close coupled, radially split casing, for in-line mounting, for 175 psig working pressure.

C. Casing: Cast steel, with suction and discharge gage port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

D. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

E. Shaft: Carbon steel with stainless steel impeller cap screw or nut [and bronze sleeve].

F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.

G. Performance: Refer to Pump Schedule on Drawings.

H. Electrical Characteristics:

1. Refer to Pump Schedule on Drawings.
2. Motor: 1750 rpm unless specified otherwise; refer to Section 23 05 13.
3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over. Refer to Section 23 05 48.

D. Provide line sized shut-off valve on pump suction, and line sized check valve and balancing valve on pump discharge.

E. Lubricate pumps before start-up.

END OF SECTION

SECTION 23 25 31

WATER TREATMENT FOR HEATING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

B. Water treatment system for:

1. Closed hot water heating system.

C. Chemical test kits.

D. Glycol protection.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 20 13 - Hydronic Piping.

C. Section 23 20 19 - Hydronic Piping Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

C. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Section 23 05 00.

B. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

C. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

D. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.6 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State or Municipality of standard for addition of non-potable chemicals to building systems and for discharge to public sewers.

B. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.

B. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS-WATER TREATMENT SYSTEMS

A. Fremont Industries.

B. Jay-Tec.

C. Nalco.

D. U. S. Water Services.

E. Substitutions: Under provisions of Section 23 05 00.

2.2 CHEMICAL TEST KIT

A. Furnish basic water test equipment, spare reagents for maintaining control of program standards in the condenser water, chilled water, heating water, and steam systems.

1. Test kits shall include the following:

a. Reagents and apparatus for determination of inhibitor level.

b. Reagents and apparatus for determination of pH, "P" and "M" alkalinity and chlorides.

c. Apparatus for determination of microbiological colony population and biocide effectiveness.

d. A hand held conductivity meter shall also be included.

2.3 MANUFACTURERS - GLYCOL PROTECTION

A. Dow Chemical.

B. Fremont Industries.

C. Noble Company.

D. Union Carbide.

E. Substitutions: Under provisions of Section 15010.

2.4 GLYCOL PROTECTION

A. Equal to Dow Dowfrost HD.

B. Industrially inhibited propylene glycol (phosphate-based) fluid.

C. Dyed to facilitate leak detection. Must be easily analyzed for glycol concentration and inhibitor level.

D. Fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals).

E. The reserve alkalinity of the fluid shall be at least 19.

PART 3 EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide all piping required for system operation.

3.3 CLEANING OF PIPING SYSTEMS

A. Concentration:

1. As recommended by manufacturer.
2. One pound of trisodium phosphate per 100 gallons of water for hot systems and one pound of trisodium phosphate per 50 gallons of water for cold systems.
3. Fill steam boilers only with cleaner and water.

B. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier.

D. Flush glycol-filled closed systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.4 CLOSED SYSTEM

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

D. Provide feeders with shutoff valves and bypass.

E. Provide sampling connection in the circulating water line including a 1/4 inch ball valve.

F. Provide chemical treatment to protect closed systems from corrosion.

3.5 CHEMICALS

A. After piping systems have been cleaned, treat systems with necessary chemicals to protect them from corrosion damage. Notify Owner in writing that this work has been completed and tested, with a copy to Engineer.

B. Chemicals shall be acceptable to FDA, City and State PCA and shall not contain any chromates. Steam will be used for humidification.

C. Water Treatment Chemicals - Closed System:

1. Provide one year's supply of the recommended formula for scale and corrosion protection for the closed recirculating system.

2. Formulation shall not contain any ingredients which are harmful to system materials of construction.

3.6 GLYCOL PROTECTION

A. Provide sufficient quantity of anti-freeze fluid into the piping systems, where required, to provide a 50 percent glycol/50 percent water solution.

B. Use water with low levels (less than 50 ppm) of chloride, sulfate and hard water ions (Ca^{++}, Mg^{++}) for filling systems that will contain the water/glycol fluid solution.

END OF SECTION

SECTION 23 31 13

METAL AND NON-METAL DUCTWORK, CASING AND PLENUMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casing and plenums.

D. Duct Cleaning.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 29 - Hangers and Supports for HVAC Piping, Ductwork and Equipment: Sleeves.

C. Section 23 05 93- Testing, Adjusting and Balancing.

D. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

E. Section 23 33 13 - Ductwork Accessories.

F. Section 23 37 13 - Air Inlets and Outlets.

1.3 REFERENCES

A. ASTM A 525 - General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.

B. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

C. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

D. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

E. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

F. SMACNA - HVAC Air Duct Leakage Test Manual.

G. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

H. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate construction methods including; duct materials, gages, reinforcing and sealing, fittings, hangers and supports.

C. Fabrication Drawings: Actual duct fabrication drawings, indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work. Indicate any deviations from applicable SMACNA Standards. Issue copies to related trades for coordination. After all coordination is complete and acceptable to all affected trades, submit to Engineer.

D. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible, unless more stringent requirements are noted herein.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum ten years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Perform Work in accordance with NFPA 90A and NFPA 90B standards.

