

**SECTION 00 4440**  
**OWNER SUPPLIED CONTRACTOR INSTALLED ITEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes administrative and procedural requirements governing material and equipment that will be furnished by the owner and installed by the contractor.

**1.3 OWNER-FURNISHED PRODUCTS**

- A. Owner will furnish the following:
1. Contract 4 - Electrical Contract
    - a. All security components and equipment as shown on SE series drawings.
    - b. All software required for security system operation.
    - c. All programming of equipment provided by Owner.
    - d. Licensing and subscription fees of software and hardware components.
- B. Contract 4 - Electrical Contract Work includes providing support systems to receive Owner's equipment, complete full installation of all equipment and to complete all field wiring to equipment shown.
1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor as applicable.
  2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
  3. Owner will arrange for integrator's field services .
  4. Contractor shall provide to the Owner the earliest possible delivery date required for Owner-furnished products. Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
  5. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect and Construction Manager noting discrepancies or anticipated problems in use of product.
  6. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
  7. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
- C. Related Sections include the following:
1. Section 26 0519 Low-Voltage Electric Power Conductors
  2. Section 26 0533.13 Conduit for Electrical Systems
  3. Section 26 0533.23 Surface Raceways for electrical
  4. Section 27 1000 Structured Cabeling

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
- B. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
- C. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

**3.2 INSTALLATION**

- A. Coordinate materials and their installation with related materials and installations to ensure that each item is completely integrated and interfaced with related work.
- B. Installation shall conform to the requirements of each section.
- C. All preparation, fasteners, devices etc, required for a complete installation shall be provided by the contractor.
- D. Contractor shall install all components in accordance with Manufacturer's and Integrator's requirements.
- E. Contractor shall assist integrator in final adjustments and setup of all equipment installed.

**END OF SECTION**

**SECTION 01 1000  
SUMMARY OF CONTRACT**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 PROJECT**

Project Description: Phase 1 of 3 for Windows, Masonry, Interior Improvements & Site Work

Facility: P.S. 32

Address: 1 Monclair, Place, Yonkers, NY 10710

Owner: Yonkers Public Schools

Address: One Larkin Center

Yonkers, NY 10701

Architect: Fuller and D'Angelo, P.C., Architects and Planners

**1.3 CONTRACT DESCRIPTION**

- A. Contract Type: Multiple contracts are separate contracts, representing significant construction activities, between Owner and separate contractors. Each contract is performed concurrently and coordinated closely with construction activities performed on Project under other contracts. Contracts for this Project include the following:
  - 1. General Construction - Contract No. 1 including asbestos abatement.
  - 2. Heating, Ventilating, Air-Conditioning (HVAC) Construction - Contract No. 2 .
  - 3. Electrical Construction - Contract No. 3 .
  - 4. Plumbing Construction - Contract No.4 .
- B. The work of each Contractor is identified in this Project Manual and on the Drawings.
- C. Local custom and trade-union jurisdictional settlements do not control the scope of Work included in each prime contract. When a potential jurisdictional dispute or similar interruption of work is first identified or threatened, the affected contractor(s) shall promptly negotiate a reasonable settlement to avoid or minimize the pending interruption and delays.
- D. If it becomes necessary to refer to the contract documents to determine which prime Contract includes a specific element of required work, begin by referring to the prime Contracts, themselves; then, if a determination cannot be made from the prime Contracts, refer, in the following order, to the Supplementary Conditions, if any, this section of the Specifications, followed by the other Division-1 sections and finally with the Drawings and other Sections of the Specifications.
- E. If, after referring to the contract documents, it cannot be clearly determined which prime Contractor will perform a specific item of required work, then, that item of work will be brought to the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. attention in writing for determination.
- F. Summary by References: Work of the Contract can be summarized by reference to the School Facilities Management Contract Manual And Specifications, Specification Sections, Drawings, or Addenda to Contract Documents issued subsequent to the initial printing of this Project Manual, and including but not necessarily limited to printed material referenced by any of these. It is recognized that the work of the Contract is unavoidably affected or influenced by governing regulations, natural phenomenon, including weather conditions, and other forces outside the contract documents.

#### **1.4 RELATED REQUIREMENTS**

- A. School Facilities Management Contract Manual And Specifications.
- B. Attachment B: Division 01 - General Requirements and Technical Specification.

#### **1.5 JURISDICTIONAL DISPUTES**

- A. If the Contractor has engaged the services of workers and/or subcontractor who are members of trade unions, the Contractor shall make all necessary arrangements to reconcile, without delay, damage or cost to the Owner and without recourse to the YPS Office of Facilities Management, any conflict between its agreement with the Owner and any agreements or regulations of any kind at any time in force among members or councils which regulate or distinguish what activities shall not be included in the work of any particular trade.
- B. The Contractor shall ensure that its work continues uninterrupted during the labor dispute and will be liable to the Owner for all damages suffered by the Owner occurring as a result of work stoppages, slowdowns, disputes or strikes

#### **1.6 SUBCONTRACTORS/SUPPLIERS**

- A. All subcontractors shall be submitted to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for approval.

#### **1.7 DESCRIPTION OF ALTERATIONS WORK**

- A. Scope of removal and alterations work is shown on drawings.
- B. Refer to paragraph 1.3 for general scope of project
- C. Maintain all building systems in operation when the Facility is occupied during construction until acceptance of the project.
- D. Plumbing: Alter existing system and add new construction, keeping existing in operation.
- E. HVAC: Alter existing system and add new construction, keeping existing in operation.
- F. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
- G. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- H. Yonkers Public Schools will remove the following items before start of work:
  - 1. All movable equipment, furniture, books etc. from all spaces being renovated.

#### **1.8 WORK BY OWNER**

- A. Yonkers Public Schools will award a contract for supply and integration of security equipment ;See specification section 00 4440..

#### **1.9 OWNER OCCUPANCY**

- A. Refer to School Facilities Management Contract Manual and Specifications for occupancy and hours building is available during constructions.
- B. Cooperate with YPS Office of Facilities Management to minimize conflict and to facilitate Yonkers Public Schools's operations.

#### **1.10 CONTRACTOR USE OF SITE AND PREMISES**

- A. Refer to School Facilities Management Contract Manual and Specifications for additional requirements.
- B. Provide access to and from site as required by law and by YPS Office of Facilities Management:
  - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
  - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Existing building spaces may not be used for storage unless approved by the YPS Office of Facilities Management.

- D. Contractors shall comply with Local Noise Ordinance.
- E. Construction deliveries shall not occur during the hours of 7:30 AM and 9:00 AM and 2:00 PM and 3:00 PM, when school buses are arriving or leaving the school grounds and school is in session.
- F. During the entire construction period the Contractor(s) shall have limited use of the premises for construction operations, including use of the site as indicated in School Facilities Management Contract Manual and Specifications and work time included in this section.
  - 1. General: Limitations on site usage as well as specific requirements that impact utilization are indicated on the drawings and/or by other contract documents. In addition to these limitations and requirements, the Construction Contractor shall administer allocation of available space equitably among the separate prime(s) and other entities needing access and space, so as to produce the best overall efficiency in performance of the total work of the project. Each Prime Contractor shall schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.
  - 2. Each Prime Contractors shall limit their use of the premises to the work indicated, so as to allow for Owner occupancy and use by the public during the period when the Owner occupies the building.
  - 3. Each Prime Contractors shall to maintain clear and unobstructed paths of exit discharge from all existing exits.
  - 4. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the YPS Office of Facilities Management at all time. Do not use these areas for parking or storage of materials.
  - 5. Lock automotive type vehicles such as passenger cars and trucks and other types of mechanized and motorized construction equipment, when parked and unattended, to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.
- G. Only materials and equipment, which are to be used directly in the work, shall be brought to and stored on the project site by the Contractor. After equipment is no longer required for the work, it shall be promptly removed from the project site. Protection of construction materials and equipment stored at the project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractors.
- H. Site work shall be scheduled and coordinated with School Facilities Management Contract Manual and Specifications and the YPS Office of Facilities Management whose decisions shall be final and binding on all contractors.
  - 1. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction
- I. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas designated by YPS Office of Facilities Management. If additional storage is necessary obtain and pay for such storage off-site.
- J. The Contractor(s) and any entity for which the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the YPS Office of Facilities Management which may be withheld in the sole discretion of the Owner.
- K. Contractor(s) shall ensure that the work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the work and all adjacent areas. The work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, each contractor shall use its best efforts to minimize any interference with the occupancy or beneficial use of:
  - 1. Any areas and buildings adjacent to the site of the work or;
  - 2. The Building in the event of partial occupancy as more.

- L. Without prior approval of the YPS Office of Facilities Management, each Contractor shall not permit any workers to use any existing facilities at the Project site, including, without limitations, lavatories, toilets, entrances and parking areas other than those designated by the YPS Office of Facilities Management. Without limitation of any other provision of the Contract Documents, the Contractor shall use its best efforts to comply with the rules and regulations promulgated by the YPS Office of Facilities Management in connection with the use and occupancy of the Project Site, and the Building, as amended from time to time. The Contractor shall immediately notify the YPS Office of Facilities Management in writing if during the performance of the Work, the Contractor finds compliance with any portion of such rules and regulations to be impracticable, setting forth the problems of such compliance and suggesting alternatives through which the same results intended by such portions of the rules and regulations can be achieved. The YPS Office of Facilities Management may, in the YPS Office of Facilities Management's sole discretion, adopt such suggestions, develop new alternatives or require compliance with the existing requirements of the rules and regulations. The Contractor shall also comply with all insurance requirements, applicable to use, and occupancy of the Project Site and the Building.
- M. Maintain the existing building in a safe and weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. When work is scheduled after hours clean and remove all temporary barriers and protection so that the building can be occupied the following day when normal building occupancy will occur.
- N. Keep public areas such as hallways, stairs, elevator lobbies, and toilet rooms free from accumulation of waste material, rubbish or construction debris.
- O. Smoking, drinking of alcoholic beverages or open fires will not be permitted on the project site.
- P. Utility Outages and Shutdown:
  - 1. Limit disruptions, shut downs, switch overs, etc. of utility services to hours the building is unoccupied, Saturdays, Sunday and/or holidays.
  - 2. Do not disrupt or shut down life safety systems, including but not limited to fire alarm system, electrical, data, and heating system, without 7 days notice to YPS Office of Facilities Management and authorities having jurisdiction.
  - 3. Prevent accidental disruption of utility services to other facilities.

#### **1.11 AVAILABILITY OF EXISTING BUILDING**

- A. Refer to School Facilities Management Contract Manual and Specifications for additional requirements.
- B. Upon request by the Contractor, the building may be made available, at the discretion of the YPS Office of Facilities Management and at the Cost to the Contractor, during such times as are allowed by local noise ordinance, in addition to the above listed hours. A request for use during these off-regular hours must be made at least two (2) days before the use. Such off-hours may include Saturdays, and Holidays.
  - 1. If the Contractor requests the use of the facility for off-hours to maintain the scheduled completion date, the Contractor shall pay all additional costs in connection with opening, providing security and project management expenses incurred with no costs to the Owner. All expenses shall be deducted from the Contractors contract price. Comply with other portions of this Section.
  - 2. Weekend, Holiday and Night Work:
    - a. The contractor shall make no claim for delay for the inability of the YPS Office of Facilities Management to make the site available for off-hours work. Should the YPS Office of Facilities Management make the site available during these hours at the contractor's request, the cost will be borne by the Contractor.
- C. ALL CONTRACTORS SHALL BE REQUIRED TO PERFORM SCHEDULED WORK WITHIN THE EXISTING BUILDING ONLY DURING THE TIME PERIODS INDICATED AND SHALL INCLUDE IN THE BID ALL COSTS FOR LABOR, MATERIAL, ETC. INCLUDING PREMIUM TIME TO PERFORM THE WORK, PER PHASE PER TIME PERIOD.

#### **1.12 COMPLETION OF WORK AFTER SCHEDULED COMPLETION DATE**

- A. Refer to School Facilities Management Contract Manual and Specifications for additional requirements.
- B. Contractor(s) shall perform work only within these limitations and all manpower, equipment, etc., shall be provided as required to complete the work as per schedule. In the event the contractor does not complete the work as scheduled all work to be performed shall be performed after 4:30 PM when the building is unoccupied and approved by the YPS Office of Facilities Management. All costs shall be borne by the Contractor.
- C. Each Contractor shall provide necessary manpower, equipment, etc., as required to maintain schedule developed within the time limitations as described above.
- D. School Calender is available on the Owner's web site. Calendar is subject to modifications for civil service holidays, changes in education programs, snow days, etc.

#### **1.13 WORK SEQUENCE**

- A. Construct Work in phases as outlined in the YPS Contract MAnual and Specifications:
- B. Coordinate construction schedule and operations with YPS Office of Facilities Management and Construction Manager .

#### **1.14 SPECIFICATION SECTIONS**

- A. Unless otherwise noted, all provisions of YPS Contract Manual and Division 01 General Requirements apply to all contracts.
  - 1. 01 1000 SUMMARY OF CONTRACTS
  - 2. 01 2000 PRICE AND PAYMENT PROCEDURES
  - 3. 01 2005 PARTIAL RELEASE OF LIEN
  - 4. 01 2500 SUBSTITUTION PROCEDURES
  - 5. 01 3000 ADMINISTRATIVE REQUIREMENTS
  - 6. 01 3216 CONSTRUCTION PROGRESS SCHEDULE
  - 7. 01 3307 SED SPECIAL REQUIREMENTS
  - 8. 01 3553 SITE SAFETY AND SECURITY PROCEDURES
  - 9. 01 4000 QUALITY REQUIREMENTS
  - 10. 01 4100 REGULATORY REQUIREMENTS
  - 11. 01 4216 DEFINITIONS
  - 12. 01 5000 TEMPORARY FACILITIES AND CONTROLS
  - 13. 01 5510 TRAFFIC AND PEDESTRIAN ACCESS & CONTROL
  - 14. 01 6000 PRODUCT REQUIREMENTS
  - 15. 01 6116 VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS
  - 16. 01 7000 EXECUTION
  - 17. 01 7310 CUTTING AND PATCHING
  - 18. 01 7600 PROCEDURES AND SPECIAL CONDITIONS FOR SEPARATE PRIME CONTRACTS
  - 19. 01 7800 CLOSEOUT SUBMITTALS
  - 20. 01 7900 DEMONSTRATION AND TRAINING

#### **1.15 GENERAL CONSTRUCTION CONTRACT No. 1**

- A. In addition to the General Requirements, Division 1, included in this bid package the General Construction Contractor-Contract No.1 shall provide for proper completion of all site and interior general construction work, including asbestos abatement, generally as indicated on drawings ASB-100, ASB-101, AR-10, A10, A20, AR-100, AR-101, AR-200, AR-201, AR-300, A-100, A-101, A-102, A-110, A-111, A-112, A-113, A-152, A-153, A-154, A-200, A-201, A-300, A-400, A-410, A-500, A-501, A-700, A-800 and A-825 and in accordance with the terms and conditions described in the following specification sections::

1. DIVISION 02 – EXISTING CONDITIONS
  - a. 02 2080 ASBESTOS REMOVAL AND DISPOSAL
2. DIVISION 03 CONCRETE
  - a. 03 3000 CAST-IN-PLACE CONCRETE
3. DIVISION 04 MASONRY
  - a. 04 0100 MAINTENANCE OF MASONRY
  - b. 04 2000 UNIT MASONRY
4. DIVISION 05 METALS
  - a. 05 5000 METAL FABRICATIONS
  - b. 05 5133 METAL LADDERS
5. DIVISION 06 WOOD, PLASTICS, AND COMPOSITES
  - a. 06 1000 ROUGH CARPENTRY
6. DIVISION 07 THERMAL AND MOISTURE PROTECTION
  - a. 07 5010 MODIFICATIONS TO EXISTING ROOFING
  - b. 07 7200 ROOF ACCESSORIES
  - c. 07 8400 FIRESTOPPING
  - d. 07 9200 JOINT SEALANTS
7. DIVISION 08 OPENINGS
  - a. 08 1113 HOLLOW METAL DOORS AND FRAMES
  - b. 08 7101 FINISH HARDWARE
  - c. 08 9100 LOUVERS
8. DIVISION 09 FINISHES
  - a. 09 2116 GYPSUM BOARD ASSEMBLIES
  - b. 09 5100 ACOUSTICAL CEILINGS
  - c. 09 6500 RESILIENT FLOORING
  - d. 09 9000 PAINTING AND COATING
9. DIVISION 31 EARTHWORK
  - a. 31 2301 EXCAVATION
10. DIVISION 32 EXTERIOR IMPROVEMENTS
  - a. 32 1216 ASPHALT PAVING
  - b. 32 1313 CONCRETE PAVING
  - c. 32 9220 RESTORATION OF TURF AREAS

**1.16 HEATING, VENTILATING, AND AIR CONDITIONING CONTRACT No.2**

- A. In addition to the General Requirements, Division 1, included in this bid package shall provide for proper completion of the work for all HVAC equipment and related construction, as generally indicated on drawings H001, H101, H102, H103, H201, H202, H203, H204, H301, H302, H303, H401, H402 and H403 and in accordance with the terms and conditions described in the following specification sections:
- B. Division 01 - General Requirements
  1. 01 5213 FIELD OFFICES AND SHEDS
- C. Division 07 - Thermal and Moisture Protection:
  1. 07 8400 - Firestopping.
  2. 07 9200 - Joint Sealants.
- D. DIVISION 23 HVAC
  1. 23 0100 GENERAL CONDITIONS
  2. 23 0110 SCOPE OF WORK
  3. 23 0120 CONVERSION OF EXISTING STEAM BOILERS TO HOT WATER
  4. 23 0130 BOILER START-UP AND TESTING



5. 23 0190 PUMPS
6. 23 0200 HYDRONIC SPECIALTIES
7. 23 0235 ROOFTOP DOAS UNITS
8. 23 0240 COMMERCIAL AIR-COOLED CONDENSING UNITS
9. 23 0245 PACKAGED ROOFTOP UNITS
10. 23 0255 VRF INDOOR UNITS
11. 23 0260 DUCTLESS SPLIT SYSTEMS
12. 23 0265 VRF HEAT RECOVERY OUTDOOR UNITS
13. 23 0280 VARIABLE FREQUENCY DRIVES
14. 23 0290 DUCT MOUNTED COILS
15. 23 0300 FANS
16. 23 0310 HOT WATER CABINET HEATERS
17. 23 0320 HOT WATER UNIT HEATERS
18. 23 0325 CEILING RADIANT PANEL HEATERS
19. 23 0330 CONVECTORS
20. 23 0340 FIN-TUBE RADIATION
21. 23 0400 SHEETMETAL WORK AND RELATED ACCESSORIES
22. 23 0405 DUCT SILENCERS
23. 23 0410 PIPING, FITTINGS, VALVES AND NOTES (HOT WATER)
24. 23 0420 SUPPORTS, SLEEVES AND PLATES
25. 23 0430 INSULATION AND COVERINGS
26. 23 0440 DAMPERS AND MISCELLANEOUS
27. 23 0460 AUTOMATIC TEMPERATURE CONTROLS
28. 23 0470 TESTING, START-UP AND ADJUSTMENTS
29. 23 0480 GENERAL LABELING, VALVE CHARTS AND PIPING IDENTIFICATION
30. 23 0485 HVAC SYSTEMS COMMISSIONING
31. 23 0490 GUARANTEE

#### **1.17 ELECTRICAL CONTRACT**

In addition to the General Requirements, Division 1, included in this bid package shall provide for proper completion of the electrical work and related construction as indicated on drawings E001, E101, E102, E103, E201, E202, E301, E302, E303, E304, E305, E501, E601, E602, EE701, E702, SE-100, SE-101 and in accordance with the terms and conditions described in the following specification sections:

Note: Electrical Contractor shall provide wiring, conduit and boxes for and installation of devices indicated on SE series drawings. All devices, equipment and accessories and programming shall be provided by the owner. See specification section 00 4440.

- A. Provide all work as specified ,but not limited to, the following sections:
- B. Division 01 - General Requirements
  1. 00 4440 Owner Supplied Contractor Installed Items.
  2. 01 5213 - Field Offices and Sheds
- C. Division 07 - Thermal and Moisture Protection:
  1. 07 8400 - Firestopping.
  2. 07 9200 - Joint Sealants .
- D. DIVISION 26 ELECTRICAL
  1. 26 0100 GENERAL CONDITIONS
  2. 26 0125 SCOPE OF WORK
  3. 26 0150 APPROVED MANUFACTURERS
  4. 26 0200 CONDUIT

5. 26 0250 DUCT BANK
6. 26 0275 15 KV MEDIUM VOLTAGE CABLE
7. 26 0300 WIRE AND CABLE
8. 26 0320 OVERCURRENT PROTECTIVE DEVICES
9. 26 0350 BOXES
10. 26 0400 WIRING DEVICES
11. 26 0425 DIGITAL LIGHTING CONTROL SYSTEM
12. 26 0450 CABINETS AND ENCLOSURES
13. 26 0500 SUPPORTING DEVICES
14. 26 0550 GENERAL LABELING AND IDENTIFICATION
15. 26 0575 INTERIOR LUMINAIRES
16. 26 0600 DISCONNECT SWITCHES
17. 26 0650 GROUNDING
18. 26 0700 PANELBOARDS
19. 26 0725 SWITCHBOARD
20. 26 0750 ELECTRIC SERVICE
21. 26 0770 SURGE PROTECTION DEVICES
22. 26 0775 PACKAGED ENGINE GENERATOR SYSTEMS – DIESEL OUTDOOR
23. 26 0785 AUTOMATIC TRANSFER SWITCH
24. 26 0800 FIRE ALARM SYSTEM
25. 26 0825 PUBLIC ADDRESS SYSTEM
26. 26 0900 GUARANTEE

**1.18 PLUMBING CONTRACT**

- A. In addition to the General Requirements, Division 1, included in this bid package shall provide for proper completion of all Plumbing work as indicated on drawing P101 and in accordance with the terms and conditions described in the following specification sections:
- B. Division 07 - Thermal and Moisture Protection:
  1. Section 07 8400 - Firestopping.
  2. Section 07 9200 - Joint Sealants
- C. DIVISION 22 – PLUMBING
  1. 22 0100 GENERAL CONDITIONS
  2. 22 0125 SCOPE OF WORK
  3. 22 0130 WATER SUPPLY SYSTEM
  4. 22 0160 SANITARY AND STORM DRAINAGE SYSTEMS
  5. 22 0420 SUPPORTS, SLEEVES AND PLATES
  6. 22 0430 INSULATION
  7. 22 0470 TESTS AND ADJUSTMENTS
  8. 22 0480 TAGS, CHARTS AND IDENTIFICATION
  9. 22 0490 GUARANTEE

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 2000  
PRICE AND PAYMENT PROCEDURES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Procedures for preparation and submittal of application for payments.

**1.3 RELATED REQUIREMENTS**

- A. Article 28 Partial Payments and Article 79 Payments of the General Engineering Agreement for additional requirements.
- B. Article 47 General Engineering Agreement for allowances requirements, if any.
- C. Section 01 5000 - Temporary Facilities and Controls.
- D. Section 01 7800 - Closeout Submittals for additional requirements for Final Payment.
- E. Section 01 2100 - Allowances: Payment procedures relating to allowances.
- F. Section 01 2300 - Alternates for bid alternates.
- G. Section 01 7800 - Closeout Submittals: Additional requirements for project record documents.

**1.4 SCHEDULE OF VALUES**

- A. Form to be used: AIA G702/703.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Fuller and D'Angelo, P.C. for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in PDF Format within 10 days after date Letter of Intent to Award.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify Bonds and Sub-contractors.
- F. Include in each line item, the amount of each Allowances specified. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Revise schedule to list approved Change Orders, with each Application For Payment.
- H. Sub-schedules: Where the Work is separated into phases provide separate payment applications, or provide sub-schedules showing values correlated with each phase.
  - 1. For public school projects identify each application with the SED Project number for each phases and YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s project number.
- I. Provide a separate line item for the following: (where applicable)
  - 1. Bonds. (Bond premium may be paid when invoice of premium is provide).
  - 2. Labor and materials, when payment is anticipated for material not installed.
  - 3. Submittals. (1% Minimum of contract amount).
  - 4. Each allowance.
  - 5. Meeting attendance.
  - 6. As-built Drawings.
  - 7. Testing, HVAC balancing reports. Minimum 0.5% of contract amount.

8. Punch list.
9. Final Cleaning.
10. Closeout Documents (1% Minimum of contract amount).
11. Authorized change orders.

#### 1.5 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement but not more than one per month.
- B. Form to be used: Approved Schedule of Values form.
- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
  1. Item Number.
  2. Description of work.
  3. Scheduled Value.
  4. Previous Applications.
  5. Work in Place and Stored Materials under this Application.
  6. Authorized Change Orders.
  7. Total Completed and Stored to Date of Application.
  8. Percentage of Completion.
  9. Balance to Finish.
  10. Retainage.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit one (1) electronic "pencil copy", in PDF format, of each Application for Payment to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for approval.
- I. After Architect's approval of the "pencil copy" submit three hard copies of approved Application for Payment to Fuller and D'Angelo, P.C..
- J. Include the following with each application:
  1. Transmittal letter as specified for submittals in Section 01 3000.
  2. Construction progress schedule, revised and current as specified in Section 01 3216.
  3. Partial Waivers of Mechanic's Lien: With each Application for Payment, submit partial waivers of mechanic's liens from Contractor, subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
    - a. Waiver Forms: Submit waivers of lien on forms, provided by the Architect in Section 01 2005.
  4. When an application shows completion of an item, submit final or full waivers.
  5. Submit Final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  6. Certified Payrolls: All Applications for Payment must be accompanied with certified payrolls for all Contract Work performed. **Each contractor and sub-contractor shall submit to the Owner within thirty days after issuance of its first payroll, and every thirty days thereafter,** a transcript of the original payroll record subscribed and affirmed as true under penalties of perjury. The Owners shall be required to receive and maintain such payroll records. The original payrolls or transcripts shall be preserved for three years from the completion of the work on the awarded project.

- a. Submit certification that all personnel listed on certified payrolls have successfully completed an OSHA construction safety and health course of at least 10 hours prior to performing any work on the project.
- K. Liens: No Payment will be made when a lien is filed against Owner by contractor or any subcontractor, or supplier or other entities until such lien is removed, bonded or similar action acceptable to the Owner
- L. Project record documents as specified in Section 01 7800 - Closeout Submittals, shall be available for review by YPS Office of Facilities Management and Fuller and D'Angelo, P.C. as a prerequisite for approval of payment.
- M. Payment for stored materials, whether on-site but not installed, or stored in secured warehouse) will require a bill of lading showing the exact value. In no case will more than 90% be approved if the item is not installed. Insurance certificates will be provided specific to materials stored for on-site or offsite items.
- N. When YPS Office of Facilities Management or Fuller and D'Angelo, P.C. requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- O. The Owner shall retain Five (5) percent of the amount of each payment.

**1.6 INITIAL APPLICATION FOR PAYMENT:**

- A. Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. Executed contract.
  - 2. Approved bonds.
  - 3. Approved insurance certificates.
  - 4. Names of full time project manager, on site superintendent, and foreman.
  - 5. Approved Schedule of Values.
  - 6. Contractor's Construction Schedule (preliminary if not final).
  - 7. Contractor's Submittal Schedule.
  - 8. Emergency Phone Numbers and Contacts.
  - 9. Health and Safety Manual.

**1.7 APPLICATION FOR PAYMENT AT SUBSTANTIAL COMPLETION**

- A. Comply with Requirements of Section 01 7800 - Closeout Submittals.

**1.8 MODIFICATION PROCEDURES**

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in its employ or subcontractors of changes to Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, YPS Office of Facilities Management will issue instructions directly to the Contractor.
- C. For other required changes YPS Office of Facilities Management will issue a document signed by YPS Office of Facilities Management instructing the Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  - 2. Promptly execute the change.
- D. YPS Office of Facilities Management may issue a document which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change. The Contractor shall prepare and submit a fixed price quotation within ten (10) days.
- E. Contractor may propose a change by submitting a request for change to YPS Office of Facilities Management, describing the proposed change and its full effect on the Work, with a statement describing

the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 25000.

- F. Computation of Change in Contract Amount:
  - 1. Refer to Article 21 and 22 of General Engineering Agreement.
- G. Substantiation of Costs: Provide full information required for evaluation.
  - 1. On request, provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  - 2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
    - a. If the contractor is directed to perform work on a "Time and Material" basis he will notify the YPS Office of Facilities Management prior to starting and will present an itemized T&M sheet daily for YPS Office of Facilities Management signature at the end of the shift. No payments will be made for any T&M work without daily signed worksheets.
- H. Execution of Change Orders: YPS Office of Facilities Management will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

#### **1.9 APPLICATIONS FOR PAYMENT WHEN BEHIND SCHEDULE**

- A. When the project falls behind schedule the contractor shall demonstrate the actions to be taken to put the project back on schedule.
  - 1. Payments will not be approved until satisfactory evidence is presented to put the project on schedule.

#### **1.10 APPLICATION FOR PAYMENT AFTER SCHEDULED COMPLETION DATE**

- A. In the event the work is not completed by the schedule date, listed in Agreement and in addition to the other remedies described, the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. will not review progress payment requisitions submitted after the construction completion date, and the District will not issue any progress payments after that date, until all work is completed.
  - 1. Only one requisition for work performed, after the construction completion date, may be submitted, and it may be submitted only when all work is complete and a Punch List inspection is conducted; said requisition may be submitted when the work at 100% complete, less 5% retainage.

#### **1.11 APPLICATION FOR FINAL PAYMENT**

- A. Refer to General Engineering Agreement and the following:
- B. Comply with Section 01 7800 - Closeout Submittals.

- C. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 01 7800 - Closeout Submittals are submitted and approved.
  - 2. All Substantial Completion Inspection Lists (Punch List) items have been completed.

**END OF SECTION**





**SECTION 01 2005  
PARTIAL RELEASE OF LIEN**

**CONTRACTOR/SUBCONTRACTOR/VENDOR'S LETTERHEAD**

Name of Facility: P.S. 32

Address: 1 Monclair, Place, Yonkers, NY 10710

Name of Owner: Yonkers Public Schools

Name of the Contractor/Subcontractor/Vendor:

Address: \_\_\_\_\_

Trade/Vendor: \_\_\_\_\_

Application # \_\_\_\_\_ Dated \_\_\_\_\_

We certify that we have completed \_\_\_\_\_% of our Contract.

Prior to this requisition we have received payment equal to \_\_\_\_\_ % of of our contract amount.

The undersigned, upon receipt of the above requisition payment hereby releases and discharges the Owner of and from any liability or obligation in any way related to or arising out of this project up to and including the date of this document.

The undersigned further covenants and agrees that it shall not in any way claim or file a mechanic's or other lien against the premises of the above designated project, or any part thereof, or against any fund applicable thereto for any of the work, labor, materials heretofore furnished by it in connection with the improvement of said premises.

The undersigned further warrants that, in order to induce the Owner to release this partial payment, they have paid all claims for labor, material, insurance, taxes, equipment, etc., employed in the prosecution of the work above, to date of this requisition.

The undersigned hereby releases and agrees to hold the Owner harmless from any and all claims in connection with the furnishing of such labor and materials, etc., for the construction of the aforementioned project.

The undersigned further guarantees that all portions of the work furnished and/or provided by them are in accordance with the contract and that the terms of the contract with respect to these guarantees will hold for the period specified in said contract. Refer to Article 79 Payments General Engineering Agreement for additional requirements.

IN WITNESS WHEREOF, we have executed under seal this release on the above date and to be legally bound hereby:

WITNESS: \_\_\_\_\_ FIRM: \_\_\_\_\_

BY: \_\_\_\_\_

State of New York, County of \_\_\_\_\_ subscribed and sworn to before me this \_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

Notary public

My commission expires \_\_\_\_\_

**END OF SECTION**



**SECTION 01 2500  
SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

**1.3 RELATED REQUIREMENTS**

- A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 01 2300 - Alternates, for product alternatives affecting this section.
- C. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- D. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling and restrictions on timing of substitution requests.

**1.4 DEFINITIONS**

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
  - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
    - a. Unavailability.
  - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
    - a. Substitution requests offering advantages solely to the Contractor will not be considered.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.1 GENERAL REQUIREMENTS**

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Yonkers Public Schools.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
  - 6. Agrees to reimburse Architect and Construction Manager for review or redesign services associated with re-approval by authorities.
  - 7. Statement indicating why specified material or product cannot be provided.
  - 8. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

9. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  10. Samples, where applicable or requested.
  11. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  12. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  13. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
  14. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  15. Cost information, including a proposal of change, if any, in the Contract Sum.
  16. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  17. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
1. Contractor's Substitution Request documentation must include the following:
    - a. Project Information:
      - a) Official project name and number, and any additional required identifiers established in Contract Documents.
    - b. Substitution Request Information:
      - a) Discrete and consecutive Substitution Request number, and descriptive subject/title.
      - b) Indication of whether the substitution is for cause or convenience.
      - c) Issue date.
      - d) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
      - e) Description of Substitution.
      - f) Reason why the specified item cannot be provided.
      - g) Differences between proposed substitution and specified item.
      - h) Description of how proposed substitution affects other parts of work.
    - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
      - a) Physical characteristics.
      - b) In-service performance.
      - c) Expected durability.
      - d) Visual effect.
      - e) Sustainable design features.
      - f) Warranties.
      - g) Other salient features and requirements.
      - h) Include, as appropriate or requested, the following types of documentation:
        - (a) Product Data:

- (b) Samples: Provide full size actual sample of item proposed for substitution. Sample shall be provided, without exception, even if the originally specified item did not require a sample.
- (c) Certificates, test, reports or similar qualification data.
- (d) Drawings, when required to show impact on adjacent construction elements.
- d. Impact of Substitution:
  - a) Savings to Yonkers Public Schools for accepting substitution.
  - b) Change to Contract Time due to accepting substitution.
- D. Limit each request to a single proposed substitution item.
  - 1. Submit an electronic document, combining the request form with supporting data into single document.
  - 2. Deliver sample to Architect.

### 3.2 SUBSTITUTION PROCEDURES AFTER AWARD OF CONTRACT

- A. Submittal Form:
  - 1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Fuller and D'Angelo, P.C. will consider requests for substitutions only within 30 days after date Letter of Award.
- C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by YPS Office of Facilities Management, in order to stay on approved project schedule.
- D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Fuller and D'Angelo, P.C. and Consultant, in order to stay on approved project schedule.
  - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Yonkers Public Schools through cost savings, time savings, greater energy conservation, or in other specific ways.
  - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected prime contractors and subcontractors.
  - 3. Bear the costs engendered by proposed substitution of:
    - a. Yonkers Public Schools's compensation to the Fuller and D'Angelo, P.C. and Consultant for any required redesign, time spent processing and evaluating the request.
    - b. Other construction by Yonkers Public Schools.
    - c. Other unanticipated project considerations.
- E. Substitutions will not be considered under one or more of the following circumstances:
  - 1. During the bidding phase.
  - 2. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  - 3. Without a separate written request.
  - 4. When acceptance will require revisions to Contract Documents.

### 3.3 RESOLUTION

- A. YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Consultant may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. YPS Office of Facilities Management will notify Contractor in writing of decision to accept or reject request.
  - 1. YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s decision following review of proposed substitution will be noted on the submitted form.

**3.4 ACCEPTANCE**

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

**3.5 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

**3.6 ATTACHMENTS**

- A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included following this section.

**SUBSTITUTION REQUEST FORM**

**SUBSTITUTION REQUEST No.** \_\_\_\_\_

(After the Bidding Phase)

Project: Phase 1 of 3 for Windows, Masonry, Interior Improvements & Site Work

Facility; P.S. 32.

Substitution Request Number: \_\_\_\_\_

From: \_\_\_\_\_

Date: \_\_\_\_\_

A/E Project Number: 19360.00

Contract For: \_\_\_\_\_

Specification Title: \_\_\_\_\_ Description: \_\_\_\_\_

Section: \_\_\_\_\_ Page: \_\_\_\_\_ Article/Paragraph: \_\_\_\_\_

Proposed Substitution:

Manufacturer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

Trade Name \_\_\_\_\_ Model no.: \_\_\_\_\_

Installer: \_\_\_\_\_ Address: \_\_\_\_\_ Phone: \_\_\_\_\_

History: \_\_\_\_\_ New product \_\_\_\_\_ 2-5 years old \_\_\_\_\_ 5-10 yrs old \_\_\_\_\_ More than 10 years old

Differences between proposed substitution and specified product:

Point-by-point comparative data attached - REQUIRED

Reason for not providing specified item: \_\_\_\_\_

Similar Installation:

Project: \_\_\_\_\_ Architect: \_\_\_\_\_

Address: \_\_\_\_\_ Owner: \_\_\_\_\_

Date Installed: \_\_\_\_\_

Proposed substitution affects other parts of Work: \_\_\_\_\_ No \_\_\_\_\_ Yes; explain \_\_\_\_\_

Savings to Owner for accepting substitution: \_\_\_\_\_ (\$ \_\_\_\_\_ )

Proposed substitution changes Contract Time: \_\_\_\_\_ No \_\_\_\_\_ Yes Add \_\_\_\_\_ Deduct \_\_\_\_\_ days.

Supporting Data Attached: \_\_\_\_\_ Drawings \_\_\_\_\_ Product Data \_\_\_\_\_ Samples \_\_\_\_\_ Tests Reports

The Undersigned certifies:

Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.

Same warranty will be furnished for proposed substitution as for specified product.

Same maintenance service and source of replacement parts, as applicable, is available.

Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.

Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.

Proposed substitution does not affect dimensions and functional clearances.

Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Fuller and D'Angelo, P.C.  
Architects and Planners

Submitted by: \_\_\_\_\_

Signed by: \_\_\_\_\_

Firm: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Attachments:

A/E's REVIEW AND ACTION

\_\_\_ Substitution approved - Make submittals in accordance with Specification Section 01330

\_\_\_ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.

\_\_\_ Substitution rejected - Use specified materials.

\_\_\_ Substitution Request received too late - Use specified materials.

\_\_\_\_\_ Date: \_\_\_\_\_

Additional Comments: \_\_\_ Contractor \_\_\_ Subcontractor \_\_\_ Supplier \_\_\_ Manufacturer \_\_\_ A/E

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**END OF SECTION**



**SECTION 01 3000  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. General administrative requirements.
- B. Preconstruction meetings.
- C. Site mobilization meeting.
- D. Contractor's daily reports.
- E. Coordination drawings.
- F. Submittals for review and information.
- G. Number of copies of submittals.
- H. Requests for Interpretation (RFI) procedures.
- I. Submittal procedures.

**1.3 RELATED REQUIREMENTS**

- A. General Engineering Agreement.
- B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- C. Section 01 6000 - Product Requirements: General product requirements.
- D. Section 01 3553 - Site Safety and Security Procedures.
- E. Section 01 7000 - Execution: Additional coordination requirements.
- F. Section 01 7800 - Closeout Submittals:
- G. Section 01 9113 - General Commissioning Requirements:

**1.4 GENERAL ADMINISTRATIVE REQUIREMENTS**

- A. Comply with requirements of Section 01 7000 - Execution for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to YPS Office of Facilities Management and Fuller and D'Angelo, P.C.:
  - 1. Requests for Interpretation (RFI).
  - 2. Requests for substitution.
  - 3. Shop drawings, product data, and samples.
  - 4. Test and inspection reports.
  - 5. Design data.
  - 6. Manufacturer's instructions and field reports.
  - 7. Applications for payment and change order requests.
  - 8. Progress schedules.
  - 9. Coordination drawings.
  - 10. Substantial Completion Inspection Correction Report and Final Correction Report.
  - 11. Closeout submittals.

## 1.5 PROJECT COORDINATOR

- A. Project Coordinator: YPS Office of Facilities Management.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other Contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation
- C. Coordinate installation of different components with other contractors and/or subcontractor to ensure maximum accessibility for required maintenance, service, and repair
- D. Cooperate with the Project Coordinator in allocation of mobilization areas of site, access, traffic, parking facilities, and field offices.
- E. During construction, coordinate use of site and facilities through the Project Coordinator.
- F. Comply with YPS Office of Facilities Management and Fuller and D'Angelo, P.C. procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- G. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 5000 - Temporary Facilities and Controls.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 PRECONSTRUCTION MEETING

- A. YPS Office of Facilities Management will schedule a meeting after Notice of Award.
- B. Attendance Required:
  - 1. YPS Office of Facilities Management.
  - 2. Fuller and D'Angelo, P.C.
  - 3. Consultants.
  - 4. Contractor(s) and field superintendent(s).
- C. Agenda:
  - 1. Status of Yonkers Public Schools - Contractor(s) Agreement.
  - 2. Submission of executed bonds and insurance certificates.
  - 3. Distribution of Contract Documents.
  - 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
  - 5. Submission of initial Submittal schedule.
  - 6. Designation of personnel representing the parties to Contract: YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Contractor(s), .
  - 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 8. Scheduling.
  - 9. Use of premises by Contractor(s).
  - 10. Yonkers Public Schools's requirements and occupancy prior to completion.
  - 11. Construction facilities and controls provided by YPS Office of Facilities Management.
  - 12. Temporary utilities provided by YPS Office of Facilities Management.
  - 13. Survey existing facilities prior to starting construction.
  - 14. Survey and site layout.
  - 15. Security and housekeeping procedures.
  - 16. Procedures for testing.
  - 17. Procedures for maintaining record documents.