B. Perform Work in accordance with International Mechanical Code with Minnesota Amendments.

C. Perform Work in accordance with Minnesota Energy Code.

D. Perform Work in accordance with State and Local Code requirements.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

B. Steel Ducts: ASTM A366.

C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

D. Insulated Flexible Ducts:

1. Manufacturers:

   a. Flex-Aire.

   b. Flexmaster.

   c. Norflex.

d. Sheet Metal Connectors.

e. Thermaflex.

f. Wiremold.

g. Substitutions: Refer to Section 15010.

2. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.

4. Maximum Velocity: 4000 fpm.

5. Temperature Range: -10 degrees F to 160 degrees F.

E. Stainless Steel Ducts: ASTM A167, Type 304.

F. Fasteners: Rivets, bolts, or sheet metal screws.

G. Sealant:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

H. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. [Comply with requirements of International Mechanical Code with Minnesota Amendments, when more stringent than those contained herein].

B. When operating pressures are not indicated on the drawings, construct the entire duct system for the fan outlet pressure.

C. Duct sealing requirements:

1. SMACNA Seal Class “A”;

a. Entire duct system where fan is rated at (+/-) 2 inches water column or greater external static pressure, unless noted otherwise.

b. Variable air volume (VAV) duct system from fan discharge to inlet of VAV box.

c. Duct system with booster coils, from fan discharge to inlet of booster coil.

d. Duct system enclosed in shafts or above inaccessible ceilings where fan is rated at (+/-) 1 inch water column or greater external static pressure.

2. SMACNA Seal Class “B”;

a. Entire duct system where fan is rated from (+/-) 1 inch to (+/-) 2 inches water column external static pressure, unless noted otherwise.

b. Duct system enclosed in shafts or above inaccessible ceilings where fan is rated less than (+/-) 1 water column external static pressure.

3. SMACNA Seal Class “C”;

a. Entire duct system where fan is rated at less than (+/-) 1 inch water column external static pressure, except gravity transfer ducts, and exhaust ducts discharging into ceiling plenum.

D. Portions of duct system with width or height dimension greater than 18 inches which are required to be constructed to SMACNA Seal Class “A” or “B”, shall utilize transverse duct connection system.

E. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

H. Rigidly construct ducts with joints mechanically tight, braced and stiffened to not breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

I. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

K. Sheet metal duct liner; [Provide solid 22 gage galvanized steel liner over interior duct insulation.][Provide perforated 22 gage galvanized steel liner over interior duct insulation. Perforations to be 3/32 inch diameter on 3/16 to 1/4 inch centers.][Provide perforated 22 gage galvanized steel liner of interior duct insulation. Perforations to be 3/32 inch diameter on 3/16 to 1/4 inch centers. Install 6 mil mylar or polyethylene sheet between insulation and liner.][Refer to Section 23 07 13 for insulation requirements.]

2.3 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, International Mechanical Code with Minnesota Amendments, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Flat Oval Ducts:

1. Manufacturers:

   a. Semco.

   b. Sheet Metal Connectors.

   c. United McGill.

   d. Substitutions: Refer to Section 23 05 00.

2. Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gages heavier metal than duct.

C. Single Wall Spiral Round Ducts:

1. Manufacturers:

   a. Semco.

   b. Sheet Metal Connectors.

c. United McGill

d. Substitutions: Refer to section 23 05 00

2. Machine made from round 4 ply spiral lockseam duct.

D. Transverse Duct Connection System:

1. Manufacturers:

a. Ductmate.

b. EZ Flange.

c. TDC.

d. Ward.

e. Substitutions: Refer to Section 23 05 00.

2. SMACNA "F" rated or SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, bolts, cleats, and corner clips.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, unless more stringent requirements are noted herein. Comply with requirements of International Mechanical Code with Minnesota Amendments, when more stringent than those contained herein.

C. Install duct as high as possible to maintain headroom.

D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

E. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Install round branch duct to rectangular mains with conical, bellmouth or flared spin-in fittings.

H. Make tee connections with a radius tap-in unless noted otherwise.

I. Lap metal ducts in direction of air flow. Hammer down edges of slips and drives with duct mastic in corners to leave smooth duct interior and a tight fitting corner.

J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports.

L. Pack space between duct and wall, ceiling or floor with glasswool. Fill with 1/2 inch sealing compound. In rated walls, ceilings or floors, use fire rated sealing compound.

M. Coordinate location of duct access panels with wall or ceiling access doors.

N. Duct hangers shall not attach to bottom chord of steel joist or metal roof decking. Attach to top chord of steel joist.

O. Provide adequate access into ductwork for cleaning purposes.

P. Elbows and angles for spiral ductwork shall be five piece standing seam construction, 18 gauge with 1 full sweep (C.L. Radius = 1.5 x Diameter) unless physical space is not available.

Q. Provide short radius 90 degree elbows with turning vanes as indicated on the drawings. Short radius elbow with turning banes shall be constructed in accordance to SMACNA 1995 standards, appendices A-41 and A-43. Construct elbow with six (6) inch inside radius for ducts up to 48 inches wide and twelve (12) inches for ducts 48 inches and over. No exceptions unless approved by the engineer.