18. Requirements for start-up of equipment.

- D. Fuller and D'Angelo, P.C. will record minutes and distribute copies within five days after meeting to all participants. Contactor shall distribute to all entities of the Contractor affected by decisions made.

### **3.2 WEEKLY COORDINATION MEETINGS**

- A. The Contractor for General Construction shall schedule and hold weekly general project coordination meetings at regularly scheduled times that are convenient for the attendance of other prime contractors and other parties involved. These meetings are in addition to specific meetings held for other purposes, such as regular project meetings and special pre-installation meetings. Required attendance includes General Construction Contractor, HVAC, Plumbing, and Electrical Contractor and every other entity identified by any prime contractor as being currently involved the coordination or planning for the work of the entire project. Conduct meetings in a manner that resolve coordination problems. The Contractor for General Construction shall preside at each meeting, and shall record meeting results. The Contractor for General Construction shall distribute copies of the meeting result to everyone in attendance, the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. and to others affected by the decisions and actions resulting from each meeting.
- B. The Prime Contractors shall schedule and hold weekly general project coordination meetings with the YPS Office of Facilities Management, to review the work schedule for the week in order to insure the planned work does not conflict with facility operations.

### **3.3 CONSTRUCTION PROGRESS SCHEDULE - See Section 01 3216**

### **3.4 DAILY CONSTRUCTION REPORTS**

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. Transmit electronically a copy to YPS Office of Facilities Management and Fuller and D'Angelo, P.C.
- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
1. Date.
  2. High and low temperatures, and general weather conditions.
  3. List of subcontractors at Project site.
  4. List of separate contractors at Project site.
  5. Approximate count of personnel at Project site.
    - a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
  6. Major equipment at Project site.
  7. Material deliveries.
  8. Safety, environmental, or industrial relations incidents.
  9. Meetings and significant decisions.
  10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (listed in most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
  11. Testing and/or inspections performed.
  12. Signature of Contractor's authorized representative.

### **3.5 PROOF OF ORDERS AND DELIVERY DATES**

- A. Within two (2) weeks after the approval of shop drawings, samples, product data and the like, the Contractor(s) shall provide copies of purchase orders for all equipment and materials which are not readily available in local stock. The Contractor(s) shall submit written statements from suppliers confirming the orders and stating promised delivery dates. Dates shall be indicated and coordinated with the Construction Schedule.

### 3.6 COORDINATION DRAWINGS

- A. Provide information required for preparation of coordination drawings.
- B. Review drawings prior to submission to Fuller and D'Angelo, P.C.
- C. Indicate all HVAC equipment, ductwork, and major piping, including elevations and dimensions to all fixed building elements, such as beams; columns; slabs; ceilings, including ceiling suspension; framing; floors; walls; doors, including door swings; and windows affected by the equipment, ductwork, and piping.
- D. Indicate all existing and proposed lighting fixtures and smoke detectors.
- E. Show location of all valves, dampers (fire, smoke, volume, and automatic), coils, humidifiers, smoke detectors, etc. requiring access for service and maintenance.
- F. Show all registers, grilles, diffusers, radiators and convectors, and other terminal elements.
- G. Locate all access doors.
- H. Include large-scale details and sections as required to fully delineate the conditions in congested areas, leaving space for the work of the other trades.
- I. Show plan layout of all equipment and anchorage and fasteners

### 3.7 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
  - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
  - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
  - 1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
    - c. Prepare RFI using form in Section 00 2115 - RFI Form.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
  - 1. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
    - a. Approval of submittals (use procedures specified elsewhere in this section).
    - b. Approval of substitutions refer to Section - 01 2500 - Substitution Procedures
  - 2. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
  - 3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
    - a. The Yonkers Public Schools reserves the right to assess for the costs (on time-and-materials basis) incurred by the Fuller and D'Angelo, P.C., and any of its consultants, due to processing of such RFIs.

- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
  - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
- H. Review Time: Fuller and D'Angelo, P.C. will respond and return RFIs within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor 's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to YPS Office of Facilities Management.
  - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
  - 2. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
  - 3. Notify Fuller and D'Angelo, P.C. within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

### **3.8 SUBMITTAL SCHEDULE**

- A. Submit to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for review a schedule for submittals in tabular format.
  - 1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
  - 2. Coordinate with construction schedule and schedule of values.
  - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
  - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
  - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

### **3.9 SUBMITTALS FOR REVIEW**

- A. All submittals are the product and the property of the Contractor. The YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Consultant shall not be responsible for the contractor's construction means, methods or techniques: safety precautions or programs; Acts or admissions; or failure to carry out the work in accordance to the contract documents
- B. Refer to "Article 76 General Engineering Agreement Shop Drawings, Product Data and Samples" for additional requirements.
- C. Shop Drawing Submittal Log no later than ten (10) days after award of contract.
- D. Shop Drawing Submittals shall be submitted no later than twenty (20) days after Letter of Award of Contract. No further payments will be made to the contractor after twenty (20) until all major submittals are made.
- E. When the following are specified in individual sections, including but not limited to the following, submit them for review:
  - 1. Product data.
  - 2. Shop drawings.
  - 3. Samples for selection.

4. Templates.
- F. Submit to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
  1. Submittals for HVAC, plumbing, electrical, structural, or others requiring consultant review submit directly to consultant with copy to YPS Office of Facilities Management and Fuller and D'Angelo, P.C.
- G. Samples will be reviewed only for aesthetic, color, or finish selection and for record documents purposes described in Section 001 7800 - Closeout Submittals.
- H. After review, provide copies and distribute in accordance with Submittal Procedures article below .
- I. The Architect shall review and approve or take other appropriate action on the Contractor submittals, such as shop drawings, product data, samples and other data, which the Contractor is required to submit, but only for the limited purpose of checking for conformance with the design concept and the information shown in the Construction Documents. This review shall not include review of the accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods, coordination of the work with other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. The Architect's review shall be conducted with reasonable promptness while allowing sufficient time in the Architect's judgment to permit adequate review. Review of a specific item shall not indicate that the Architect has reviewed the entire assembly of which the item is a component. **The YPS Office of Facilities Management and Fuller and D'Angelo, P.C. shall not be responsible for any deviations from the Construction Documents not brought to the attention of the Architect, in writing, by the Contractor.** YPS Office of Facilities Management and Fuller and D'Angelo, P.C. shall not be required to review partial submissions or those for which submissions of correlated items have not been received.
- J. Marking or comments on shop drawings shall not be construed as relieving the Contractor from compliance with the contract project plans and specifications, nor departure therefrom. The contractor remains responsible for details and accuracy for conforming and correlating all quantities, verifying all dimensions, for selecting fabrication processes, for techniques of assembly and for performing their work satisfactorily and in a safe manner.
- K. **Architect will review the original submittal and one (1) re submittal. Additional reviews will be additional services provided to the Owner and charged accordingly. The Owner will back charge the contractor accordingly.**
- L. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- M. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

### 3.10 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
  1. Design data.
  2. Certificates.
  3. Inspection reports.
  4. Manufacturer's instructions.
  5. Manufacturer's field reports.
  6. Other types indicated.
- B. Submit for YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s knowledge as contract administrators. for. No action will be taken.

### 3.11 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Refer to Section 01 7800 - Closeout Submittals and General Engineering Agreement.

### 3.12 NUMBER OF COPIES OF SUBMITTALS

- A. Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. All submittals shall be in electronic format and conforming to the following:
  - 1. Each item shall be in a separate file.
  - 2. Each file name shall start with the specification section number and contain an abbreviated explanation of what it contains; for example:
    - a. 03 3000 Concrete; 07 5323 EPDM.pdf; 07 5323 Bond Adh.pdf ; 07 7100 Drain.pdf; 07 7100 Hatch.pdf; 09900 Painting;
  - 3. Add Revision number (Rev2 Rev3, etc) to the file name when resubmitting items, for example:
    - a. 07 5323 EPDM Rev1.pdf 07 5323 Bond AdhRev1.pdf
  - 4. Do not zip the files, and do not put the files in Folders.
  - 5. Do not send MSDS with the technical submittals; collate all of the MSDS needed for the entire project in three ring binders, organized by specification section, and submit the binders to the YPS Office of Facilities Management, with copy of Transmittal to the Architect, and maintain one copy at the project site.
- C. Samples: Submit the number specified in individual specification sections; one of which will be retained by YPS Office of Facilities Management.
  - 1. After review, produce duplicates.
  - 2. Approved sample will be retained at the project site.
  - 3. Retained samples will not be returned to Contractor unless specifically so stated.
  - 4. Submit with each sample, in electronic PDF, data, cuts, photos, color, charts, etc.

### 3.13 SUBMITTAL PROCEDURES

- A. General Requirements:
  - 1. Use a separate transmittal for each item attached to this section.
  - 2. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
    - a. Submittals from sources other than the Contractor, with or without Contractor's stamp will not be acknowledged, reviewed, or returned.
  - 3. All submitted shop drawings shall be stamped and signed by the Contractor with the following note:
    - a. "We the undersigned certify that we have reviewed and coordinated this shop drawing and they are in conformance to the plans, specifications, applicable codes and other provisions of the Contract Documents."
  - 4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
    - a. Deliver submittals to YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Consultant at e-mail address.
  - 5. Schedule submittals to expedite the Project, and coordinate submission of related items.
    - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
    - b. For sequential reviews involving Fuller and D'Angelo, P.C.'s consultants, Yonkers Public Schools, or another affected party, allow an additional 7 days.
  - 6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
  - 7. Provide space for Contractor and YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Consultant review stamps.

8. When revised for resubmission, identify all changes made since previous submission.
  9. Submittals not requested will not be recognized or processed.
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
  2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
  2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
- E. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

### 3.14 SUBMITTAL REVIEW

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Submittals for Review: Fuller and D'Angelo, P.C. will review each submittal, and approve, or take other appropriate action.
- C. Submittals for Information: Fuller and D'Angelo, P.C. will acknowledge receipt and review. See below for actions to be taken.
- D. Fuller and D'Angelo, P.C.'s actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

### 3.15 ARCHITECT'S ACTION

- A. Fuller and D'Angelo, P.C.'s and Consultants' actions on items submitted for review:
1. Final Unrestricted Release: The work covered by the submittal may proceed provided it complies with the requirements of the contract documents; acceptance of the work will depend upon that compliance.
    - a. "No Exception Taken".
  2. Final-But-Restricted Release: When the submittals are marked as follows, the work covered by the submittal may proceed provided it complies with both the Architect's/Engineer's notations or corrections on the submittal and with the requirements of the contract documents; acceptance of the work will depend on that compliance.
    - a. "Make Corrections Noted" Resubmission not required.
  3. Returned for Re-submittal: When the submittal is marked as follows, do not proceed with the work covered by the submittal, including purchasing fabrication, delivery or other activity. Revise the submittal or prepare a new submittal in accordance with the Architect's/Engineer's notations stating the reasons for returning the submittal; resubmit the submittal without delay. Repeat if necessary to obtain a different action marking. Do not permit submittals with the following marking to be used at the project site, or elsewhere where work is in progress.
    - a. "Revise and Resubmit".
    - b. Not Authorizing fabrication, delivery, and installation:
    - c. "Rejected".
      - a) Submit item complying with requirements of Contract Documents.



- d. "Submit Specified Item".
- B. Fuller and D'Angelo, P.C.'s actions on items submitted for information:
- 1. Items for which no action was taken:
    - a. "Examined and Reviewed" - to notify the Contractor that the submittal has been received for record only.

**SUBMITTAL COVERSHEET**

**Yonkers Public Schools**  
**Phase 1 of 3 for Windows, Masonry, Interior Improvements & Site Work**  
**P.S. 32**

**ARCHITECT:**  
**Fuller and D'Angelo, P.C.**  
**45 Knollwood Rd.**  
**Elmsford, NY10523**

**OWNER:**  
**Yonkers Public Schools**  
**One Larkin Center**  
**Yonkers, NY 10701**

**CONTRACTOR:** \_\_\_\_\_ **CONTRACT:** \_\_\_\_\_

**ADDRESS:** \_\_\_\_\_

**TELEPHONE:** \_\_\_\_\_ **FAX:** \_\_\_\_\_ **EMAIL:** \_\_\_\_\_

**Facility Name:** P.S. 32

**Type of Submittal: Re-submittal:**  No  Yes

Shop Drawings  Product Data  Schedule  Sample

Test Report  Certificate  Color Sample  Warranty

**SUBMITTAL DESCRIPTION:** \_\_\_\_\_

**PRODUCT NAME:** \_\_\_\_\_

**MANUFACTURER:** \_\_\_\_\_

**SUBCONTRACTOR/** \_\_\_\_\_

**SUPPLIER:** \_\_\_\_\_

**SPEC. SECTION NO.:** \_\_\_\_\_ **DRAWING NO(S):** \_\_\_\_\_

**PARAGRAPH:** \_\_\_\_\_ **RM. OR DETAIL NO(S):** \_\_\_\_\_

**CONTRACTOR'S REVIEW STAMP**

Contractor Review Statement: These documents have been checked for accuracy and coordinated with job conditions and Contract requirements by this office and have been found to comply with the provisions of the Contract documents.

Remarks:

\_\_\_\_\_  
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\_\_\_\_\_

**NAME:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**END OF SECTION**

**SECTION 01 3216**  
**CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

**1.3 RELATED SECTIONS**

- A. Section 01 1000 - Summary of Contract: Work sequence.
- B. Section 01 1010 - Milestone Schedule.
- C. Section 01 3000 - Administrative Requirements.

**1.4 REFERENCE STANDARDS**

- A. Article 5 General Engineering Agreement for additional requirements.
- B. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

**1.5 RESPONSIBILITY**

- A. Each Contractor shall develop a full schedule, in sufficient detail and clarity of form and technique so that the contractor can plan and control his work properly and the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. can readily monitor and follow the progress for all portions of the work. Each Contractor shall complete the detailed schedule within 10 days after contract award.
  - 1. Identify all long lead items and dates required on site.
  - 2. In the event of conflict YPS Office of Facilities Management and Fuller and D'Angelo, P.C. shall resolve a provide direction which is in the best interest on the Owner.
- B. Each Contractor shall coordinate their work with work of all prime contractors.
- C. The General Construction Contractor shall be responsible for incorporating all schedules, of all prime contractors, and prepare a full master schedule, and updates, as required or directed by the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. Each Contractor shall coordinate their work with work of the other prime contracts.
  - 1. In the event of conflicts the YPS Office of Facilities Management shall resolve and provide direction which is in the best interest on the District.
  - 2. Identify all long lead items and dates required on site.
- D. The activities identified in the schedule shall be analyzed in detail to determine activity time durations in units of whole working days. All duration's shall be the result of definitive manpower and resource planning by the Contractor.
- E. The activity data shall include activity codes to facilitate selection, sorting and preparation of summary reports and graphics. Activity codes shall be developed for:
  - 1. Area: Subdivision of the building(s) and site(s) into logical modules or blocks and levels. Pods A, B, C and D.
  - 2. Responsibility: Contractor or subcontractor responsible for the work.
  - 3. Specifications: 16 Division CSI format.
  - 4. System: Division of the work into building systems for summary purposes.

5. Milestone: Work associated with completion of interim completion dates or milestones
6. Pay Item: Work identified with a pay item on the Schedule of Values.

#### **1.6 SUBMITTALS**

- A. After the Letter of Award, as scheduled in the Milestone Schedule each Contractor shall submit to the General Construction Contractor a preliminary schedule with copies to YPS Office of Facilities Management and Fuller and D'Angelo, P.C..
- B. Within ten (10) days after date Notice of Award, submit preliminary schedule .
- C. If preliminary schedule requires revision after review, submit revised schedule within 5 days.
- D. Within 5 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
  1. Include written certification that all Prime Contractors have reviewed and accepted proposed schedule.
- E. Within 10 days after joint review, the General Construction Contractor submit completed master schedule.
- F. The General Construction Contractor shall submit updated master schedule with each Application for Payment based upon update information provide by Each Contractor.
- G. Submit in PDF format.
- H. Submit under transmittal letter form specified in Section 01 3000 - Administrative Requirements.
- I. The Contractor(s) are hereby notified that payment requisitions will not be processed by the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. nor paid by the Owner until all schedules are reviewed and approved by YPS Office of Facilities Management and Fuller and D'Angelo, P.C. .

#### **1.7 QUALITY ASSURANCE**

- A. Scheduler: Contractor 's personnel or specialist Consultant specializing in construction scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.
- B. Contractor's Administrative Personnel: 3 years minimum experience in using and monitoring Bar Chart schedules on comparable projects.

#### **1.8 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each phase and each activity. Identify each activity with the applicable specification section number.
- B. Submit schedule in electronic PDF format.
- C. Scale and Spacing: To allow for notations and revisions.

#### **PART 2 PRODUCTS - NOT USED**

#### **PART 3 EXECUTION**

##### **3.1 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.
- B. Based on the preliminary development of the progress schedule and on feedback from YPS Office of Facilities Management and Fuller and D'Angelo, P.C. or whatever updating may have occurred during the project start-up, the Contractor shall, for the entire work of the contract, prepare the Master Schedule, secure critical time commitments for performing major elements of all the work.

##### **3.2 GENERAL CONTENT.**

- A. Each prime contractor shall prepare a schedule for their work.
- B. Milestones: Include milestones in schedule, including, but not limited to, Notice of Award, Submittals, Verification of existing conditions, Removals, Installation, Substantial Completion Inspection, (Punch List), Final Substantial Completion Inspection, and Closeout

- C. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- D. Identify each item by specification section number.
- E. Identify work of separate floors and other logically grouped activities.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Provide legend for symbols and abbreviations used.

### **3.3 BAR CHARTS**

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

### **3.4 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with YPS Office of Facilities Management and Fuller and D'Angelo, P.C. at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 5 days.
  - 1. When project work is behind schedule indicate revisions required to put the project on schedule.
  - 2. Payments will not approved until satisfactory evidence is presented to put the project on schedule.

### **3.5 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Update diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### **3.6 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to YPS Office of Facilities Management , Fuller and D'Angelo, P.C., Contractor's site files, subcontractors, and major suppliersand other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

**END OF SECTION**



**SECTION 01 3307**  
**SED SPECIAL REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY**

- A. This Section specifies special requirements of State Education Department, including Commissioner's Regulation Part 155.5, 155.7
  - 1. Copies of Commissioner's Regulation Part 155.5, 155.7 are available on the State Education Department's web site. [www.p12nysed.gov](http://www.p12nysed.gov)
  - 2. Copy of Commissioner's Regulation Part 155.5 is included as Appendix to the specification.

**1.3 CERTIFICATE OF OCCUPANCY**

- A. The occupied portion of any school building shall always comply with the minimum requirements necessary to maintain a Certificate of Occupancy.

**1.4 GENERAL SAFETY AND SECURITY DURING CONSTRUCTION**

- A. All construction materials shall be stored in a safe and secure manner.
- B. Fences around construction supplies or debris shall be maintained.
- C. Gates shall always be locked unless a worker is in attendance, to prevent unauthorized entry.
- D. During exterior renovation work, overhead protection shall be provided for any sidewalks or areas immediately beneath the work site or such areas shall be fenced off and provided with warning signs to prevent entry.
- E. Workers shall be required to wear photo-identification badges at all times for identification and security purposes while working at occupied sites.

**1.5 SEPARATION OF CONSTRUCTION**

- A. Separation of construction areas from occupied spaces. Construction areas that are under the control of a contractor and therefore not occupied by district staff or students shall be separated from occupied areas. Provisions shall be made to prevent the passage of dust and contaminants into occupied parts of the building. Periodic inspection and repairs of the containment barriers must be made to prevent exposure to dust or contaminants. Metal stud and gypsum board (Type X) must be used in exit ways or other areas that require fire rated separation. Heavy duty plastic sheeting may be used only for a vapor, fine dust or air infiltration barrier, and shall not be used to separate occupied spaces from construction areas.
  - 1. A specific stairwell and/or elevator may be assigned for construction worker use during work hours, when approved by the Owner. Workers may not use corridors, stairs or elevators designated for students or school staff.
  - 2. Large amounts of debris must be removed by using enclosed chutes or a similar sealed system. There shall be no movement of debris through halls of occupied spaces of the building. No material shall be dropped or thrown outside the walls of the building.
  - 3. All occupied parts of the building affected by renovation activity shall be cleaned at the close of each work day. School buildings occupied during a construction project shall maintain required health, safety and educational capabilities at all times that classes are in session.
  - 4. A plan detailing how exiting required by the applicable building code will be maintained.
  - 5. A plan detailing how adequate ventilation will be maintained during construction.

## **1.6 FIRE PREVENTION**

- A. There is no smoking on school property for fire prevention and conformance to New York State Law.
- B. Any holes in floors or walls shall be sealed with a fire resistant material.
- C. Owner shall maintain existing fire extinguishers.
- D. Fire alarm and smoke detection systems shall remain in operation at all times.

## **1.7 CONSTRUCTION DIRECTIVES**

- A. Construction Noise. Construction and maintenance operations shall not produce noise in excess of 60 dba in occupied spaces or shall be scheduled for times when the building or affected building spaces are not occupied or acoustical abatement measures shall be taken.
- B. Construction Fume Control: Each Contractor shall be responsible for the control of chemical fumes, gases, and other contaminants produced by welding, gasoline or diesel engines, roofing, paving, painting, etc. to ensure they do not enter occupied portions of the building or air intakes.
- C. Off-Gassing Control. Each Contractor shall be responsible to ensure that activities and materials which result in "off-gassing" of volatile organic compounds such as glues, paints, furniture, carpeting, wall covering, drapery, etc., are scheduled, cured or ventilated in accordance with manufacturer's recommendations before a space can be occupied.

## **1.8 ASBESTOS**

- A. Asbestos/Lead Test Asbestos Letter. Indication that all school areas to be disturbed during renovation or demolition have been or will be tested for lead and asbestos.
- B. Asbestos Code Rule 56. Large and small asbestos abatement projects as defined by 8 NYCRR 155.5(k) shall not be performed while the building is occupied. Note: It is SED's interpretation that the term "building" as referenced in this section, means a wing or major section of a building that can be completely isolated from the rest of the building with sealed non combustible construction. The isolated portions (the occupied portion and the portion under construction) of the building must contain separate code compliant exits. The ventilation systems must be physically separated and sealed at the isolation barrier(s).
  - 1. Asbestos TEM. The asbestos abatement area shall be completely sealed off from the rest of the building and completely cleaned and tested by TEM prior to re-entry by the public.
  - 2. Lead Abatement Projects. A project that contains materials identified to be disturbed which tests positive for lead shall include that information in the Construction Documents. The Construction Documents must address the availability of lead testing data for the building and include a statement that the OSHA regulations be followed and that cleanup and testing be done by HUD protocol.

## **1.9 VENTILATION**

- A. The work, as scheduled in the existing building, is to be performed when the facility is unoccupied. In the event that work is required to be performed during times when the building is occupied, all existing ventilation system between areas of work and areas of occupancy shall be disconnected, separated and code complying ventilation requirements be provided the occupied area. Prior to such work commencing the contractor shall submit a plan, for review indicating procedure to be taken. Also see paragraph 1.5 above for additional requirements."

## **1.10 ELECTRICAL CERTIFICATION:**

- A. The electrical Contractor shall obtain UL Certification or Inspection from a Certified Electrical Organization for electrical installation.

## **1.11 EXITING**

- A. Exiting: Work will be performed when school is not in session or after school hours. All exiting will be clear and usable at all times.
- B. All exits shall be clear and usable at all times.



- C. All modifications or changes to the exiting plan shall be approved by the Architect.

**1.12 CONSTRUCTION WORKERS IN OCCUPIED AREAS**

- A. No worker shall be permitted in areas occupied by students. If access is required by the contractor's personnel they will be supervised by District personnel. Contractor shall provided 24 hour notice to the Owner when such access will be required.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**



**SECTION 01 3553**  
**SITE SAFETY AND SECURITY PROCEDURES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. The safety requirements, which must be followed by each Contractor during the execution of this contract.
- B. Each Contractor agrees that the work will be completed with the greatest degree of safety and:
  - 1. To conform to the requirements of the Occupational Safety and Health Act (OSHA) and the Construction Safety Act including all standards and regulations that have been or shall be promulgated by the governmental authorities which administer such acts, and shall hold the Owner, Owner's Representative, the Architect, and all their employees, consultants and representatives harmless from and against and shall indemnify each and everyone of them for any and all claims, actions, liabilities, costs and expenses, including attorneys fees, which any of them may incur as a result of non-compliance.
- C. Security measures including entry control, personnel identification, and miscellaneous restrictions.

**1.3 REFERENCES:**

- A. Code of Federal Regulations OSHA Safety and Health.

**1.4 RELATED REQUIREMENTS**

- A. Articles 68 and 73 of General Engineering Agreement for additional requirements.
- B. Section 01 5510 - Traffic and Pedestrian Access & Control
- C. Section 01 5713 - Temporary Erosion and Sediment Control.

**1.5 DEFINITIONS**

- A. Public shall mean anyone not involved with or employed by the contractor to perform the duties of this contract.
- B. Site shall mean the the entire property, regardless of the work area.
- C. Contractor shall mean each Contractor, his/her subcontractors and any other person related to the contract execution.

**1.6 SECURITY PROGRAM**

- A. Security and Protection Facilities and Services shall be the responsibility of each contractor and all costs shall be included in their bid.
- B. Protect Work including existing premises and Yonkers Public Schools's operations from theft, vandalism, and unauthorized entry.
- C. Coordinate with Yonkers Public Schools's security program.
- D. Initiate program in coordination with YPS Office of Facilities Management 's existing security system at project mobilization.
- E. Maintain program throughout construction period until directed by YPS Office of Facilities Management .

## 1.7 ENTRY CONTROL

- A. The existing building contains a security alarm system maintained and operated by the Owner. Access into the existing building shall not be permitted unless the YPS Office of Facilities Management is notified and arrangements made to deactivate the system
- B. Restrict entrance of persons and vehicles into Project site .
- C. Allow entrance only to authorized persons with proper identification.
- D. YPS Office of Facilities Management will control entrance of persons and vehicles related to Yonkers Public Schools's operations.
- E. Coordinate access of Yonkers Public Schools's personnel to site in coordination with YPS Office of Facilities Management and Yonkers Public Schools and security forces.
- F. Traffic Control
  - 1. Each Contractor shall maintain access for emergency vehicles, fireman and pedestrians and protect from damage all persons and property within the limits of and for the duration of the contract;
  - 2. Conduct construction operations so that the traveling public and pedestrian safety is subjected to a minimum of hazard and delay.
  - 3. Each Contractor shall perform the following minimum requirements as directed by YPS Office of Facilities Management.
    - a. Keep the surface of the traveled way free from mounds, depressions, and obstructions of any type which could present hazards or annoyance to traffic.
    - b. Keep the surface of all pavements used by the public free and clean of all debris, masonry, stucco, and concrete or other obstructions to provide safe traveled ways.
    - c. Control dust and keep the traveled way free from materials spilled from hauling and construction equipment.
    - d. Provide all cones, barricades, signs and warning devices as may be required and/or as ordered by YPS Office of Facilities Management to safely carry out the foregoing. All such signs and devices shall be fabricated and placed in accordance with the latest "Federal Manual on Uniform Control Devices". Use of Open Flares Is Prohibited.
    - e. **Each Contractor shall cover with steel plates all open trenches at the close of each work day. Such plates to abut each other and be wedged at each end of trench to prevent plates from sliding open**
  - 4. Ingress and Egress
    - a. Contractor shall provide and maintain at all times safe and adequate ingress and egress to and from site at existing or at new access points consistent with work, unless otherwise authorized by the YPS Office of Facilities Management.
  - 5. If, upon notification by YPS Office of Facilities Management, and the contractor fails to correct any unsatisfactory condition within 24 hours of being so directed, YPS Office of Facilities Management will immediately proceed with adequate forces to properly maintain the project and the entire cost of such maintenance shall be deducted (back charged) from any moneys due the contractor
  - 6. All traffic control costs shall include the base bid of furnishing all labor, material and equipment including the cost of any and all incidental required by job conditions as ordered by YPS Office of Facilities Management.

## 1.8 FIRE PREVENTION AND CONTROL

- A. Each Contractor shall provide Fire Extinguishers as follows: Provide type "A" fire extinguishers for temporary offices and similar spaces where there is minimal danger of electrical fires or grease-oil-flammable liquid fires. In other locations provide either type "ABC" dry chemical extinguishers, or a combination of several extinguishers of NFPA recommended types for the exposures in each case.

1. All required exits, fire alarm, security, automatic temperature control, PA, sprinkler and similar systems shall be maintained and operable throughout the entire construction contract.
  - a. Contractor(s) will be back-charged for all fines imposed for false alarms or service calls.
- B. Free access to fire hydrants and standpipe connections shall be maintained at all times during construction operations. Portable fire extinguishers shall be provided by the Contractor and made conveniently available throughout the construction site. Contractor(s) shall notify their employees of the location of the nearest fire alarm box at all locations where work is in progress.
- C. Each Contractor shall take all possible precautions for the prevention of fires. Where flame cutting torches, blow torches, or welding tools are required to be used within the building, their use shall be as approved by the Construction Manager at the site. When welding tools or torches of any type are in use, have available in the immediate vicinity of the work a fire extinguisher of the dry chemical 20 lbs. Type. The fire extinguisher(s) shall be provided and maintained by the Contractor doing such work.
- D. Fuel for cutting and heating torches shall be gas only and shall be contained in Underwriters laboratory approved containers.
- E. Storage of gas shall be in locations as approved by the Owner and subject to Fire Department regulations and requirements.
- F. No volatile liquids shall be used for cleaning agents or as fuels for motorized equipment or tools within a building except with the express approval of the Owner and/or Architect and in accordance with local codes. On-site bulk storage of volatile liquids shall be outside the buildings at locations directed by the Owner, who shall determine the extent of volatile liquid allowed within the building at any given time.
- G. Each Contractor shall comply with the following requirements relating to compressed gas:
  1. Where compressed gas of any type is used for any purpose at the site, it shall be contained in cylinders complying with ICC regulations. Gases of different types shall not be stored together except when in use and when such proximity is required.
  2. All gas cylinders shall be stored in sheds constructed of noncombustible materials. Sheds shall be well ventilated and without electric lights or fixtures and shall be located as far from other buildings as is practicable. All gas cylinders not in actual use, or in proposed immediate use, shall be removed from the building under construction or reconstruction. Empty gas cylinders shall be removed prior to bringing in a replacement cylinder. Cylinders shall at all times be supported and braced in an upright position. When not in use, the protective cap shall be screwed over the valve.
  3. All persons required to handle gas cylinders or to act as temporary firemen (Fire Watchers) shall be able to read, write and understand the English language; they shall also be required by the Contractor to read Part 3 of Pamphlet P-1 "Safe Handling of Compressed Gases" published by the Compressed Gas Association, 500 Fifth Avenue, New York, NY 10036.
  4. Where local ordinances are in effect regarding gas cylinders, (their use, appurtenances and handling), such ordinances shall supplement the requirements of this paragraph. All personnel engaged in fire watch shall be certified by the Local Fire Department having jurisdiction.
  5. LP-Gas Heating will not be permitted in enclosed areas below grade.
  6. Any cylinder not having the proper ICC markings or reinspection marking, or any cylinder with a leak shall be isolated immediately away from any building and the supplier shall be immediately notified; such other precautions as may be required to prevent damage or injury shall also be taken by the Contractor.

#### **1.9 PERSONNEL IDENTIFICATION**

- A. Provide identification badge or other approved identification to each contractor, their subcontractor's project superintendent, employees, directly or indirectly employed by the contractors or persons authorized to enter premises.
  1. Badge To Include: Personal photograph, name and employer.
- B. Maintain a list of accredited persons, submit copy to YPS Office of Facilities Management on request.

**1.10 RESTRICTIONS**

- A. Do not allow cameras on site or photographs taken except by written approval of YPS Office of Facilities Management.

**PART 2 PRODUCTS -**

**2.1 MATERIALS**

- A. Refer to Section 01 5000 - Temporary Facilities and Controls for additional barrier requirements.

**PART 3 EXECUTION**

**3.1 GENERAL**

- A. In the performance of its contract, each Contractor shall exercise every precaution to prevent injury to workers and the public or damage to property.
  - 1. Each Contractor shall, at their own expense, provide temporary structures, place watchmen, design and erect barricades, fences and railings, give warnings, display such lights, signals and signs, exercise such precautions against fire, adopt and enforce such rules and regulations, and take such other precautions as may be necessary, desirable or proper or as may be directed.
  - 2. Each Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work to be done under this contract. Each Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss including but not limited to:
    - a. All employees working in connection with this contract, and other persons who may be affected thereby.
    - b. All the work materials and equipment to be incorporated therein whether in storage on or off site; and including trees, shrubs, lawns, walks, pavements, facilities not designated for removal, relocation or replacement in the course of construction.
- B. Each Contractor's duties and responsibilities for the safety and protection of the work: shall continue until such time as all the work is completed and contractor has removed all workers, material and equipment from the site, or the issuance of the certificate of final completion, whichever shall occur last.
- C. Each Contractor shall use only machinery and equipment adapted to operate with the least possible noise, and shall so conduct his operations that annoyance to occupants of the site and nearby homes and facilities shall be reduced to a minimum
- D. It shall be the responsibility of the Contractor to insure that all employees of the contractor and all subcontractors, and any other persons associated with the performance of their contract shall comply with the provisions of this specification.
- E. The Contractor shall clean up the site daily and keep the site free of debris, refuse, rubbish, and scrap materials. The site shall be kept in a neat and orderly fashion. Before the termination of the contract. Each Contractor shall remove all surplus materials, falsework, temporary fences, temporary structures, including foundations thereof.
- F. The Contractor shall follow all rules and regulations put forth in the Code of Federal Regulations (OSHA Safety and Health Standards).

**END OF SECTION**

**SECTION 01 4000**  
**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Contractor's design-related professional design services.
- G. Control of installation.
- H. Mock-ups.
- I. Tolerances.
- J. Manufacturers' field services.
- K. Defect Assessment.

**1.3 RELATED REQUIREMENTS**

- A. "Artical 12 General Engineering Agreement" for additional requirements.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures.
- C. Section 01 4216 - Definitions.
- D. Section 01 6000 - Product Requirements: Requirements for material, product quality and substitution procedures.

**1.4 REFERENCE STANDARDS**

- A. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2017.
- B. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2015a, with Editorial Revision (2016).
- C. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- D. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2018.
- E. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2015.
- F. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2017.

**1.5 DEFINITIONS:**

- A. Refer to "Article 7 and Article 47 of the General Engineering Agreement".

#### **1.6 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES**

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
  - 1. Temporary sheeting, shoring, or supports.
  - 2. Temporary scaffolding.
  - 3. Temporary hoist(s) and rigging.

#### **1.7 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES**

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
  - 1. Concrete Mix Design: As described in Section 03 3000 - Cast-in-Place Concrete. No specific designer qualifications are required.
  - 2. Structural Design of Metal Fabrications: As described in Section 05 5000 - Metal Fabrications.
  - 3. Structural Design of Railings: As described in Section 05 5213 - Pipe and Tube Railings.

#### **1.8 SUBMITTALS**

- A. Design Data: Submit for YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to YPS Office of Facilities Management and Fuller and D'Angelo, P.C.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Compliance with Contract Documents.
    - k. Provide YPS Office of Facilities Management and Fuller and D'Angelo, P.C., interpretation of results.
  - 2. Test report submittals are for YPS Office of Facilities Management's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents
- C. Certificates: When specified in individual specification sections, submit certification by the manufacturer and installation/application subcontractor to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. in quantities specified for Product Data.
  - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to YPS Office of Facilities Management and Fuller and D'Angelo, P.C..



- D. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, for the YPS Office of Facilities Management's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- E. Manufacturer's Field Reports: Submit reports for YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s benefit as contract administrator or for Yonkers Public Schools.
  - 1. Submit report in duplicate within 30 days of observation to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for information.

#### **1.9 QUALITY ASSURANCE**

- A. Testing Agency Qualifications:
  - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State of New York.
- C. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

#### **1.10 REFERENCES AND STANDARDS**

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Fuller and D'Angelo, P.C. before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of YPS Office of Facilities Management and Fuller and D'Angelo, P.C. shall be altered from Contract Documents by mention or inference otherwise in any reference document.
- G. Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries or the internet.

#### **1.11 TESTING AND INSPECTION AGENCIES AND SERVICES**

- A. Yonkers Public Schools will employ and pay for services of an independent testing agency to perform specified testing which is the responsibility of the YPS Office of Facilities Management.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:

1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM C1077, and ASTM C1093.
2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
3. Laboratory: Authorized to operate in the State in which the Project is located.
4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.1 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Fuller and D'Angelo, P.C. before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

### **3.2 MOCK-UPS**

- A. Accepted mock-ups establish the standard of quality the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for the work and they will be the sole judge the Work.
- B. Integrated Exterior Mock-ups: construct integrated exterior mock-up as directed. Coordinate installation of exterior envelope materials and products as required in individuals Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- C. Room Mock-ups: Construct room mock-ups as indicated on drawings or individual sections. Coordinate installation of materials, products, and assemblies as required in specification sections; finish according to requirements. Provide required lighting and any supplemental lighting where required to enable Fuller and D'Angelo, P.C. to evaluate quality of the mock-up.
- D. Notify YPS Office of Facilities Management and Fuller and D'Angelo, P.C. seven (7) working days in advance of dates and times when mock-ups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s approval of mock-ups before starting work, fabrication, or construction.
- I. Accepted mock-ups shall be a comparison standard for the remaining Work.
- J. Where mock-up has been accepted by YPS Office of Facilities Management and Fuller and D'Angelo, P.C. and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by YPS Office of Facilities Management.

### 3.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Fuller and D'Angelo, P.C. before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### 3.4 TESTING AND INSPECTION

- A. Testing Agency Duties:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at site. Cooperate with YPS Office of Facilities Management and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify YPS Office of Facilities Management and Fuller and D'Angelo, P.C. of observed irregularities or non-conformance of Work or products.
  - 6. Perform additional tests and inspections required by YPS Office of Facilities Management
  - 7. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the Work.
  - 3. Agency may not assume any duties of the Contractor.
  - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
  - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  - 4. Notify YPS Office of Facilities Management and Fuller and D'Angelo, P.C. and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
  - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  - 6. Arrange with YPS Office of Facilities Management's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Fuller and D'Angelo, P.C..
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.
- F. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by YPS Office of Facilities Management. Payment for re testing will be charged to the Contractor by deducting testing charges from the Contract Price.

### 3.5 OWNER'S TESTING AND INSPECTIONS

- A. YPS Office of Facilities Management will engage a qualified testing agency or special inspector to conduct tests and inspections as the responsibility of and paid for by Owner as follows:
  - 1. Asbestos inspection and air monitoring
  - 2. Soil bearing capacity and bottom of footings.
  - 3. Compaction and backfilling.
  - 4. Mortar sampling and testing.
  - 5. Placement of joint reinforcement.
  - 6. Placement of anchors.
  - 7. Placement of concealed flashing.
  - 8. Welder's certificates.
  - 9. Steel studs.
  - 10. Gypsumboard
  - 11. Aluminum windows connections and fasteners.
  - 12. Commissioning.
- B. Contractor shall perform the work in an efficient manner consistent with industry standards. Excessive testing resulting from the contractor's inability to perform efficiently will result in back charges to the contractor.
- C. All re-inspections required for work not properly installed shall be paid for by the contractor.
- D. The Owner will not be liable for any costs or delay claims due to the testing agency or special inspector failure to provide inspection without proper and sufficient notification.
- E. All requests by the contractor for inspection that are cancelled and result in charges to the Owner will be back charged to the contractor.