3.2 FLEXIBLE DUCTS:

A. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct.

B. Connect diffusers to low pressure ducts directly or with 3 feet maximum length of flexible duct held in place with strap or clamp.

C. Connect flexible ducts to metal ducts with draw bands and additional sealing to provide air tight joint.

D. Support flexible duct properly to avoid sags and crimping.

E. Do not use flexible duct to change direction.

3.3 PROTECTION

A. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.4 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION

SECTION 23 33 13
DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers.

C. Combination fire and smoke dampers.

D. Duct access doors.

E. Duct test holes.

F. Fire dampers.

G. Flexible duct connections.

H. Volume control dampers.

I. Pressure gages and Pressure gage taps.

J. Thermometers and thermometer wells.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork, Casings and Plenums.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. NFPA 70 - National Electrical Code.

C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

D. UL 33 - Heat Responsive Links for Fire-Protection Service.

E. UL 555 - Fire Dampers and Ceiling Dampers.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

E. Product Data: Provide manufacturers data and list which indicates use, operating range, total range, accuracy, and location for manufactured components.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00: Procedures for submittals.

B. Project Record Documents: Record actual locations of components and instrumentation.

C. Operation and Maintenance Data: Include instructions for calibrating instruments.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., or similar testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not install instruments when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.9 MAINTENANCE PRODUCTS

A. Supply two bottles of red gage oil for static pressure gages.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. No manufactured turning vanes in square elbows are allowed. See Section 23 31 13 for short radius elbow with turning vanes. No exceptions unless approved by Engineer.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS.

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Louvers and Dampers.
5. Nailor.
6. Pottorff.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Gravity Backdraft Dampers, Furnished with Air Moving Equipment: Air moving equipment manufacturers standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 16 gage thick galvanized steel, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A, UL 555 (latest edition), UL 555S (latest edition).

C. Rated for 1-1/2 hour Leakage Class II or 3 hour Leakage Class I protection. Refer to drawings for type based on partition.

D. Rated for 2.5 inches WG pressure and 2000 fpm velocities or 4.0 inches WG pressure and 4000 fpm velocities. Refer to drawings for type based on system.

E. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

F. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and actuator shaft.

G. Actuators: UL listed and labeled spring return [pneumatic type suitable for operation on 0-20 psig instrument air.] [electric type suitable for 120 volts, single phase, 60 Hz.] [electric type suitable for 24 volts, DC.] [Provide end switches to indicate damper position.] Locate damper operator on [interior] [exterior] of duct and link to damper operating shaft. Provide for testing or resetting [at damper] [from remote location].

H. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.

I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices [to ensure positive closure for units mounted horizontally].

2.4 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. 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: Provide two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Provide an additional hinge.

C. Access doors with sheet metal screw fasteners are not acceptable.

2.5 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.

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance.
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A and UL 555 (latest edition), and as indicated.

C. Free area 90% minimum.

D. Rated for 1-1/2 hour or 3 hour protection depending on partition type.

E. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

F. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side, and one layer on bottom side for round flaps, with locking clip.

G. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

H. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations and closure under air flow conditions. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

I. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

J. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Ventfabrics.
2. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inches wide, 24 gage thick, galvanized steel.

D. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.087 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.8 SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Cesco.
3. Greenheck.
4. Nailor.
5. Pottorff.
6. Prefco.
7. Ruskin.
8. Safe-Air.
9. Substitutions: Refer to Section 23 05 00.

B. Fabricate in accordance with NFPA 90A, UL 555 (latest edition), UL 555S (latest edition), Leakage Class II up to 2.5 inches w.g. or Leakage Class I for 2.5 inches to 4 inches w.g.

C. Rated for 2.5 inches WG pressure and 2000 fpm velocities or 4.0 inches WG pressure and 4000 fpm velocities. Refer to drawings for type based on system.

D. Provide factory sleeve and collar for each damper, either break-away or rigid, based on system.

E. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and actuator shaft.

F. Actuators: UL listed and labeled spring return electric type suitable for 24 volts, DC. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft. Provide for testing or resetting at damper.

2.9 VOLUME CONTROL DAMPERS.

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.

2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

4. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. 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.

E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 13 for duct construction and pressure class.

B. Install control dampers furnished by Controls Contractor.

C. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, humidifiers, duct mounted smoke detectors, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

E. Provide duct test holes where indicated and required for testing and balancing purposes.

F. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through rated partitions. Install with required perimeter mounting angles, sleeves, breakaway or rigid duct connections based on system type, corrosion resistant springs, bearings, bushings and hinges.

G. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

H. Demonstrate re-setting of fire dampers to Owner's representative.

I. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.

J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

K. Use splitter dampers only where indicated.

L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 37 13

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grilles, registers and diffusers.