### 3.6 CONTRACTOR'S TESTING AND INSPECTION

- A. Testing and Inspections shall be conducted by a qualified testing agency or special inspector, approved by the YPS Office of Facilities Management and as indicated in individual Specification Sections.
- B. Contractor's responsibility including:
  - 1. Notifying YPS Office of Facilities Management, Fuller and D'Angelo, P.C, and Contractor promptly of irregularities and deficiencies observed in the work during performance of its services.
  - 2. Submitting a certified written report of each test, inspection, and similar quality-control service to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. with copy to Contractor and to authorities having jurisdiction.
  - 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  - 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  - 5. Retesting and re-inspecting corrected work.
  - 6. All design mixes.
  - 7. Testing and balancing of all plumbing and mechanical .
  - 8. Testing Fire Alarm, smoke detection systems, and emergency light.
  - 9. Testing public address system.
  - 10. Electrical systems.
  - 11. Electrical Certification: The contractor shall obtain UL Certification or Inspection from a Certified Electrical Organization for electrical installations.

### 3.7 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation,

quality of workmanship, start up of equipment, balancing of equipment, adjusting, and traffic coatings as applicable, and to initiate instructions when necessary.

- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

**3.8 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of YPS Office of Facilities Management, it is not practical to remove and replace the work, YPS Office of Facilities Management will direct an appropriate remedy or adjust payment.

**END OF SECTION**



**SECTION 01 4100  
REGULATORY REQUIREMENTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY OF REFERENCE STANDARDS**

- A. The YPS Office of Facilities Management shall file and obtain the Building Permit.
- B. Each Contractor shall furnish and pay for all other permits, fees and other installation costs required for the various installations by governing authorities and utility companies; prepare and file drawings and diagrams required; arrange for inspections of any and all parts of the work required by the authorities and furnish all certificates necessary to the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. as evidence that the work installed under this Section of the Specifications conforms with all applicable requirements of the State Codes and Municipal Code.
- C. Regulatory requirements applicable to this project are the following:
  - 1. 28 CFR 35 - Nondiscrimination on the Basis of Disability in State and Local Government Services; Final Rule; Department of Justice; current edition.
  - 2. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
  - 3. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
  - 4. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.
  - 5. NFPA 1 - Fire Code; 2018.
  - 6. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 7. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 8. New York State Uniform Fire and Building Codes known as the "Building Codes of the State of New York" and consist of the following:
    - a. Building Code of New York State
    - b. State Education Department Planning Standards, including Commissioner's Regulation Part 155.5, 155.7
    - c. Energy Conservation Construction Code of New York State
    - d. Fire Code of New York State
    - e. Fuel Gas Code of New York State
    - f. Mechanical Code of New York State
    - g. Plumbing Code of New York State
    - h. Utility Company Regulations and Requirements.
    - i. Classification of Construction: Type I.
    - j. Occupancy Classification: Education E
    - k. State Education Department: Planning Standards is applicable to the work. Any conflicts between the Building Codes of New York and the State Education Department Planning Standards, the most restrictive shall apply. Copies of the Planning standards are available at the SED web site. [www.p12.nysed.gov](http://www.p12.nysed.gov) > facplan > documents > mps
- D. Electrical Certification: The Electrical Contractor shall obtain UL Certification or Inspection from a Certified Electrical Organization for certification of electrical installations.

- E. Any items of work specified herein and shown on the drawings which conflict with aforementioned rules, regulations and requirements, shall be referred to the Fuller and D'Angelo, P.C. for decision, which decision shall be final and binding.
- F. The work shall not be deemed to have reached a state of Substantial Completion until the certificates have been delivered
- G. EPA - Environmental Protection Agency.
- H. OSHA Part 1926 Safety and Health Regulations for Construction.
- I. Federal Regulation for Asbestos Abatement
  - 1. Title 30 CFR Part 61, Subpart G; The Transport and Disposal of Asbestos Waste
  - 2. The Transport and Disposal of Asbestos Waste]
  - 3. Title 40 CFR, Part 763 Asbestos Containing Materials in Schools; Final Rule and Notice
  - 4. Title 49 CFR Parts 106, 107, and 171-179. The Transportation Safety Act of 1974 and the Hazardous Material Transportation Act..
  - 5. Public Law 101-637 ASHARA
- J. New York State Official Compilation of Codes, Rules and Regulations
  - 1. Title 12 Part 56
  - 2. Title 10 Part 73
  - 3. Title 6 Parts 360-364
  - 4. Labor Law - Article 30 and Sections 900-912
  - 5. All applicable Additions, Addenda, Variances and Regulatory Interpretation Memoranda

### **1.3 MANDATORY OSHA CONSTRUCTION SAFETY AND HEALTH TRAINING**

- A. Pursuant to NYS Labor Law §220-h - All laborers, workers and mechanics working on the site are required to be certified as having successfully completed an OSHA construction safety and health course of at least 10 hours prior to performing any work on the project.

### **1.4 RELATED REQUIREMENTS**

- A. Section 01 4000 - Quality Requirements.
- B. Section 01 4219 - Reference Standards

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 4216**  
**DEFINITIONS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

**1.3 DEFINITIONS**

- A. Owner: The term "Owner shall mean Yonkers Public Schools and their duly authorized representative.
  - 1. The word "Owner" and the words "School Board", "City School District", "Board of Education", "Union Free School District", "Central School District", etc., shall have the same meaning.
- B. Architect: The term "Architect" or "Engineer" or the words "Architect/Engineer" shall mean the Professional Architect responsible for the contract documents Fuller and D'Angelo, P.C., Architects and Planners.
- C. Owner's Representative: The term Owner's Representative shall mean YPS Office of Facilities Management
- D. MEP Consultant shall mean Barile Gallagher Associates, 35 Marble Avenue, Pleasantville, New York 10570
- E. Site Consultant shall mean Hudson Engineering & Consulting, 45 Knollwood Road. Suite 201 - Elmsford. NY 10523
- F. Environmental Consultant shall mean Warrenpanzer, 228 East 45th Street New York, NY 10017
- G. Contractor for Construction: The term "Contractor for Construction", "General Contractor" "Contractor for General Work" "Construction Contractor" shall have the same meaning.
- H. Contractor for Plumbing: The term "Plumbing Contract", "Plumbing Contractor" "Contractor for Plumbing" shall have the same meaning.
- I. Contractor for HVAC: The term "HVAC Contract", "HVAC Contractor" "Contractor for HVAC", "Mechanical Contractor" "Ventilation Contractor" shall have the same meaning.
- J. Contractor for Electrical: The term "Electrical Contract", Electrical Contractor" "Contractor for Electric" shall have the same meaning.
- K. Contractor(s): Shall include all separate contractor(s) have contracts with the Owner for the same project and may include but not limited to: General Construction, Plumbing, HV, HVAC, Electrical, Site and others
- L. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract and Section 01 3000 - Administrative Requirements.
- M. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.
- N. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.
- O. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

- P. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.
- Q. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- R. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- S. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.
- T. The term "Building Code" shall mean the Building Code of the State of New York including all amendments and reference standards to date.
- U. "Work" - Labor, materials, equipment, apparatus, controls, accessories, and all other items customarily furnished and/or required for proper and complete disconnection and reconnection, installation of new work.
- V. "Wiring" - Conduit, fittings, wire, junction and outlet boxes, switches, cutouts, and receptacles and all items necessary or required in connection with or relating to such wiring.
- W. "Concealed" - Embedded in masonry or other construction, installed behind wall furring, within double partitions, or hung ceilings, in trenches, or in crawl spaces.
- X. "Exposed" - Not installed underground or "Concealed" as defined above.
- Y. Furnish: The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations..
- Z. Install: The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- AA. 'Noted' - as indicated on the drawings and/or specifications.
- AB. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- AC. Provide: To furnish and install complete and ready for the intended use.
- AD. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

**SECTION 01 5000**  
**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Dewatering
- B. Temporary water.
- C. Temporary electric power and light.
- D. Temporary telephone service.
- E. Temporary sanitary facilities.
- F. Temporary Controls: Barriers, enclosures, and fencing.
- G. Vehicular access and parking.
- H. Hoists and temporary elevator use
- I. Waste removal facilities and services.
- J. Construction aids and miscellaneous services and facilities.
- K. Enclosure fence for the construction equipment.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements for submittals.
- B. Section 01 3553 - Site Safety and Security Procedures.
- C. Section 01 5213 - Field Offices and Sheds.
- D. Section 01 7000 - Execution progress cleaning.
- E. Divisions 2 through 40 ventilation and humidity requirements for products in those Sections.

**1.4 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.

**1.5 DEWATERING**

- A. Provide temporary means and methods for dewatering all temporary facilities and controls.
- B. Maintain temporary facilities as directed by YPS Office of Facilities Management.

**1.6 REFERENCES**

- A. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

**1.7 QUALITY ASSURANCE**

- A. Regulations: Each contractor shall comply with industry standards and with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
  - 1. Building code requirements.
  - 2. Health and safety regulations.
  - 3. Police, fire department and rescue squad rules.
  - 4. Environmental protection regulations

- B. Standards: Each prime contractor shall comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

#### **1.8 PROJECT CONDITIONS**

- A. General: Each contractor shall provide each temporary service and facility ready for use at each location, when first needed to avoid delays in performance of work. Maintain, expand as required, and modify as needed throughout the progress of the work. Do not remove until services or facilities are no longer needed, or are replaced by the authorized use of completed permanent facilities.
- B. Temporary Use of Permanent Facilities: Regardless of previously assigned responsibilities for temporary services and facilities, the Installer of each permanent service or facility shall assume responsibility for its operation, maintenance and protection during use as a construction service or facility prior to the YPS Office of Facilities Management's acceptance and operation of the facility.
- C. Conditions of Use: Operate temporary services and facilities in a safe and efficient manner. Do not overload, and do not permit temporary services and facilities to interfere with the progress of work, or occupancy of existing facility by owner. Do not allow unsanitary conditions, public nuisances or hazardous conditions to develop or persist on the site.
- D. Temporary Construction and Support Facilities: Maintain temporary facilities in a manner to prevent discomfort to users. Take necessary fire prevention measures. Maintain temporary facilities in a sanitary manner so as to avoid health problems.
- E. Security and Protection: Maintain site security and protection facilities in a safe, lawful, publicly acceptable manner. Take measures necessary to prevent site erosion.

#### **1.9 TEMPORARY UTILITIES**

- A. YPS Office of Facilities Management will provide the following:
  - 1. Electrical power, consisting of Contractor's connection to existing facilities.
  - 2. Water supply, consisting of Contractor's connection to existing facilities.
- B. Each Contractor shall provide and pay for all temporary local electrical power, water, and ventilation required for their construction purposes.
  - 1. Existing facilities may be used.
- C. Use trigger-operated nozzles, with back flow devices, for water hoses, to avoid waste of water.

#### **1.10 DIVISION OF RESPONSIBILITIES**

- A. Each Contractor is responsible for the following:
  - 1. Installation, operation, maintenance, and removal of each temporary facility usually considered as its own normal construction activity, as well as the costs and use charges associated with each facility.
  - 2. Plug-in electric power cords and extension cords.
  - 3. Supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
  - 4. Special power requirements for installation of its own work such as welding.
  - 5. Its own field office complete with necessary furniture, utilities, and telephone service.
  - 6. Its own storage and fabrication sheds.
  - 7. Temporary telephone service.
  - 8. All hoisting and scaffolding for its own work.
  - 9. Collection and disposal, off site, of its own hazardous, dangerous, unsanitary, or other harmful waste material.
  - 10. Collection and disposal of all major equipment removed such as unit ventilators, heaters, fans, toilet fixtures, and light fixtures.
  - 11. Secure lockup of its own tools, materials and equipment.

12. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
  13. Containerized bottled-water drinking-water units.
  14. First Aid Station and Supplies.
  15. Barricades, warning signs, and lights required to secure thier work areas.
  16. Security enclosure and lockup of thier own equipment or materials.
  17. Temporary Protection for existing flooring, from altered areas to exits.
  18. Construction aids and miscellaneous services and facilities.
- B. Temporary Lighting: Each Contractor shall provide and pay all costs to provide temporry lighting suitable for work-in-progress, at thier local work areas. .

#### **1.11 USE CHARGES**

- A. General: Cost or use charges for temporary facilities are not chargeable to the Owner or the Architect, Engineer or the Owner's Representative. The YPS Office of Facilities Management will not accept a contractor's cost or use charges for temporary services or facilities as a basis of claim for an adjustment in the Contract Sum or the Contract Time.
1. Water Service Use Charges: Water from the Owner's existing water system may be used without metering, and without payment for use charges.
  2. Electric Power Service Use Charges: Electric power from the Owner's existing system may be used without payment of use charges. Contractor and Sub-Contractors shall exercise measures to conserve energy usage.
    - a. Use of owner electric for items not specific to project (e.g. heating construction shanties, etc.) will not be permitted.
  3. Temporary Utility Services: Where Owner's existing services is inadequate or would disrupt owners use of the existing facility, contractor shall provide utility services for the temporary use at the project site from the utility company, and pay all costs, including use charges.

#### **1.12 TELECOMMUNICATIONS SERVICES**

- A. Each Contractor shall provide and pay for its own telephone service.
1. Provide mobile phone service for all field superintendents and foreman.
- B. HVAC Contractor, at the Field Office trailer, post a list of important telephone numbers, including the following:
1. Local police and fire department.
  2. Ambulance service.
  3. Contractor's temporary and home office.
  4. YPS Office of Facilities Management temporary and home office
  5. Architect's home office.
  6. Principal subcontractors temporary and home office

#### **1.13 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Use of existing facilities is not permitted.
- C. Maintain daily in clean and sanitary condition.
- D. Sanitary Facilities: Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with governing regulations including safety and health codes for the type, number, location, operation and maintenance of fixtures and facilities; provide not less than specified requirements. Install in locations which will best serve the project's needs.
1. Responsibilities: The General Construction Contractor is responsible for temporary sanitary facilities and their maintenance, including supplies. .
  2. Install self-contained toilets to the extent permitted by governing regulations.

3. Supply and maintain toilet tissue, paper towels, paper cups and other disposable materials as appropriate for each facility for full contract duration. Provide covered waste containers for used material.
4. Provide separate toilet facilities for male and female construction personnel where required by law.

#### **1.14 BARRIERS**

- A. Responsibility: General construction barriers required for the project shall be the responsibility of the each contractor.
  1. Construction barriers required exclusively for each prime contractor are the responsibility of that contractor
- B. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and removals .
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

#### **1.15 FENCING**

- A. Each contractor shall be responsible for its own fencing.
- B. Construction: Commercial grade chain link fence.
- C. Provide 8 foot (2.4 m) high fence around any materials or equipment stored on-site.; equip with vehicular and pedestrian gates with locks.
- D. Coordinate size and location with YPS Office of Facilities Management or Construction Manager. Do not erect any fencing prior to obtaining approval from same.

#### **1.16 EXTERIOR ENCLOSURES**

- A. Responsibilities: Each contractor is responsible for temporary enclosure for thier wotk that penetrates the existing building exterior.
- B. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks, if required for access.
- C. Enclosure: Install tarpaulins or equivalent materials securely, using a minimum of metal framing, 4" - 20 ga. metal framing 16" o.c., and ½" plywood plus 6 mil poly for secure and weather tight protection of the school. Individual openings of 16-sq. ft. or less may be closed with plywood or similar materials.
  1. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures where work is being or will be performed, provide translucent tarpaulins made of nylon reinforced laminated polyethylene to admit the maximum amount of daylight and reduce the need for temporary lighting
- D. Close openings through floor and roof deck and other horizontal surfaces with substantial load-bearing metal framing or similar construction

#### **1.17 INTERIOR ENCLOSURES**

- A. Provide temporary dustproof partitions as required to separate work areas from Yonkers Public Schools-occupied areas, to prevent penetration of dust and moisture into Yonkers Public Schools-occupied areas, and to prevent damage to existing materials and equipment.
- B. Temporary Dustproof Partitions: The Each Contractor shall provide dustproof partitions to separate work area from occupied sections of building where thier work would create dust or debris. Partitions shall be full height metal stud surfaced with minimum 2 layers of poly sheathing, overlapped and edges taped. Provide zippered access point where acces to corridor is required..
  1. Where isolated work is being performed by a prime contractor the contractor performing the work shall be responsible for protecting the occupied areas from the work areas as directed by the Architect, including providing dust protection.

2. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
- C. Contractor shall remove and reinstall any devices impacted by temporary partition installation. At conclusion of project electrician will again remove and reinstall these devices onto the permanent locations

**1.18 SITE SAFETY AND SECURITY PROCEDURES- See Section 01 3553**

**1.19 VEHICULAR ACCESS AND PARKING**

- A. Responsibilities: Each Contractor is responsible for vehicular access and parking for thier vehicles and thier employee vehicles.
- B. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- C. Coordinate access and haul routes with Yonkers Public Schools.
- D. Provide and maintain access to fire hydrants, free of obstructions.
- E. Existing parking areas may not be used for construction parking unless designated and approved by the YPS Office of Facilities Management.

**1.20 WASTE REMOVAL**

- A. General Construction Contractor shall provide containers, at grade, sufficient for the depositing of non-hazardous/non-toxic waste materials, and shall remove such waste materials from project site as required or directed by the Owner's representative.
  1. Provide specific containers for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  2. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  3. Contractors shall not utilize the Owner's bins or dumpsters.
- B. Each Contractor shall broom clean the work area at the end of each work day.
  1. If the contractor fails to clean areas at the end of each work day the YPS Office of Facilities Management shall perform the cleaning and back charge the contractor accordingly.
- C. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- D. Provide containers with lids. Remove trash from site periodically.
- E. Each prime contractor shall be responsible for daily cleaning up of spillage and debris resulting from its operations and from those of its subcontractors; and shall be responsible for complete removal and disposition of hazardous and toxic waste materials.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- F. Burying or burning of waste materials on the site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- G. Provide rodent proof containers located on each floor level to encourage depositing of garbage and similar wastes by construction personnel. General Construction
- H. Site: The Each Contractor shall maintain Project site free of waste materials and debris.
- I. Installed Work: Keep installed work clean. Each Contractor shall clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- J. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- K. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- L. Work Areas: The Each Contractor shall clean areas daily where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- M. Each Prime Contractor is responsible to provide dust protection for their construction-related activities.
- N. If daily cleaning and dust protection is not provided the Contractor will be back charged for cleanup performed by employees of the Owner or a separate contractor retained by the Owner.

**1.21 FIELD OFFICES - See Section 01 5213**

**1.22 HOISTS**

- A. Each Contractor shall provide facilities for hoisting materials and employees. Do not permit employees to ride hoists which comply only with requirements for hoisting materials. Selection of type, size and number of facilities is the Contractor's option. Truck cranes and similar devices used for hoisting are considered tools and equipment and not temporary facilities
- B. Elevator Use: Owner's existing elevator may not be used by the Contractor.

**1.23 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION -**

**3.1 CONTRACTOR FIELD OFFICES Refer to Section 5213**

**3.2 STORAGE FACILITIES**

- A. Each Contractor and each subcontractor shall provide temporary storage facilities as required for his own use. Temporary structures shall be located at the fenced staging area, and shall be removed upon completion of the work or when directed.
  - 1. All temporary storage facilities and location shall be subject to the approval of YPS Office of Facilities Management.
- B. Materials delivered to the site shall be safely stored and adequately protected against loss or damage. Particular care shall be taken to protect and cover materials that are liable to be damaged by the elements.
- C. Due to limited on site storage space, each Contractor shall coordinate delivery of his materials with the YPS Office of Facilities Management who will determine when large deliveries shall be made and shall be designate storage locations on site for delivered materials. All stored materials must be stored in locked, watertight trailers, paid for by applicable contractor.

**3.3 SCAFFOLDING AND STAGING**

- A. All scaffold, staging and appurtenances thereto shall comply in total to the requirements of Safety and Health Regulations for Construction Chapter XVII of OSHA, Part 1926 and all related amendments.
- B. Install and maintain pipe scaffolding where masonry, roofing, and window restoration or replacement work is specified until all work and punch list work is complete and approved by the Architect.
  - 1. Scaffolding may be installed and removed in phases as the work progresses, at the Contractor's option and approved by the Architect
  - 2. No work shall occur on any roof area until the scaffold is erected on that entire wing.



### **3.4 ROOF PROTECTION**

- A. Each Contractor(s) shall provide temporary protection on any existing roof surface when it is necessary for work to take place on completed sections.
- B. Upon such notification as required in subparagraph A, the Contractor shall assume responsibility for damages, if any, to the roofing system caused by the work of other trades, except that financial liability for any and all damages rests with the offending trade.

### **3.5 DISCONTINUE, CHANGES AND REMOVAL**

- A. Each Contractor(s) shall:
  - 1. Discontinue all temporary services required by the Contract when so directed by the YPS Office of Facilities Management .
  - 2. The discontinuance of any such temporary service prior to the completion of the work shall not render the Owner liable for any additional cost entailed thereby and the Contractor shall thereafter furnish, at no additional cost to the Owner, any and all temporary service required by such Contractors work.
  - 3. Remove and relocate such temporary facilities as directed by the YPS Office of Facilities Management without additional cost to the Owner, and shall restore the site and the work to a condition satisfactory to the Owner.

### **3.6 VENTILATION AND HUMIDITY CONTROL FOR CONSTRUCTION**

- A. Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- B. Each Prime Contractor shall be responsible for own temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity.
- C. Ventilate enclosed area to dissipate humidity, and to prevent accumulation of dust, fumes, vapors or gases.
- D. Provide equipment as necessary for air and fresh exchange for the work area per OSHA standards.
- E. Remove temporary ventilation equipment prior to the completion of construction.
- F. Each Contractor will provide negative air machines of sufficient size/qty for square footage of work areas to exhaust any dust / fumes through flexible duct hose to exterior to eliminate any odors/smoke etc. During second shift work, there can be no odors in school the following day.
- G. The Contractor(s) who allows water infiltration into the building is responsible for cleanup and commercial dehumidifiers of sufficient size and quantity to prevent mold growth. Failure to immediately address will result in owner hiring others and back charging in order to insure safe school environment

### **3.7 ENVIRONMENTAL PROTECTION:**

- A. The Contractor shall provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near Project site.

### **3.8 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

**END OF SECTION**

**SECTION 01 5213  
FIELD OFFICES AND SHEDS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Temporary field offices for use of YPS Office of Facilities Management and Construction Manager.
- B. Maintenance and removal.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary of Contract: Use of premises.
- B. Section 01 5000 - Temporary Facilities and Controls:
  - 1. Temporary telecommunications services for administrative purposes.
  - 2. Temporary sanitary facilities required by law.
- C. Section 01 5000: Parking and access to field offices.
- D. Section 01 5510 - Traffic and Pedestrian Access & Control.

**1.4 USE OF EXISTING FACILITIES**

- A. Existing facilities shall not be used for field offices.
- B. Due to limited areas location, size and number of field offices for use by the contractors may be limited and subject to the approval of YPS Office of Facilities Management.

**PART 2 PRODUCTS**

**2.1 MATERIALS, EQUIPMENT, FURNISHINGS**

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

**2.2 CONSTRUCTION**

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove at completion of Work or when directed by the YPS Office of Facilities Management.
- C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy requirements.
- D. Exterior Materials: Weather resistant, finished in one color.
- E. Interior Materials in Offices: Sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for Offices: 50 fc (538 lx) at desk top height, exterior lighting at entrance doors.
- G. Fire Extinguishers: Appropriate type fire extinguisher at each office.

**2.3 ENVIRONMENTAL CONTROL**

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

**2.4 CONTRACTOR(S) OFFICE AND FACILITIES**

- A. Contractor's Option.
- B. Each Contractor is responsible for all cost for their field offices.

- C. Size: For Each Contractor's needs .

## 2.5 OWNER AND CM OFFICE

### A. Contract Responsibilities:

1. The HVAC Contractor Contract #2, shall be responsible and pay all costs for YPS Office of Facilities Management and Construction Manager's field office, including delivery and setup. Field Office shall be provided for the duration of the project.
2. The HVAC Contractor - Contract #2 shall remove the field office and restore the site at the completion of the project.
3. The EC Electrical Contractor - Contract #4 shall provide and pay all costs for temporary power to trailer.
4. The Electrical Contractor - Contract #4 shall remove the temporary power components and return systems to their original condition at the completion of the project.

### B. Trailer Manufacture:

1. Cassone Inc, Ronkonkoma, NY. Model #: CA 832.
  - a. Refer to Section 01 2500 - Substitution Procedures.

### C. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

### D. Separate spaces for sole use of Construction Manager with separate entrance door with new lock and two keys.

### E. Area: At least 224 sq ft (21 sq m), with minimum dimension of 8 ft (2.4 m).

### F. Windows: At least five, with minimum total area equivalent to 10 percent of floor area, with an operable sash and insect screen. Locate to provide views of construction area.

### G. Electrical Distribution Panel: 100 amp breaker panel, Two circuits minimum, 110 volt, 60 hz service.

### H. Minimum six 110 volt duplex convenience outlets, one on each wall.

### I. Telephone: As specified in Section 01 5000.

### J. Furnishings:

1. One desk 54 by 30 inch (1372 by 762 mm), with three drawers.
2. One drafting table 36 by 72 inch (914 by 1829 mm), with one equipment drawer and a 48 inch wide parallel straight edge.
3. One computer workstation with 24 by 48 inch (609 by 1219 mm) work surface, CPU shelf, retractable keyboard tray, and space for computer monitor and 11 by 17 inch (279 by 432 mm) printer.
4. One metal, double-door storage cabinet under table.
5. One standard four-drawer legal size metal filing cabinet with locks and two keys per lock.
6. Two swivel arm chairs.
7. One tackboard 36 by 30 inch (914 by 762 mm).
8. One waste basket per desk and table.
9. Conference Table: 8' folding with ten (10) folding chairs.
10. Internet service with 4 port router.
11. Two exterior stairs and platforms.
12. All support, foundations and miscellaneous support and installation items.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Fill and grade sites for temporary structures if required. Grading modifications shall provide drainage away from buildings.

**3.2 INSTALLATION**

- A. Install YPS Office of Facilities Management and Construction Manager office spaces ready for occupancy 15 days prior to date fixed for start of work on site.

**3.3 MAINTENANCE AND CLEANING**

- A. Weekly janitorial services, including supplies for YPS Office of Facilities Management and Construction Manager's offices; periodic cleaning and maintenance for offices.
- B. Maintain approach walks free of mud, water, and snow.

**3.4 REMOVAL**

- A. At completion of Work H Contractor shall remove buildings, foundations, and debris from site and Restore disturbed areas. E Contractor shall remove temporary electrical service components.

**END OF SECTION**



**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations and procedures.
- F. Maintenance materials, extra materials.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary of Contract.
- B. Section 01 2500 - Substitution Procedures: Substitutions made after the Bidding/Negotiation Phase.
- C. Section 01 3000 - Administrative Requirements.
- D. Section 01 4000 - Quality Requirements: Product quality monitoring.
- E. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- F. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

**1.4 REFERENCE STANDARDS**

- A. ISO 21930 - Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services; 2017.
- B. NEMA MG 1 - Motors and Generators; 2017.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.5 DEFINITIONS**

- A. Refer to "Article 7 General Engineering Agreement" for additional requirements
- B. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- C. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
- D. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
- E. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension,

in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- F. Substitutions: Changes in products, materials, equipment, and methods of construction from those required or specified by the Contract Documents and proposed by Contractor.
- G. Basis-of-Design Or Equal Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," or "or equal", including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers **shall be submitted as substitutions**.
  - 1. Refer to Section 01 2500 - Substitution Procedures.
- H. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Yonkers Public Schools.

## 1.6 SUBMITTALS

- A. Refer to Section 01 3000 - Administrative Requirements for additional requirements
- B. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
  - 1. Submit within 10 days after date of Notice of Award.
  - 2. For products specified only by reference standards, list applicable reference standards.
- C. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

## 1.7 ASBESTOS

- A. Asbestos: All products, materials, etc., used in conjunction with this Project shall be Asbestos-Free.
  - 1. Contractor shall provide a certified letter to the YPS Office of Facilities Management stating that no asbestos containing material has been used in this project. Refer to Section 01 7800 - Closeout Submittals.
- B. Contractor(s) and sub contractors must provide test results upon completion from a New York State accredited testing lab certifying that all material including joint and pipe insulation on this project is non-asbestos.
  - 1. This certification shall be based on a sampling of 10% of all linear feet of pipe insulation, (unless manufacturer's certificate is submitted).

## PART 2 PRODUCTS

### 2.1 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Yonkers Public Schools, or otherwise indicated as to remain the property of the Yonkers Public Schools, become the property of the Contractor(s); remove from site.



## 2.2 NEW PRODUCTS

- A. Provide new products for all unless otherwise specifically required or permitted by the Contract Documents.
- B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
  - 1. Made outside the United States, its territories, Canada, or Mexico.
  - 2. Made using or containing CFC's or HCFC's.
  - 3. Made of wood from newly cut old growth timber.
  - 4. Containing lead, cadmium, or asbestos.

## 2.3 PRODUCT OPTIONS

- A. Refer to Section 00 2113 - Instructions to Bidders for Product/Assembly/System Substitutions.
- B. Refer to Section 01 2500 - Substitution Procedures.
- C. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 3000 - Administrative Requirements. All products, **other than "Basis of Design"**, shall be submitted as a substitution. Show compliance with requirements. Submit on form attached.

## 2.4 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
  - 1. Deliver to YPS Office of Facilities Management; obtain receipt prior to final payment.

## PART 3 EXECUTION

### 3.1 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.
- B. Substitutions will not be considered during the bidding phase.

### 3.2 SUBSTITUTION SUBMITTAL PROCEDURE AFTER BIDDING PHASE

- A. Refer to Section 01 2500 - Substitution Procedures.

### 3.3 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

### **3.4 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
  - 1. Execute a formal supplemental agreement between Yonkers Public Schools and Contractor allowing off-site storage, for each occurrence.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**

**SECTION 01 6116**  
**VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.
- C. VOC restrictions for product categories listed below under "DEFINITIONS."
- D. All products of each category that are installed in the project must comply; Yonkers Public Schools's project goals do not allow for partial compliance.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.
- B. Section 01 4000 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 6000 - Product Requirements: Fundamental product requirements and product options, delivery, storage, and handling.
- D. Section 07 9200 - Joint Sealants: Emissions-compliant sealants.
- E. Section 09 5100 - Acoustical Ceilings.
- F. Section 09 9123 - Interior Painting.
- G. Section 09 9113 - Exterior Painting.
- H. Section 09 6500 - Resilient Flooring.

**1.4 DEFINITIONS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Products making up wall and ceiling assemblies.
  - 5. Thermal and acoustical insulation.
  - 6. Free-standing furniture.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Exterior and interior paints and coatings applied on site.
  - 2. Exterior and interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.
- C. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
  - 1. Interior of Building: Anywhere inside the exterior weather barrier.
  - 2. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

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3. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- D. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  1. Concrete.
  2. Clay brick.
  3. Metals that are plated, anodized, or powder-coated.
  4. Glass.
  5. Ceramics.
  6. Solid wood flooring that is unfinished and untreated.

### 1.5 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).
- C. BIFMA e3 - Furniture Sustainability Standard; Business and Institutional Furniture Manufacturers Association; 2014.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- E. CHPS (HPPD) - High Performance Products Database; Current Edition at [www.chps.net/](http://www.chps.net/).
- F. GreenSeal GS-36 - Adhesives for Commercial Use; 2013.
- G. SCAQMD 1113 - Architectural Coatings; 1977 (Amended 2016).
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- I. SCS (CPD) - SCS Certified Products; Current Edition.
- J. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

### 1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

### 1.7 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  1. Wet-Applied Products: State amount applied in mass per surface area.
  2. Paints and Coatings: Test tinted products, not just tinting bases.
  3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current listing in CHPS (HPPD) as a low-emitting product.
    - c. Current CRI (GLP) certification.
    - d. Test report showing compliance and stating exposure scenario used.
  4. Product data submittal showing VOC content is NOT acceptable evidence.
  5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  1. Evidence of Compliance: Acceptable types of evidence are:

- a. Report of laboratory testing performed in accordance with requirements.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Aerosol Adhesives: GreenSeal GS-36.
  - 3. Joint Sealants: SCAQMD 1168 Rule.
  - 4. Paints and Coatings: Each color; most stringent of the following:
    - a. 40 CFR 59, Subpart D.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
  - 5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.
- C. All VOC-Restricted Products: Provide products having VOC content of types and volume not greater than those specified in State of California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GREENGUARD Children & Schools certification; [www.greenguard.org](http://www.greenguard.org).
    - b. Current SCS Indoor Advantage Gold certification; [www.scs-certified.com](http://www.scs-certified.com).
    - c. Product listing in the CHPS Low-Emitting Materials Product List at [www.chps.net/manual/lem\\_table.htm](http://www.chps.net/manual/lem_table.htm).
    - d. Current certification by any other agencies acceptable to CHPS.
    - e. Report of laboratory testing performed in accordance with CHPS requirements for getting a product listed in the Low-Emitting Materials Product List; report must include laboratory's statement that the product meets the specified criteria.
  - 2. Product data submittals showing VOC content are NOT acceptable forms of evidence.
- D. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
- E. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GreenSeal Certification.
- F. Paints and Coatings: Provide products having VOC content as specified in Section 09 9113 - Exterior Painting and 09 9123 - Interior Painting.

## **PART 3 EXECUTION**

### **3.1 FIELD QUALITY CONTROL**

- A. Yonkers Public Schools reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Yonkers Public Schools.

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- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION**

**SECTION 01 7000  
EXECUTION**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Inspections prior to start of work.
- B. Examination, preparation, and general installation procedures.
- C. Requirements for alterations work, including selective removals .
- D. Pre-installation meetings.
- E. Surveying for laying out the work.
- F. Site scoping.
- G. Construction layout.
- H. General installation of products.
- I. Progress cleaning.
- J. Protection of installed construction.
- K. Correction of the Work.
- L. Dust control
- M. Cleaning and protection.
- N. Starting of systems and equipment.

**1.3 RELATED REQUIREMENTS**

- A. YPS General Engineering Agreement for additional requirements.
- B. Section 01 1000 - Summary of Contract: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials
- C. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- D. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- E. Section 01 5000 - Temporary Facilities and Controls.
- F. Section 01 3553 - Site Safety and Security Procedures .
- G. Section 01 5713 - Temporary Erosion and Sediment Control.
- H. Section 01 7310 - Cutting and Patching.
- I. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- J. Section 01 7800 - Closeout Submittals: Project substantial completion, record documents, operation and maintenance data, warranties .
- K. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- L. Section 01 9113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.

- M. Section 07 8400 - Firestopping.
- N. Section 07 9200 - Joint Sealants.
- O. Individual Product Specification Sections:
  - 1. Advance notification to other sections of openings required in work of those sections.

#### **1.4 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

#### **1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. Submit documentation verifying accuracy of existing survey.
  - 2. Submit surveys and survey logs for the project record.
- C. Certified Surveys: Submit two copies signed by land surveyor or professional engineer for each the following surveys:
  - 1. Final Survey: Before substantial completion, the Surveyor shall prepare a final property survey showing significant features (real property) that have resulted from construction of the project, including underground utilities, tanks and similar work install under all contracts.
    - a. Each prime contractor shall provide related information to the surveyor for the work installed under their contract. Include on the survey a certification, signed by the Surveyor, to the effect that the principal lines and levels of the project are accurately positioned as shown on the drawings.
    - b. Show, where applicable, boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
    - c. Final Survey: Submit one (1) CAD drawing showing the Work performed and record survey data.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Cutting and Patching: Refer to Section 01 7310 - Cutting and Patching for requirements.

#### **1.6 QUALIFICATIONS**

- A. Refer to individual sections for additional requirements.
- B. Each Contractor shall do all cutting, patching, repairing as necessary for their work In all cases, the cutting, patching, repairing and finishing shall be performed mechanics skilled in the particular trade required at no additional cost to the Owner.
- C. For survey work, the Construction Contractor shall employ a land surveyor registered in New York and acceptable to YPS Office of Facilities Management . Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- D. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in State of New York.

#### **1.7 PROJECT CONDITIONS**

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.



- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Each Contractor shall execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
  - 1. The General Construction Contractor shall provide dust-proof barriers between construction areas and non construction areas inside or outside the construction areas .
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Refer to Section 01 5713 - Temporary Erosion and Sediment Control for additional requirements.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations when thr building is occupied..
  - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day when building is occupied; excessively noisy includes jackhammers and pneumatic hammers.
  - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
  - 3. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.

#### **1.8 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Contract Manual and Specification to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of work of separate sections.
- F. After Yonkers Public Schools occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Yonkers Public Schools's activities.
- G. General: The General Construction Contractor includes general coordination of the entire work of the project, including preparation of general coordination drawings, diagrams and schedules and control of site utilization from the beginning of construction activity through project closeout and warranty periods.
- H. Alterations: Where applicable, requirements of the contract documents apply to alteration work in the same manner as to new construction. Refer to drawings for specific requirements of alteration work. Primarily, alterations can be described as normal architectural, mechanical and electrical alterations. Contractors shall review phasing and scheduling of the work to understand that certain areas of work must be completed and occupied prior to start of other work. This is essential to the Owner in their ability to maintain the educational programs during construction.

#### **1.9 CODES, PERMITS, FEES**

- A. Refer to Section 01 4100 - Regulatory Requirements.

### **1.10 MANDATORY OSHA CONSTRUCTION SAFETY AND HEALTH TRAINING**

- A. Pursuant to NYS Labor Law §220-h - On all public work projects all laborers, workers and mechanics working on the site are required to be certified as having successfully completed an OSHA construction safety and health course of at least 10 hours prior to performing any work on the project.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.
- D. Barriers shall be constructed of sturdy lumber having a minimum size of 2 x 4.
  - 1. Signs shall be made of sturdy plywood of 1/2" minimum thickness and shall be made to legible at a distance of 50 feet.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Prior to start of construction take photographs, video's or similar documentation as evidence of existing project conditions as follows:
  - 1. Interior views: Each room and areas of outside work area which could be construed as damaged caused by the contractor.
  - 2. Exterior views: Each area of work and areas of outside work area which could be construed as damage caused by the contractor.
- B. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- C. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- D. Examine and verify specific conditions described in individual specification sections.
- E. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

### **3.2 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.3 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site **prior to commencing work of the section.**
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify YPS Office of Facilities Management and Fuller and D'Angelo, P.C. four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:

1. Review conditions of examination, preparation and installation procedures.
  2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to YPS Office of Facilities Management and Fuller and D'Angelo, P.C., participants, and those affected by decisions made.

### **3.4 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify YPS Office of Facilities Management of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to YPS Office of Facilities Management the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to YPS Office of Facilities Management
- F. Utilize recognized engineering survey practices.
- G. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.5 REMOVAL AND DUST CONTROL**

- A. The following procedures shall be followed when removals will create dust:
  1. Exterior
    - a. Work must be in compliance with OSHA Construction Standard (29 CFR 1926.62).
    - b. Windows directly below, above and adjacent to the work area shall be closed.
    - c. Provide tarps on the outside of the building to catch all dust, debris and paint chips when items are being removed and/or installed.
    - d. Roof top exhaust fans and HVAC equipment to shut down and intakes covered.
  2. Interior:
    - a. Floor surfaces shall be provided with a minimum of one layer of six mil plastic from work area to exits.
    - b. All air vents in the room shall be closed, shut off and sealed.
    - c. Access to all rooms undergoing removals shall be restricted to prevent unauthorized entry.
    - d. All moveable objects will be moved away from the vicinity of the removals by the Contractor. The Contractor shall cover with a drop cloth.
    - e. All corridors used by Contractors shall be mopped and left clean daily prior to occupancy.
  3. General Construction Contractor shall provide labor for daily cleanup on the interior and the exterior of the building as required or directed by the YPS Office of Facilities Management. Any visible debris shall be removed prior to occupancy the following day.
  4. All debris shall be disposed of properly in accordance with Federal, State and Local Regulations. Refer to Section 01 5000 - Temporary Facilities and Controls and asbestos and lead abatement sections for containers required.
  5. Do not leave any openings unprotected at end of work day or during periods of excessive cold weather or precipitation.

6. At completion of each work area HEPA vacuumed and wet wipe.

### **3.6 CHEMICAL FUMES AND OTHER CONTAMINATES**

- A. Each Contractor shall be responsible for the control of chemical fumes, gases and other contaminants produced by welding, gasoline or diesel engines, roofing, paving, painting, etc., to ensure they do not enter occupied portions of the building or air intakes.
- B. Each Contractor shall be responsible to ensure that activities and materials which result in “off-gassing” of volatile organic compounds such as glues, paints, furniture, carpeting, wall covering, drapery, etc., are scheduled, cured or ventilated in accordance with manufacturer’s recommendations before a space can be occupied.