B. Louvers.

1.2 RELATED SECTIONS

A. Section 09 91 23 – Interior Painting: Painting of ductwork visible behind outlets and inlets.

B. Section 23 05 00 - Common Work Results for HVAC Equipment.

C. Section 23 31 13 – Metal and Non-Metal Ductwork, Casings and Plenums.

D. Section 23 33 13 - Ductwork Accessories.

1.3 REFERENCES

A. ADC 1062 - Certification, Rating and Test Manual.

B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.

C. ARI 650 - Air Outlets and Inlets.

D. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

E. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

F. NFPA 70 - National Electrical Code.

G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 05 00.

B. Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

B. Test and rate louver performance in accordance with AMCA 500.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

PART 2 PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS

A. Manufacturers:

1. Titus.
2. Krueger.
3. MetalAire.
4. Nailor.
5. Price.
6. Anemostat.
7. Tuttle & Bailey.
8. Substitutions: Refer to Section 23 05 00.

B. Refer to Schedule on drawings for type, frame, fabrication, finish and accessories.

2.2 LOUVERS

A. Manufacturers:

1. American Warming and Ventilating.
2. Arrow United.
3. Cesco.
4. Greenheck.
5. Louvers and Dampers.
6. Ruskin.
7. Substitutions: Refer to Section 23 05 00.

B. Type: 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

C. Fabrication: 16 gage thick galvanized steel, welded assembly, with factory baked enamel finish, color to be selected.

D. Mounting: Furnish with exterior flange for installation.

PART 3 EXECUTION

3.1 GRILLES, REGISTERS AND DIFFUSERS

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Rigidly fasten grilles, registers and diffusers to duct.

D. Install grilles, registers and diffusers to ductwork with air tight connection.

E. Adjust directional tabs in square diffusers and in linear diffusers to provide proper air distribution pattern.

F. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

G. Paint ductwork visible behind air outlets and inlets matte black.

3.2 LOUVERS

A. Provide collars and connections to louvers and blank off unused portions.

B. Construct plenums and blank-off panels to form airtight seal with louver edges. Construct plenums watertight to drain moisture back outside louver.

C. Insulate plenum with 2 inch thick rigid fiberglass with vapor barrier.

D. Provide drains when plenum is lower than bottom edge of louver. Run to floor drain.

E. Install in accordance with manufacturer's instructions.

F. Install louvers in exterior walls, complete with lintels, mullions and sills. Caulk perimeter of each section with silicone sealant to make weather tight.

G. Provide collars and connections to louvers and blank off unused portions.

H. Construct plenums and blank-off panels to form airtight seal with louver edges. Construct plenums watertight to drain moisture back outside louver.

I. Insulate plenum with 2 inch thick rigid fiberglass with vapor barrier.

J. Provide drains when plenum is lower than bottom edge of louver. Run to floor drain.

END OF SECTION

SECTION 23 52 38

CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Condensing High Efficiency Boilers.

B. Packaged Control System.

C. Condensate neutralizer/drainer.

1.2 RELATED SECTIONS

A. Section 23 20 19 - Hydronic Specialties

B. Section 25 95 00 - Sequence of Operation.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.

D. ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

E. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

G. NFPA 54 - National Fuel Gas Code.

H. NFPA 70 - National Electrical Code.

I. UL - Gas and Oil Equipment Directory.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Shop Drawings: Indicate general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

D. Submit manufacturer's installation instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Submittals for project closeout.

B. Test Reports: Indicate specified performance and efficiency is met or exceeded. Provide combustion test that includes boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.

C. Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in installing and servicing the products of this section with minimum five years documented experience approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

A. Conform to ASME SEC 4, SEC 8D, AGA Z21.13 Code, and UL 726 for construction of boilers.

B. Units: UL labeled.

C. Conform to applicable NFPA 70 code for internal wiring of factory wired equipment.

D. Conform to State of Minnesota requirements.

E. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.9 WARRANTY

A. Section 23 05 00 - Warranties.

B. Provide a minimum of a five (5) year warranty for flue gas corrosion compromising the pressure vessel and exhaust assembly.

C. Provide a one (1) year parts and labor warranty entire package. The warranty period is to begin at the final date, as determined and agreed upon by the engineer and contractor, of Substantial Completion.

1.10 MAINTENANCE/BOILER SYSTEM CONTROL PROGRAMMING SERVICE

A. Provide a service and maintenance program of the boiler system for the duration of the warranty period. The program is to consist of the five (5) following on-site service procedures:

1. Initial Start-up and Owner training: Late Summer/early Autumn.
2. Mild heating weather control & efficiency monitoring/check-up: Late Autumn.
3. Cold weather control & efficiency monitoring/check-up: Winter (Outdoor temperature must be below 0F).
4. Mild heating weather control & efficiency monitoring/check-up: Late Winter/Spring.
5. Fall start-up/control & efficiency monitoring/warranty close-out: Autumn of second season.