### **3.7 GENERAL INSTALLATION REQUIREMENTS**

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Saw cut all concrete slabs and asphalt paving.
- E. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- F. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- G. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.8 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to YPS Office of Facilities Management before disturbing existing installation.
  3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are occupied or unoccupied.
  1. Provide, erect, and maintain temporary dustproof partitions of construction as indicated in Section 01 7000 .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
  1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
  2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
  1. Remove items indicated on drawings.
  2. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  3. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Identify new equipment installed, but not in service, with appropriate signage or other forms of identification, indicating "Not in Service".
    - b. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - c. Provide temporary connections as required to maintain existing systems in service.
    - d. Perform all switchovers, shutdowns, etc after hours, weekends, holidays or times when the building is not occupied. All switchover scheduling shall be approved by the Owner.
  4. Verify that abandoned services serve only abandoned facilities.
  5. Remove conduits; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  2. Where a change of plane of 1/4 inch (6 mm) or more occurs in existing work, submit recommendation for providing a smooth transition for Fuller and D'Angelo, P.C. review and request instructions.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
- J. Remove debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before removals are complete.
- L. Comply with all other applicable requirements of this section.

### **3.9 CUTTING AND PATCHING Refer to Section 01 7310 - Cutting and Patching**

#### **3.10 SPECIAL REQUIREMENTS**

- A. All existing systems are required and shall remain operational during the performance of the work.
- B. Notwithstanding anything contained in the Contract Documents to the contrary, the contractor shall not be permitted to disrupt operation of any building system or any of the services without YPS Office of Facilities Management's prior written consent, which shall not be unreasonably withheld. Any request to perform such work shall be in writing, received by YPS Office of Facilities Management and Fuller and D'Angelo, P.C. no less than 5 working days prior to the commencement of the request for disruption, and shall detail:
  1. The exact nature and duration of such interruption;
  2. The area of the Building affected, and;
  3. Any impact upon the Construction Schedule caused by such proposed temporary disruption. All Work shall be performed during the hours and on the days set forth in the Specifications.

**3.11 FIRE PREVENTION AND CONTROL Refer to Section 01 3553**

**3.12 UNDERGROUND UTILITIES**

- A. Call 1-800-962-7962 (Call Before You Dig) and register before beginning any excavation at least two (2) working days prior to the start of construction.
- B. Locate and identify existing underground and overhead services and utilities within the Contract Limits. Provide adequate means of protection of utilities and services designated to remain. Repair utilities damaged during site work operations.
  - 1. Arrange for disconnection, disconnect and seal or cap all utilities and services designated to be removed before start of site work operations. Perform all work in accordance with the requirements of the applicable utility company or agency involved.
  - 2. When uncharted or incorrectly charted underground piping or other utilities and services are encountered during site work operations, notify the YPS Office of Facilities Management immediately to obtain procedural directions. Cooperate with the applicable utility companies in maintaining active services in operation.
- C. Broken utilities from work are the responsibility of the Contractor. Use extreme caution when uncovering utilities. If a utility is broken while uncovering because the utility was not in the exact location identified, the cost of repair is the responsibility of the Contractor.

**3.13 WATCHMAN**

- A. The YPS Office of Facilities Management will not provide watchman. The Contractor will be held responsible for loss or injury to persons or property or work where his work is involved and shall provide such watchman and take such precautionary measures as he may deem necessary to protect his own interests.

**3.14 SECURITY SYSTEM Refer to 01 3553 - Security Procedures**

- A. The existing building contains a security alarm system maintained and operated by the Owner. Access into the existing building shall not be permitted unless the owner is notified and arrangements made to deactivate the system.

**3.15 VERIFICATION OF CONDITIONS**

- A. All openings, measurements, door frames, existing conditions and other similar items or conditions shall be field measured prior to submission of any shop drawings or manufacturers literature for approval.
  - 1. Each Contractor shall investigate each space into and through which equipment must be moved. Equipment shall be shipped from manufacturer in sections, of size suitable for moving through restricted spaces. Where sectional fabrication and or delivery cannot be achieved, openings, enlargements etc shall be provided by each contractor whose equipment requires access, at no additional cost to the Owner.

**3.16 PROGRESS CLEANING**

- A. Each Prime Contractor is responsible for their own daily debris removal into containers provided by the General Construction Contractor. Working areas are to be broom swept on a daily basis by the General Construction Contractor.
- B. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- C. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space pipe chases, plenums, attics, crawl spaces, and and other closed or remote spaces,.
- D. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- E. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.17 PROTECTION OF INSTALLED WORK**

- A. Each Contractor shall be responsible for the protection of all his work and shall make good all damage to the Owners property, adjoining property, and/or to any work or material in place in the premises, or included in his contract, which is caused by his work or workmen. which may occur to his work prior to the date of the final acceptance.
  - 1. From the commencement to the completion of the Project, each Contractor shall keep the parts of the work and the buildings free from accumulation of water no matter what the source or cause.
- B. Each Contractor shall be held responsible for and be required to make good at his own expense any and all damage done to the Owners property, adjoining property, and/or to any work or material in place in the premises, or included in his contract, which is caused by his work or workmen.
  - 1. From the commencement to the completion of the Project, Each Contractor shall keep the parts of the work and the buildings free from accumulation of water no matter what the source or cause of
- C. Mechanical and electrical equipment delivered and stored at the site, properly packed and crated. Each piece of equipment shall remain packed and crated at location until final installation. Uninstalled and installed equipment and materials shall be protected against damage by weather, water, paint, plaster, moisture, fumes, dust or physical damage.
- D. Protect installed work from damage by construction operations.
- E. Provide special protection where specified in individual specification sections.
- F. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- G. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- H. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- I. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- J. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.18 SYSTEM STARTUP**

- A. Coordinate with requirements of Section 01 9113 - General Commissioning Requirements.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of Contractor's personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.19 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.

### **3.20 ADJUSTING**

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

- B. Refer to Individual Sections for Testing, adjusting, and balancing of systems: .

**3.21 FINAL CLEANING**

- A. Final cleaning shall be the responsibility of the General Construction Contractor and all costs for final cleaning shall be included in the Base Bid. Final cleaning responsibility shall be limited to all areas where renovations occur.
- B. Execute final cleaning prior to final project assessment.
- C. Use cleaning materials that are nonhazardous.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean debris from area drains.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.
- H. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- I. Remove snow and ice to provide safe access to building.
- J. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- K. Touch up and otherwise repair and restore marred, exposed finishes and surfaces evidence of repair or restoration. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show
- L. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
- M. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- N. Leave Project clean and ready for occupancy.
- O. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

**3.22 CLOSEOUT PROCEDURES Refer to Section 01 7800**

**3.23 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.

**END OF SECTION**



**SECTION 01 7310  
CUTTING AND PATCHING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. This Section includes procedural requirements for cutting and patching.
  - 1. Refer to other Sections for specific requirements and limitations applicable to cutting and patching.
  - 2. Requirements of this Section apply to all contracts. Refer to various sections and divisions of these specifications for other requirements and limitations applicable to cutting and patching.
  - 3. Contractor acknowledges that the work involves renovation and alteration of existing improvements and, therefore, cutting and patching of the work is essential for the Project to be successfully completed. Contractor shall perform any cutting, altering, patching and fitting of the work necessary for the work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any work which requires cutting, fixing, or patching, Contractor shall use its best efforts to protect and preserve the visual appearance and aesthetics of the project to the reasonable satisfaction of both the Owner and the Architect.
  - 4. Each Contractor shall do all cutting, patching, repairing as necessary for their work. In all cases, the cutting, patching, repairing and finishing shall be performed by mechanics skilled in the particular trade required at no additional cost to the Owner.

**1.3 RELATED SECTIONS**

- A. Division 1 Section 01 7132 - Selective Removals Single Prime for removals of selected portions of the building for alterations.
- B. Section 01 7330 - Selective Removals Multiple Contracts.
- C. Section 07 8400 - Firestopping for patching fire-rated construction.
- D. Requirements in this Section apply to all contractor(s) installations. Refer to Divisions 22, 23, and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

**1.4 DEFINITIONS**

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

**1.5 SUBMITTALS**

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Structural integrity of any element of Project.
  - 2. Visual qualities of sight exposed elements.
  - 3. Work of Yonkers Public Schools or separate Contractor.
  - 4. Effect on work of Yonkers Public Schools or separate Contractor.
  - 5. Written permission of affected separate Contractor.

6. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
7. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
8. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
9. Obtain approval of cutting and patching proposal before cutting and patching from YPS Office of Facilities Management. Approval does not waive right to later require removal and replacement of unsatisfactory work.

## 1.6 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  1. Primary operational systems and equipment.
    - a. Fire-protection systems.
    - b. Control systems.
    - c. Communication systems.
    - d. Conveying systems.
    - e. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  1. Water, moisture, or vapor barriers.
    - a. Membranes and flashings.
    - b. Exterior curtain-wall construction.
    - c. Equipment supports.
    - d. Piping, ductwork, vessels, and equipment.
    - e. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in YPS Office of Facilities Management's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
- B. Prior to cutting and patching verify with YPS Office of Facilities Management all existing warranties in effect.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

### **3.3 PERFORMANCE**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
- B. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition. A sufficient time in advance of the construction of new walls, floors, or roofing etc. Each Contractor shall be responsible for properly locating and providing in place all sleeves, inserts and forms required for work.
- C. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete/Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Section 31 2316 - Excavation where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
- D. All cutting of holes in existing walls, existing floors, existing roofs, existing ceilings, etc. for the removal of any existing work (including, but not limited to ducts, fans, fixtures, motors, equipment, drains, wiring,

conduit, etc.) or for the installation of any new work shall be done in a neat manner by each Contractor. Debris caused by such cutting or removals will be removed by each Contractor.

- E. Where sleeves, inserts or openings are required in existing walls, floors, roofs, vaults and pavements of existing buildings or structures, all necessary cutting, furnishing and installing of sleeves, inserts, lintels, etc., shall be done by each Contractor.
- F. Adequate blocking, fastening, etc., required to support equipment, casework, etc., from existing walls shall be included as required to complete work.
- G. All surfaces where existing items are removed from existing walls, floors, ceilings, roofs, vaults, etc. shall be patched to match existing surfaces.
  - 1. All patching shall be provided with prime and finish paint or other material to match existing. In areas indicated to be completely painted/finished by the Contractor for Construction, other prime contractors shall be required only to patch existing surfaces to match as required to accept new finishes.
  - 2. Proceed with patching after construction operations requiring cutting are complete.
- H. Removals of selected portions of the building for alterations is included in Section "Selective Removals".
- I. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
  - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  - 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
  - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

### 3.4 CLEANING

- A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

**END OF SECTION**

**SECTION 01 7600**  
**PROCEDURES AND SPECIAL CONDITIONS FOR SEPARATE PRIME CONTRACTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 DESCRIPTION OF WORK**

- A. The types of minimum requirements for procedures and performance or control work of a general nature, to be fulfilled collectively by prime contractors, and must be participated in by each prime contractor (where applicable) even though certain lots of work may be assigned to a specific prime contractor.

**1.3 USE OF PREMISES**

- A. Refer to Section 01 1000 Summary of Contract(s).

**1.4 MISCELLANEOUS PROVISIONS:**

- A. Except as otherwise indicated comply with applicable requirements of Division-22, 23, and 26 sections for mechanical provisions within units of general (Divisions 2-14) work. Except as otherwise indicated, comply with applicable requirements of Division-26 section for electrical provisions within units of general (Divisions 2-14) work.
- B. Service Connections: Refer to Division-22, Division-23 and Division-26 sections for the characteristics of the mechanical and electrical services to be connected to units of general work. Provide units manufactured or fabricated for proper connection to and utilization of available services, as indicated. Except as otherwise indicated, final connection of mechanical services to general work is defined as being mechanical work, and final connection of electrical services to general work is defined as electrical work.

**1.5 DISSIMILAR METAL**

- A. Wherever dissimilar metals would otherwise come in contact with each other, they must be isolated by use of an approved, permanent non-staining material. Where one of the metals is aluminum, a coat of zinc-chromate primer followed by a coat of alkali-resistant bituminous paint shall be applied.

**1.6 MODIFICATION OF WORK**

- A. Where necessary, because of job or space conditions, the Contractor shall modify his work to suit these conditions, within accepted standards and limitations. No allowance will be made for this modification. Comply with Section 01 2100.
  - 1. If work is executed without regard for other trades as cited above, the Architect may direct its removal and modification. No allowance will be made for this work.

**1.7 ACCESSIBILITY, SIZE AND LOCATION OF EQUIPMENT AND WORK**

- A. Each Contractor shall investigate each space into and through which equipment must be moved. Equipment shall be shipped from manufacturer in sections, of size(s) suitable for moving through restricted spaces.
- B. Each Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and sizes of duct enclosures, for the proper installation of his work. They shall cooperate with the all other contractors whose work is in the same spaces and shall advise the Construction Contractor of their requirements. Such spaces and clearances shall, however, be kept to the minimum size required.
- C. Each Contractor shall locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Equipment shall include, but not be limited to: valves, traps, cleanouts, motors, controllers, switch-gear, and drain point etc. Minor deviations from drawings may be made to allow for

better accessibility, but changes of magnitude or which involves extra cost shall not be made without approval.

#### **1.8 ACCESS DOORS**

- A. Provide all access doors for all dampers, valves, cleanest, junction boxes, pull boxes or similar items located above finished ceilings or ceiling breaks or extensions, behind finished walls or below finished floors. The access doors shall be steel, hinged types as required for type of construction.
  - 1. Where feasible locate all dampers, valves, cleanest, junction boxes, pull boxes or similar items above acoustical tile ceiling.

#### **1.9 MACHINERY GUARDS**

- A. Moving parts of machinery exposed to contact by personnel shall be guarded by a barrier of a type approved by the Architect.
  - 1. Exposed moving parts such as belts and couplings shall have 3/4" No 16 gauge galvanized expanded metal mesh guards, with all edges rounded. Guards shall be 1-1/2" x 1-1/2" x 1/8" angle iron framed properly supported.
  - 2. All machinery guards covering the ends of motor or equipment shafts shall have openings for the insertion of a tachometer.

#### **1.10 DRIP PANS**

- A. The respective mechanical contractor shall provide 20 oz. copper all soldered reinforced pans with 2" high lips under all heating, domestic water piping, soil and waste piping which runs over electric switchboards, mounting boards, motors or electric motor starters. Each drip pan shall have a copper drain piped to discharge where shown on the drawings, or if not shown, to discharge to the nearest available open drain or floor where directed by the YPS Office of Facilities Management. All piping shall be copper 1-1/2" minimum in diameter.

#### **1.11 CONCEALMENT OF UNSIGHTLY INSTALLATIONS**

- A. Piping and conduit work is to be run concealed in all occupied areas, in partitions, construction and pipe spaces. Obtain exact dimensions locations of partitions, use special care to see that no joints, fittings, piping or conduit will be exposed except as shown or specified. In the event of any unsightly exposed piping or conduit work or unsightly partitions resulting, the Contractor shall rebuild, and re-run lines at his own expense. When approved by the YPS Office of Facilities Management all exposed conduit shall be installed in wiremold.

#### **1.12 SUPPORTS FROM OVERHEAD CONSTRUCTION**

- A. Where overhead equipment does not permit fastening of supports for equipment, furnish at no additional cost to the Owner, additional framing, supplementary steel, etc., as required, subject to approval by the YPS Office of Facilities Management. Specific types of hangers and supports which are required in certain areas are to be installed as indicated on the drawings.

#### **1.13 ESCUTCHEONS**

- A. Where exposed un-insulated mechanical piping or conduits pass through floors, ceilings or walls of finished rooms, apply, approved hinged escutcheon of sufficient outside diameter to cover the pipe sleeve.
  - 1. Where exposed insulated pipes pass through walls, floors, or ceilings of finished rooms, provide escutcheons fastened to the sleeves.
  - 2. Finish shall be stainless steel in toilets, janitor's closet and similar "wet areas". Submit samples.

#### **1.14 WATERPROOFING**

- A. Where any work pierced waterproofing, including waterproof concrete, the method of installation shall be approved by YPS Office of Facilities Management before work is done. Each Contractor shall furnish all necessary sleeves, caulking and flashing required making openings absolutely watertight. (See Cutting and Patching, Section 00 1731.)

**1.15 SALVAGEABLE MATERIALS:**

- A. The Owner will prepare a list of salvageable items it wishes to retain. All salvageable items shall be delivered by the Contractor to a storage area designated by the Owner on site. All demolished equipment etc., except those items specifically requested by the Owner shall become the Contractor's property and shall be removed from the premises.

**1.16 CONSERVATION:**

- A. General: It is a requirement for each prime contractor's supervision and administration of the work, that construction operations be carried out with the maximum possible consideration given to conservation of energy, water and materials.

**1.17 MATERIALS AND WORKMANSHIP**

- A. All material, apparatus and accessories shall be new and of the best quality of their respective kind.
  - 1. All labor shall be performed in a first-class workmanlike manner, and adequate supervision must be provided to insure against neglect or faulty installations of any part of the systems during the progress of the work.
  - 2. Any inferior material and/or workmanship shall be removed at once, when directed by the YPS Office of Facilities Management and replaced with material and workmanship in accordance with the true intent and meaning of the drawings and specifications, at no additional cost to the Owner.
  - 3. If material or equipment is installed before it is approved, as to manufacture and shop drawings, the Contractor shall be liable for the removal and replacement at no extra charge, if in the opinion of the YPS Office of Facilities Management the material or equipment does not meet the intent of the drawings and specifications.
  - 4. If after installation (with or without prior approval) operation of any equipment proves to be unsatisfactory by reasons of defects, workmanship, error or omissions, the YPS Office of Facilities Management reserves the right to operate equipment until it can be removed from service for correction or replacement by the Contractor. The Contractor shall pay for the repair of all damage to work of other prime contractors caused by this defective equipment and its correction or replacement.
  - 5. No advertising matter exclusive of nameplates containing required data shall appear on any equipment without the written consent of the YPS Office of Facilities Management. The equipment furnished under this specification shall be essentially the standard product of a manufacturer regularly engaged in the manufacture of such equipment. Where two or more units of the same class of equipment are required, the units shall be products of a single manufacturer; however, the component parts of the equipment need not be products of the same manufacturer.

**1.18 SELECTIVE REMOVAL OF EXISTING PLUMBING, HEATING, ELECTRICAL AND RELATED WORK**

- A. All selective removal work shall be in accordance with the time schedule as specified herein.
  - 1. All mechanical and electrical removals shall be performed as required to complete the work as intended.
  - 2. Remove all plumbing, heating and electrical apparatus, equipment, specialties, drains, controls, hangers, bases supports, piping, pneumatic tubing, conduit, panels, switches, wiring, plumbing accessories and electrical fixtures, etc., that are not incorporated in the new layout or required.
  - 3. Where removal is indicated, or implied, or not incorporated in the new layout, the item itself is to be removed completely together with all connecting conduits, specialties, supports, controls, etc. Connecting conduits are to be removed back to the mains and panels where they are to be capped or disconnected. All abandoned open ends shall be sealed and capped or disconnected. This includes all heating, electric, water, gas, etc. Patching and finishing of all surfaces to match existing shall be performed by the Contractor doing the removal. (See Cutting and Patching, Section 00 1731.)

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4. Where existing conduit, etc., enter inaccessible trenches, tunnels, shafts, walls, and ceilings, inside of the existing building, they shall be cut back at least 2" into such inaccessible spaces and shall be suitably capped and sealed by the Contractor.
5. Each Contractor shall exercise all normal caution to prevent unnecessary cutting and damage to the existing building. Any excessive damage, as determined by the YPS Office of Facilities Management shall be repaired and paid for by the Contractor causing the damage.

**1.19 GENERAL LABELING**

- A. All mechanical and electrical equipment such as unit ventilators, heating and ventilating units, exhaust fans, etc., shall have appropriate descriptive labels, identification tags and nameplates, furnished and installed under the respective control under which the corresponding item is provided, and shall be properly placed and permanently secured to (or adjacent to) the item being installed.
  1. Submit complete schedules, listings, and descriptive data, together with samples for checking and approval before purchasing.
  2. Refer to respective M/E specifications for additional requirements.