B. The intent of each service call is to set and obtain optimum thermal efficiency of the boiler system as the weather changes without compromising heating comfort within the facility. Each procedure is to consist of scheduling a service technician to be on-site for two (2) hours, provide monitoring of the current boiler reset as it relates to the current weather conditions, obtaining trending data (by working with and coordinating with the Owner's building automation system contractor) of how the boiler system has been responding to the reset schedule sequencing/setpoints along with interviewing the building operator regarding overall heating comfort in the building. The result of each service call is to provide a report demonstrating the controls are operating as intended while meeting building occupant comfort over a trended amount of time from previous site visit.

C. Include an additional follow-up site visit in addition to the on-site service procedures by a service technician with two (2) hours of on-site time to make adjustments to setpoints and programming necessary. A total of a possible five (5) follow-up site visits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Boilers:

1. Hydrotherm 'KN' Series.
2. Lochinvar 'Crest' Series.
3. Aerco 'Benchmark' Series.
4. Cleaver-Brooks 'ClearFire' Series.
5. Substitutions: None.

B. Integrated Boiler Management System:

1. Hydrotherm 'HeatNet' controller.
2. Lochinvar 'SmartTouch' controller.
3. Aerco 'C-More' unit controller'.
4. Cleaver-Brooks 'Falcon' controller.
5. Approved third party boiler integrator: Modsync, Siemens,
6. Substitutions: None.

2.2 GENERAL DESCRIPTION

A. Modulating, forced draft, condensing type; complete with boiler fittings and automatic controls. The boiler (with all wiring) shall be completely factory assembled as a self contained unit. Boiler design and construction shall be in accordance with ASME Section IV for hot water heating boilers with a maximum water working pressure of 30 psig. Boiler shall also comply with CSD-1 Code requirements.

2.3 BOILER DESIGN

A. The boiler shall have the ability to operate with a variable flow through the boiler. The boiler is to be designed for a minimum of 5:1 continuous turn down with constant CO2 over the turndown range. The boiler is to operate with natural gas and have a CSA International certified input rating as noted on the drawings, and a thermal efficiency rating up to 99% at minimum input. The boiler is to use a proven pilot interrupted spark ignition system. The boiler is to use a UL approved flame safeguard ignition control system using UV detection flame sensing. The design is to provide for silent burner ignition and operation. Adequate openings are to be provided to allow access to the water side of the boiler.

B. The condensing section of the exhaust pipes are to be constructed of SAF 2205 Deflex stainless steel. The vessel shell shall be SA-53B ERW pipe or SA-516 Grade 70 plate. The heads shall be SA-516 Grade 70 plate. The pressure vessel is to be fully insulated with 2" of high temperature insulation.

C. Provide a condensate drainer and neutralizer kit with capacity and ability to address the boiler system condensate loading. Provide the kit complete and piped to a floor drain. The drainer is to be provided and installed in conformance with the boiler manufacturers recommendations.

2.4 BOILER SIZE AND RATINGS

A. Refer to schedule on drawings for capacities.

B. The boiler shall have a low fire efficiency of 94% at 100 degree F. return water temperature and 100 degree F. flue gas temperature.

C. The boiler shall have a high fire efficiency of 84% at 160 degree F. return water temperature and 250 degree F. flue gas temperature.

2.5 BOILER FLUE VENTING

A. This contractor is to provide all necessary materials and labor for a complete installation. Exhaust venting shall be constructed of AL294C piping and installed in conformance with the manufacturers recommendations based on the conditions of the site. Refer to the drawings for pipe routing.

2.6 COMBUSTION AIR DUCTING

A. This contractor is to provide all necessary materials and labor. Schedule 80 PVC Pipe. Provide PVC fittings with solvent welded joints. Install per ASTM D2321 and the boiler manufacturers recommendations based on conditions of the site. Provide field-installed external insulation on entire combustion air ducting, including the combustion chamber box on the boiler. Refer to the drawings.

2.7 BOILER FITTINGS

A. A temperature and pressure relief valve is to be provided with each boiler.

B. A temperature and pressure gauge shall pre provided with each boiler.

2.8 COMBUSTION EQUIPMENT

A. Provide boiler with a UL approved flame safeguard. The controller shall provide a 30 second pre-purge and post-purge. The controller shall maintain a running history of operating hours, number of cycles, and the most recent six flame failures. This controller shall have the capability to be connected to an AZL Display Module, which will retrieve that information.

B. Each boiler shall be equipped for fully modulating operation. Turn down shall be 5:1.

C. The furnace location shall be such that all furnace components are located within water-backed areas. Boiler safety controls shall be:

1. Operating temperature controller for automatic start and stop of the pulse combustor.
2. High limit temperature controller (manual reset).
3. One low water cutoff probe in boiler shell (manual reset).
4. One auxiliary low water cutoff (manual reset).
5. Air safety switch to prevent operation until sufficient prepurge air is assured.
6. Infrared scanner to prove combustion.

D. All controls are to be panel mounted and so located on the boiler as to provide ease of servicing the boiler without disturbing the controls. All controls shall be mounted and wired according to A.G.A requirements.

E. Provide single point power connection.

F. Refer to schedule on drawings for electrical requirements.

2.9 CONTROL SYSTEM

A. The boiler control system is to be provided by the boiler equipment manufacturer/supplier and be independent from the building automation system. Refer to Part 2.1 (of this section) for manufacturers.

B. Provide a completely integrated independent controller to control and manage the operation and input of the multiple boiler plant.

C. The controller is to be BACnet compatible and factory-wired to a terminal strip to allow field-connection to a building automation system.

D. The system shall be comprised of a microprocessor based control, utilizing a 4 to 20 mA signal for modulation of header temperature and sequential firing.

E. The controller shall have the ability to vary each individual modulate input throughout its full firing rage, to maximize the condensing capability of the module and the entire plant without header temperature swings.

F. The controller shall be PID type for temperature control with frequency response.

G. The control shall provide contact closure for automatic adjustable heat start circuit for plant activation and have contact closure for auxiliary equipment such as pumps and auxiliary loops.

H. The control will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature outlet to +/-2 degrees F. Maximum efficiency shall be achieved at minimum firing input.

I. Reset ratio shall be fully field adjustable. The controller shall have LCD display for monitoring of all sensors and percent of modulation on one screen. Real time and date. Controller will automatically balance operating time.

J. Connection between the control system and individual units shall be wired to internal terminal strips for easy installation.

K. Controller is to be capable of controlling a minimum of six (6) boilers. The controller shall modulate the boiler burners to maintain proper loop temperature. Refer to sequence of operation, Part 3 of this section.

L. Control system shall contain the following:

1. CPU Board.
2. Hand-Off-Auto Relay Output Board with LED indicators.
3. Auto/Manual Analog Output Board.
4. NEMA 1 enclosure.
5. Provide the unit complete with an BACnet interface card to allow the building automation system to monitor the unit.
6. Electrical power supply connection.
7. Operator Control Panel with operator inface keyboard/keypads.

2.10 CONDENSATE NEUTRALIZER/DRAINER

A. Provide one (1) central common condensate drainer/neutralization kit with drain controls.

B. Condensate drainer to be constructed entirely of polypropylene. The basin is to have a removable lid to allow neutralization media to be added/maintained. Unit is to have a basin/baffels to hold water, complete with float mechanism and ½" cold water connection in order to maintain a trap seal utilizing make-up water as necessary. Basin to be similar/equal to an AXIOM Model NT25 and modified with a chamber to hold and maintain a water level as a trap. Provide all piping materials and labor from each boiler to the neutralizer and extend to a floor drain. Provide two (2) complete fills of neutralization media equal to Axiom's '*Liphter*' media.

C. Unit to be installed in an accessible location to allow neutralization media to be maintained and added.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install boiler on concrete housekeeping pad, sized minimum 4 inches larger than boiler base. Elevate the boiler unit(s) to allow adequate sloping of condensate drainage by gravity.

D. Provide connection of natural gas service in accordance with NFPA 54.

E. Provide piping connections and accessories.

F. Pipe relief valves to nearest floor drain.

G. Install condensate drainer. Pipe condensate drains from boiler to condensate drainer neutralizing tank and from condensate drainer to nearest floor drain. Provide a valved cold water supply line and connect to condensate drainer.

H. Provide all necessary wiring between boiler control panel, temperature sensors, boiler control units and each boiler circulation pump to obtain a complete and functioning system. All wiring to be installed in EMT conduit.

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide a field representative for unit/system start-up, training operator and all necessary programming and programming revisions necessary to 'tune' and adjust boiler sequencing.

3.3 BOILER SYSTEM SEQUENCE OF OPERATION

A. Application:

1. Condensing Hot Water Boilers.
2. Hot water boiler circulation pumps.

B. Provide a package control system which will control the hot water boilers. The control system is control and obtain modulation, turn-down, and condensing utilizing an outdoor air master reset schedule. The reset schedule is compare the outdoor temperature to reset the main supply water temperature.

C. Heating/Winter Mode:

1. The boiler control is to be 'enabled'.
2. The heating controller is to be manually switched on/off by the Building Operator.
3. The outdoor air temperature is to be monitored and compared to the heating water supply temperature. Provide a reset schedule program which will increase the supply water temperature as the outdoor temperature decreases in temperature. The reverse sequence is to apply as the outdoor air temperature becomes warmer, the supply water temperature is to be decreased down to 130F.
4. The controller is to individually control each boiler module and its respective boiler circulation pump (pumps are to be on/off) in order to obtain turn-down and utilize the condensing process in order to optimize thermal efficiency of the boiler system. The controller is to control each module turn-down ratio and stage/rotate the firing of the boiler modules, along with starting/stopping its respective circ pump to obtain both efficiency/condensing of the boilers while maintaining a reset supply water temperature.

D. Summer Mode: Boilers and controls are to be 'disabled' (off) and locked-out.

E. Miscellaneous:

1. Provide input point for outside air temperature signal from Building Management System.
2. Provide general alarm to Building Automation System.
3. Boiler controller is to be BACnet compatible and factory-wired to a terminal strip to allow field-connection by the BAS contractor. Provide a BACnet card/gateway, integral with the controller to allow the system to interface with a building automation system.

END OF SECTION

SECTION 23 74 13

PACKAGED, OUTDOOR ROOF TOP UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged roof top unit.

B. Roof mounting curb and base.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

1.3 REFERENCES

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. AMCA 99 - Standards Handbook.

D. AMCA 210 - Laboratory Methods of Testing Fans for Rating.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

G. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

H. ARI 340/360 - Standard for Commercial and Industrial Unitary Air Conditioning & Heat Pump Equipment.

I. ARI 610 - Central System Humidifiers.

J. NEMA MG1 - Motors and Generators.

K. NFPA 70 - National Electrical Code.

L. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

M. UL 900 - Standard for Air Filter Units.

N. UL - Fire Resistance Directory.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals.

B. Product Data:

1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.

2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.

4. Sound Power Level Data: Fan outlet, air handler inlet and outlet openings, and casing radiation at rated capacity.

5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings: Indicate assembly, unit dimensions and lifting lug locations, weight loading and center of gravity, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include installation instructions.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, coil removal and replacement, spare parts lists, and wiring diagrams.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

B. Manufacturer shall operate each system at the factory before shipment to insure proper operation and balance.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., E.T.L. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Accept products on site in factory-fabricated protective containers [shrink wrapped form], with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.10 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

B. Supply one set of filters for each unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Carrier

B. Aaon

C. Trane

D. York

E. Substitutions: Refer to Section 23 05 00.

2.2 GENERAL DESCRIPTION

A. Configuration: Refer to drawings for specific requirements.

1. Outside Air Intake section
2. Economizer section
3. Supply fan and Discharge section
4. Cooling coil section
5. Heating Section
6. Power exhaust section
7. Filter section
8. Air Cooled Condenser section.
9. Spacer/access sections

B. Performance Base: Sea level conditions.

C. Fabrication: Conform to AMCA 99 and ARI 430.

D. Performance: Refer to Schedule on Drawings.

2.3 CABINET

A. Construction: Heavy gage galvanized steel with acrylic lacquer finish, stainless steel fasteners, and shall have vinyl coated fan guards. The cabinet shall be thermally insulated with 1" thick, 11/2 lb. Density glass fiber insulation.

B. Finish: Manufacturer's standard finish

C. Cabinet Access Panels: Compressor/controls/heating area access panels, blower access panel and air filter/economizer access panel hinged with tool-less access handles, gaskets on all edges for tight seal, filter and blower access panels have steel panel inner liner with insulation sandwiched in-between.

D. Roof Mounting Curb: Furnish and install a steel roof mounting frame for bottom discharge and return air duct connection. It shall mate to bottom perimeter of the equipment. When flashed into the roof it shall make a unit mounting curb and provide a weatherproof duct connection and entry into the conditioned area.

2.4 FANS AND MOTORS

A. Supply Fan: Centrifugal supply air blower shall have ball bearings and adjustable belt drive. Blower assembly shall slide out of unit for servicing. Blower wheel shall be statically and dynamically balanced. Refer to schedule on drawings.

B. Supply Fan Motor: Refer to schedule on drawings.

C. Condenser Fan: Direct drive propeller type condenser fans shall discharge vertically. Refer to schedule on drawings.

D. Condenser Fan Motor: Fan shall have ball bearings and be permanently lubricated. Refer to schedule on drawings.

E. Power Exhaust Fans: Shall be available for all models with economizer. Fans shall exhaust air through gravity exhaust dampers.

2.5 COILS

A. Air Coils: The evaporator and condenser coils shall be non-ferrous construction with aluminum fins mechanically bonded to durable copper tubes. Evaporator coil condensate drain shall be extended outside of the cabinet. Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

B. Coil Performance: Refer to schedule on Drawings.

2.6 FILTERS

A. Filter Media: Disposable 2 inch thick pleated, MERV 8.

2.7 ECONOMIZER

A. Economizer section: Furnish and install economizer complete with return air dampers, outside air dampers and controls. The economizer section shall provide for the introduction of outdoor air for minimum ventilation and free cooling. Damper actuator shall be opposing gear driven with a fully modulating design.

2.8 DAMPERS

A. Outside Air Dampers: Dampers shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Dampers shall be designed to operate from 0-100%. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper. Damper motor shall be spring return to insure closing of outdoor air damper during periods of unit shut down or power failure.

B. Return Air Dampers: Dampers shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per square foot of damper area when subjected to 2" WG air pressure differential across the damper

C. Gravity Relief Dampers: Pressure operated dampers made of extruded aluminum shall prevent blow-back and outdoor air infiltration during off cycle.

2.9 GAS FIRED HEATER

A. Indirect Gas Fired Heater Type: Unit shall heat using natural gas fuel with a minimum two stages of capacity. Unit shall be provided with a gas heating furnace consisting of an aluminized steel tubular heat exchanger, and induced draft blower and an electric pressure switch to lockout the gas valve until the combustion chamber is purged and combustion air flow is established. Unit shall be provided with a gas ignition system consisting of an electronic ignitor to a pilot system, which will be continuous when the heater is operating, but will shut off the electronic ignition system which will de-energize upon flame detection]. Unit shall have gas supply piping entrances in the unit base for through the curb gas piping. Refer to schedule on drawings

2.10 COMPRESSOR

A. Multiple compressors shall be resiliently mounted, have overload protection and crankcase heaters.

B. Provide step capacity control by cycling compressors.

2.11 AIR COOLED CONDENSER

A. Direct drive propeller type condenser fans shall discharge vertically. Fan motor shall have ball bearings and be permanently lubricated and inherently protected. Fans shall have a safety guard. The refrigeration system shall have discharge, suction and liquid line gauges, high pressure switches, low pressure switches, dryers, a freezestat and full refrigerant charge. Refer to schedule on drawings.

B. Provide refrigerant pressure switches to cycle condenser fans.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with Manufacturer's instructions.

B. Install in accordance with ARI 435.

C. Make connections to coils with unions or flanges.

D. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil.

E. Insulate coil headers located outside air flow as specified for piping. Refer to Section 23 07 19.

SECTION 23 82 36

FINNED TUBE RADIATION HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Baseboard radiation.

B. Finned tube radiation.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.,

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 WARRANTY

A. Section 23 05 00 - Warranties.

1.9 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 FINNED TUBE RADIATION

A. Manufacturer:

1. Sterling.
2. Sigma.
3. Rittling.
4. Vulcan.
5. Substitutions: Refer to Section 23 05 00.

B. Hydronic Heating Elements: Seamless copper tubing, mechanically expanded into evenly spaced aluminum fins, suitable for soldered fittings.

C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

D. Enclosures: 14 gage stainless steel. Enclosure style, height and mounting height, as indicated in Schedule on Drawings. Support rigidly, on wall with full backplate or floor mounted brackets at least 3 feet on center maximum. Provide end trim, corners, end enclosures, and column enclosures. Provide air seal for field installation on all backplates.

E. Finish: Factory applied baked enamel finish; color selected by Architect from standard color chart.

F. Damper: Provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, with tamperproof fasteners, 6 x 7 inch minimum size, integral with cabinet.

H. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install wall angles where units butt against walls.

E. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. Provide with vent, if not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit heaters.

B. Cabinet unit heaters.

1.2 RELATED SECTIONS

A. Section 23 05 00 – Common Work Results for HVAC Equipment.

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. Section 23 20 13 - Hydronic Piping.

D. Section 23 20 19 - Hydronic Specialties.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Section 23 05 00 - Submittals: Procedures for submittals.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
3. Indicate mechanical and electrical service locations and requirements.,

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

A. Section 23 05 00 - Project Closeout.

B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

C. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 WARRANTY

A. Section 23 05 00 - Warranties.

1.9 EXTRA MATERIALS

A. Section 23 05 00 - Project Closeout.

PART 2 PRODUCTS

2.1 UNIT HEATERS

A. Manufacturer:

1. Airtherm.
2. McQuay.
3. Modine.
4. Reznor.
5. Rittling.
6. Sigma.
7. Sterling.
8. Substitutions: Refer to Section 23 05 00.

B. Coils: Seamless heavy wall copper tubing, silver brazed to copper headers, and with evenly spaced aluminum fins mechanically bonded to tubing. Factory tested at 250 psi and rated at 150 pounds of saturated steam pressure.

C. Casing: 0.0478 inch steel with threaded pipe connections for hanger rods.

D. Finish: Factory applied baked enamel.

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: Louvered cone diffuser on vertical models and double deflection louvers on horizontal throw models.

G. Motor: Totally Enclosed, specifically designed for unit heater service with automatic reset inherent overload protection. Motor and fan assembly resiliently mounted to eliminate vibration and minimize sound. Refer to Section 23 05 13.

H. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

I. Accessories: Strap on aquastat, Thermostat with selector switches; Auto/Off/Fan.

J. Electrical: Starters and disconnects by Division 26.

2.2 CABINET UNIT HEATERS

A. Manufacturer:

1. Airtherm.
2. McQuay.
3. Rittling.
4. Sigma.
5. Sterling.
6. Vulcan.
7. Substitutions: Refer to Section 23 05 00.

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, factory tested at 250 psig and are rated at 50 pounds of saturated steam pressure.

C. Cabinet: 16 gage steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet and inlet grilles, wall seal with gasket.

D. Finish: Factory applied baked enamel finish, color selected by Architect on visible surfaces of enclosure or cabinet from factory color chart.

E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

F. Motor: Tap wound variable speed permanent split capacitor with sleeve bearings, resiliently mounted.

G. Control: Solid state fan speed controller, factory wired, located in cabinet.

H. Filter: Easily removed 1 inch thick permanent washable type, located to filter air before coil.

I. Accessories: Return air grille, line voltage thermostat, rear perimeter gasketing, wall plate, leveling leg kit.

J. Heating Capacity: As scheduled, at 65 degrees F air temperature and 180 degrees F average water temperature.

K. Electrical: Motor starter with thermal overload protection and disconnect switch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

F. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. Provide with vent, if not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.

3.2 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters.

END OF SECTION