**1.20 IDENTIFICATION OF PIPING**

- A. The respective Mechanical Contractor shall provide on all new exposed, insulated and uninsulated piping, semi-rigid, wrap-around plastic identification markers.
  1. Each marker background is to be appropriately color-coded with a clearly printed legend to identify the contents of the pipe conformance with the Scheme for the Identification of Piping Systems (ASA A13.1-1956). Direction of flow arrows is to be included on each marker.
  2. Exposed locations for the pipe markers to be as follows:
    - a. Adjacent to each valve.
      - a) At each branch and riser take-off.
      - b) At each pipe passage through wall, floor and ceiling construction.
      - c) On all horizontal pipe runs - marked every 15 feet.
      - d) At each inlet and outlet of coils, pumps, etc.
  3. Refer to respective M/E specifications for additional requirements.

**1.21 PAINTING**

- A. All apparatus, cabinets, etc., furnished under the Mechanical and Electrical Sections of the specifications, shall be provided with a priming coat, and enamel finish. All patched surfaces and surfaces where removals have occurred (by each Contractor) shall receive a prime coat and a finish coat to match adjacent surfaces acceptable to the YPS Office of Facilities Management unless noted otherwise.
  1. All finish painting of new insulated and uninsulated piping, new duct work, apparatus, and appurtenances, will be performed by each contractor, unless noted otherwise.
  2. All concealed supports and ironwork not otherwise protected against corrosion shall be given two (2) coats of bituminous base paint.

**1.22 MOTORS**

- A. Each contractor shall furnish and install the electric motors required for the motor-driven equipment supplied under his contract. The motors shall be of sufficient size for the duty to be performed, and shall not exceed their full rated load when the driven equipment is operating at required capacity under the most severe conditions likely to be encountered. The speed and horsepower for each motor are given in the schedule on the drawings, or are specified.
  1. All motors shall be suitable for operating on alternating current, sixty (60) cycle frequency. Motors 1/2 horsepower and smaller shall be wound for single-phase, 60 cycle, 120 volt current. Motors exceeding 1/2 horsepower shall be designed for operation on three phase, 60 cycle, 208 volt current.
    - a. Fractional horsepower motors shall be of the sealed prelubricated ball bearing type.
      - a) All motors shall be approved by the Underwriters Laboratories, Inc., for the service and location intended.



- b) All motors shall be equipped with ball bearings unless specified otherwise in other sections of these specifications.
- c) Motors for single-phase operation shall be of the capacitor type.

### **1.23 WIRING**

- A. The wiring of prewired equipment or apparatus is specified under the corresponding sections of the Specifications. The Electrical volt systems design as indicated on the Electrical Drawings and Specifications.
- B. The Electrical Contractor will perform all Power wiring; however, each Contractor shall furnish all magnetic starters and automatic controls, suitable for the equipment furnished by the Contractor. Motor starters shall be installed by the Electrical Contractor.
- C. Each Contractor shall prepare wiring diagrams and submit same for approval Submit in electronic PDF format. Approved copies with any additional instructions are to be given to the Electrical Contractor.
  - 1. All prewired and job wired control panels for motors shall be provided with approved high interrupting capacity circuit breakers.
  - 2. All electrical wiring for equipment where exposed to the weather (factory or field installed) shall be installed in weathertight conduits and shall be U.L. approved.

### **1.24 CONTROL WIRING**

- A. Control wiring is required wiring, conduit, relays, contractors, electro-mechanical, hydraulic activators and solid state regulating devices either low or line voltage, to the controlled device that is regulated by the controller and necessary for the operation, controlling, sequencing etc. of the equipment or system. Control wiring shall be furnished and installed by each contractor furnishing and installing such equipment or systems.
  - 1. Power wiring to equipment, including wiring and installation of magnetic starters and disconnect switches, where required, shall be the responsibility of the Electrical Contractor. The Electrical Contractor shall furnish and install all disconnect switches, where required, and install all magnetic starters. All magnetic starters shall be furnished by each contractor furnishing the equipment or systems.
  - 2. Each Contractor shall supervise the wiring of all equipment included under his Contract.

### **1.25 MOTOR STARTERS**

- A. Except where specified to be motor or pedestal mounted as part of a prewired control panel furnished with the equipment they serve, all magnetic starters shall be provided by each Contractor. Magnetic starters, with thermal and under voltage protection, suitable for the voltages indicated, shall have a heater in each phase and reset button on the cover.
  - 1. Motors 1/2 HP and larger shall have Allen Bradley, Emerson Phase Guard or approved substitute phase failure relays suitable for the voltages indicated, included in the starter enclosure. Refer to specific section of specifications for special starters.
- B. Motors over 1 HP shall be provided with variable frequency drive. (VFD), unless shown otherwise
- C. Where the installation of phase failure non-reversing relays are required, these shall, wherever possible, be wired and installed at the equipment manufacturer's factory panel mounted equipment in connection with refrigeration equipment and temperature controls. Starters shall be Allen Bradley, Square D or approved equal.

### **1.26 UNDERWRITERS' LABORATORIES CERTIFICATION**

- A. All mechanical and electrical equipment shall bear the UL label of approval where such inspection service is furnished for the particular type of equipment.

### **1.27 LOCATIONS AND MEASUREMENTS**

- A. The locations of fixtures, appliances, conduits, etc., are specified and shown on the plans as accurately as possible, but in all cases, they are to be adjusted to the surrounding conditions. Contractor must take all measurements at the building, and should the space allotted for any appliance be inadequate, it shall be the

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Contractor's responsibility to immediately notify in writing, and shall he fail to do so, he must bear the expense necessary to correct the conditions. All work shall be coordinated with the work of other trades.

**1.28 GROUNDING**

- A. Standards set forth by the latest edition of the National Electric Code, relative to the grounding of system and equipment, shall be followed together with the rules and regulations of the Utility Company. All non-current carrying metal parts shall be solidly grounded. All motor frames that are not clamped to supply conduits shall be grounded by suitable wire and ground clamp.
  - 1. The identified neutral wire or white wire of the interior wiring system shall be permanently grounded to the water services. The grounded wire shall be connected to the supply side of the main service switch and mechanically connected to an approved ground clamp and securely bonded to the water service at the point of entry. The ground connection shall be made on the supply side of the first main control valve. The conductors shall be protected from mechanical injury by rigid steel conduit to which the conductors shall be securely bonded in each length of connection. Conduit system shall be securely grounded to the above described ground of wiring system.
  - 2. Ground connections to water mains shall be made to non-current carrying metal parts of distribution panels, instrument cases, and instrument transformer cases.

**1.29 FIRESTOPPING:**

- A. All openings thru walls, floors, shafts, etc. shall be fire stopped with approved material to maintain rating. See Section 07 8400 - Firestopping.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**SECTION 01 7800  
CLOSEOUT SUBMITTALS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Substantial Completion.
- B. Final Completion.
- C. Project Record Documents.
- D. Operation and Maintenance Data.
- E. Warranties and bonds.

**1.3 RELATED REQUIREMENTS**

- A. Refer to Article 81 YPS General Engineering Agreement for additional requirements.
- B. YPS General Engineering Agreement Article 81 for additional requirements.
- C. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

**1.4 SUBSTANTIAL COMPLETION**

- A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the YPS Office of Facilities Management can occupy or utilize the Work for its intended use.
- B. When the Contractor considers that the Work, or a portion thereof which the YPS Office of Facilities Management agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. a comprehensive list of items to be completed or corrected prior to issuing Certificate of Substantial Completion. The Contractor shall proceed promptly to complete and correct the items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.
- C. Upon completion of the Contractor's list, the Contractor shall notify the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. in writing and the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. will make an inspection to determine whether the Work or designated portion thereof is substantially complete (Punch List). If the YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the YPS Office of Facilities Management can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before the issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the YPS Office of Facilities Management. In such case, the Contractor shall then submit a request for another inspection by the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. to determine Substantial Completion.

1. If re-inspection discloses any item not sufficiently complete, the Contractor shall complete or correct such item upon notification by the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. the Certificate of Substantial Completion will not be issued,
  - a. If necessary re-inspection(s) will be repeated and the Contractor shall pay for all additional inspections.
- D. When the Work or designated portion thereof is substantially complete, the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the YPS Office of Facilities Management and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.
- E. Application for Payment showing 100 percent completion as of the date of Substantial Completion of the Work submit the following:
  1. Manufacturer's Warranties (guarantees).
  2. Contractor's Warrantee (Five Years) and extended warranties.
  3. Manifest for disposal of Hazardous material.
  4. Test/adjust/balance records.
  5. Maintenance Manuals and Instructions Manuals
  6. Spare parts and Attic Stock.
  7. Start-up performance reports.
  8. Final cleaning.
  9. List of incomplete Work, recognized as exceptions to YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s Substantial Completion of the Work (punch list).
  10. YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s (punch list) certifying all punch list items have been completed with each item signed off by the YPS Office of Facilities Management and Contractor.
  11. Removal of temporary facilities and services.
  12. Removal of surplus materials, rubbish and similar elements.
  13. This application shall reflect Certificates of Partial Substantial Completion issued previously for YPS Office of Facilities Management occupancy of designated portions of the Work.
  14. As Built Drawings.
  15. Project Record Documents.

## 1.5 FINAL PAYMENT

- A. Refer to School Facilities Management Contract Manual and Specifications for additional requirements.
- B. Following issuance of the Substantial Completion of work submit the following:
  1. Update final statement, accounting for final changes to the Contract Sum.
  2. Release of liens from contractor and all entitles of the contractor.
  3. Consent of Surety to Final Payment, AIA Document G707.
  4. Final Liquidated Damages settlement statement.
  5. Contractor's Affidavit of Release of Liens (AIA G706A).
  6. Contractors Affidavit of Payment of Debts and Claims (AIA G706).
  7. Contractor's Certification of Payment of Prevailing Wage Rates.
  8. Contractor's Certified Statement that no asbestos containing material was incorporated into the project.
  9. Asbestos manifest.
  10. Underwriters Certificate.

## 1.6 SUBMITTALS

- A. Contractor shall submit all documentation identified in this section within thirty (30) working days from the time the Contractor submits the list of items to be corrected, in addition to other rights of the Owner set forth elsewhere in the Contract Documents, to include but not limited to withholding of final payment. If the documentation has not been submitted within Thirty (30) day period, the Owner will obtain such through whatever means necessary. The Contractor shall solely be responsible for all expenses incurred by the Owner, provided the Owner has advised the Contractor of this action seven7 days prior to the culmination date by written notice
- B. Project Record Documents: Submit documents to Fuller and D'Angelo, P.C. with claim for final Application for Payment.
- C. Warranties and Bonds:
  - 1. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by YPS Office of Facilities Management.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Field changes of dimension and detail.
  - 2. Details not on original Contract drawings.

### 3.2 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and approved Shop Drawings at the project site.
- B. Each Prime Contractor is responsible for marking up Sections that contain its own Work and for submitting the complete set of record Specifications as specified.
- C. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
- D. Content: Types of items requiring marking include, but are not limited to, the following:
  - 1. Dimensional changes to Drawings.
  - 2. Revisions to details shown on Drawings.
  - 3. Locations and depths of underground utilities.
  - 4. Revisions to routing of piping and conduits.

5. Revisions to electrical circuitry.
  6. Actual equipment locations.
  7. Duct size and routing.
  8. Changes made by Change Order or Construction Change Directive.
  9. Changes made following YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s written orders.
  10. Details not on the original Contract Drawings.
- E. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
- F. Mark important additional information that was either shown schematically or omitted from original Drawings.
- G. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- H. **Provide three copies of final record contract drawings, specifications and approved shop drawings on CD in PDF format.**

### 3.3 RECORD CAD DRAWINGS

- A. Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with YPS Office of Facilities Management and Fuller and D'Angelo, P.C.. When authorized, prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:
1. Format: Same CAD program, version, and operating system as the original Contract Drawings.
  2. Incorporate changes and additional information previously marked on Record Prints. Delete, re draw, and add details and notations where applicable.
  3. Refer instances of uncertainty to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. for resolution.
- B. Fuller and D'Angelo, P.C. and Consultant will furnish Contractor one set of CAD Drawings of the Contract Drawings for use in recording information.
1. Fuller and D'Angelo, P.C. and Consultant makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
  2. CAD Software Program: The Contract Drawings are available in Auto CAD 2007.

### 3.4 FORMAT

- A. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Contractor shall certify and sign.
- B. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Identify Record Drawing as follows:
1. Project name.
    - a. Date.
    - b. Designation "PROJECT RECORD DRAWINGS."
    - c. Name of Owner, YPS Office of Facilities Management, Fuller and D'Angelo, P.C., and Contractor(s)
    - d. Contractor(s) shall certify and sign each drawing.

### 3.5 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### **3.6 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

### **3.7 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  - 1. Description of unit or system, and component parts.
  - 2. Identify function, normal operating characteristics, and limiting conditions.
  - 3. Include performance curves, with engineering data and tests.
  - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - 1. Include HVAC outdoor and exhaust air damper calibration strategy.
    - a. Include provisions which ensure that full closure of dampers can be achieved.
  - 2. Include Carbon Dioxide Monitoring Protocol.
  - 3. Include Carbon Monoxide Monitoring Protocol.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

### 3.8 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for Yonkers Public Schools's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of YPS Office of Facilities Management, Fuller and D'Angelo, P.C., Consultant, Contractor(s), and Sub-contractor(s) , with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Project Directory.
  - 2. Table of Contents, of all volumes, and of this volume.
  - 3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Operation and maintenance data.
    - c. Field quality control data.
    - d. Photocopies of warranties and bonds.
- K. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
  - 1. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

### 3.9 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with YPS Office of Facilities Management's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.



- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor(s) and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

**CHECKLIST FOR PROJECT CLOSEOUT  
AND PROCESSING OF FINAL PAYMENT**

A. **PROJECT:** Phase 1 of 3 for Windows, Masonry, Interior Improvements & Site Work.

**BOARD OF EDUCATION BID NUMBER:** PS 32- YPS # 10876

**CLOSE-OUT SUBMITTALS: (As Applicable)**

- PREVAILING WAGE CERTIFICATION.**
- UL CERTIFICATION**
- THREE (3) 3-RING BINDER BROCHURES OF OPERATION AND MAINTENANCE MANUALS FOR ALL EQUIPMENT INSTALLED ON THE PROJECT INCLUDING THE FOLLOWING:**
  - TYPED OR PRINTED INSTRUCTIONS COVERING THE CARE AND OPERATIONS OF EQUIPMENT AND SYSTEMS FURNISHED AND INSTALLED.**
  - MANUFACTURERS INSTRUCTION BOOKS, DIAGRAMS, SPARE PARTS LISTS COVERING ALL EQUIPMENT.**
  - INSTRUCTION OF OWNER'S REPRESENTATIVE IN CARE AND MAINTENANCE OF NEW EQUIPMENT.**
  - ALL APPROVED SHOP DRAWINGS.**
  - CERTIFICATES OF COMPLIANCE AND INSPECTION. (WHERE APPLICABLE MANUFACTURER'S REPORTS, ELECTRIC, ELEVATOR, ETC.)**
  - SPARE PARTS AND MAINTENANCE MATERIALS. (RECEIPT SIGNED BY FIELD SUPERINTENDENT)**
  - EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES (CERTIFICATES OF INSPECTION ELECTRICAL).**
  - CERTIFICATES OF INSURANCE FOR PRODUCTS AND COMPLETED OPERATIONS.**
  - NOTARIZED STATEMENT THAT ONLY NON-ASBESTOS MATERIALS WERE INSTALLED ON THIS PROJECT.**
  - FULLY EXECUTED CERTIFICATE OF SUBSTANTIAL COMPLETION: AIA G704.**
  - CONTRACTOR'S WRITTEN FIVE-YEAR WARRANTY, MANUFACTURER'S WARRANTY, AND EXTENDED WARRANTIES (IF ANY REQUIRED).**
  - PROJECT RECORD DOCUMENTS: SECTION 7800.**
  - AS-BUILT DRAWINGS.**

**EVIDENCE OF PAYMENT AND RELEASE OF LIEN**

- CONTRACTOR'S AFFIDAVIT OF PAYMENT OF DEBTS AND CLAIMS: AIA G706.**
- CONTRACTOR'S AFFIDAVIT OF RELEASE OF LIENS - AIA G706A PRIME CONTRACTORS AND SUBCONTRACTORS.**
- CONSENT OF SURETY TO FINAL PAYMENT AIA G707.**

**REFER TO SCHOOL FACILITIES MANAGEMENT CONTRACT MANUAL AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS. FINAL PAYMENT WILL NOT BE PROCESSED UNTIL ALL ITEMS INDICATED ARE RECEIVED.**

**END OF SECTION**



**SECTION 01 7900  
DEMONSTRATION AND TRAINING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of YPS Office of Facilities Management personnel in operation and maintenance is required for:
  - 1. All software-operated systems.
  - 2. HVAC systems and equipment.
  - 3. Electrical systems and equipment.
- C. Training of YPS Office of Facilities Management personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Finishes, including flooring, wall finishes, ceiling finishes.
  - 2. Fixtures and fittings.
  - 3. Items specified in individual product Sections.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Section 01 9113 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Plan.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.
- B. Draft Training Plans: YPS Office of Facilities Management will designate personnel to be trained; tailor training to needs and skill-level of attendees.
  - 1. Submit to Commissioning Authority for review and inclusion in overall training plan.
  - 2. Submit not less than four weeks prior to start of training.
  - 3. Revise and resubmit until acceptable.
  - 4. Provide an overall schedule showing all training sessions.
  - 5. Include at least the following for each training session:
    - a. Identification, date, time, and duration.
    - b. Description of products and/or systems to be covered.
    - c. Name of firm and person conducting training; include qualifications.
    - d. Intended audience, such as job description.
    - e. Objectives of training and suggested methods of ensuring adequate training.

- f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
  - g. Media to be used, such as slides, hand-outs, etc.
  - h. Training equipment required, such as projector, projection screen, etc., to be provided by YPS Office of Facilities Management.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
- 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
- 1. Identification of each training session, date, time, and duration.
  - 2. Sign-in sheet showing names and job titles of attendees.
  - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
  - 4. Include Commissioning Authority's formal acceptance of training session.

## 1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
- 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by YPS Office of Facilities Management.
- B. Demonstrations conducted during Functional Testing need not be repeated unless YPS Office of Facilities Management personnel training is specified.
- C. Demonstration may be combined with YPS Office of Facilities Management personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
- 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
- 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

### 3.2 TRAINING - GENERAL

- A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.
- B. Conduct training on-site unless otherwise indicated.

- C. YPS Office of Facilities Management will provide classroom and seating at no cost to Contractor.
- D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- E. Provide training in minimum of two (2) - two hour segments.
- F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.
- G. Training schedule will be subject to availability of YPS Office of Facilities Management's personnel to be trained; re-schedule training sessions as required by YPS Office of Facilities Management; once schedule has been approved by YPS Office of Facilities Management failure to conduct sessions according to schedule will be cause for YPS Office of Facilities Management to charge Contractor for personnel "show-up" time.
- H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
  - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
  - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
  - 3. Typical uses of the O&M manuals.
- I. Product- and System-Specific Training:
  - 1. Review the applicable O&M manuals.
  - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
  - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  - 6. Discuss common troubleshooting problems and solutions.
  - 7. Discuss any peculiarities of equipment installation or operation.
  - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  - 10. Review spare parts and tools required to be furnished by Contractor.
  - 11. Review spare parts suppliers and sources and procurement procedures.
- J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION**





**ASBESTOS REMOVAL AND DISPOSAL**

**PART 1 - GENERAL**

**1.01 Work Included**

- A. The Contractor shall furnish all labor, materials, services, insurance, patents, and equipment necessary to perform the Work of this Contract. All work will be conducted in compliance with EPA, OSHA, and NYS regulations, any other applicable federal, state, and local regulations and in accordance with these specifications. In the event, there is a conflicting point between these provisions, the most stringent one shall apply.
- B. The work will involve the removal of all Asbestos Containing Materials and all Asbestos Waste from within the Work Zones in accordance with all applicable rules and regulations and this specification. Location of asbestos indicated is provided for guidance only. The Contractor shall be responsible for establishing quantities and locations. The project will take place at Family School 32, 1 Montclair Place Yonkers, New York 10704.

**Family School 32 –Various Locations**

- Exterior Window Caulking & Glazing – Exterior Windows: 16,000 LF
- Fire stopper – interior: 200 SF
- Vent Caulking – Lower Floor – Exterior: 100 LF
- TAR Paper on Beam – 150 SF
- 12 x 12 & 9 x 9 Floor tile & Mastic – 10,800 SF

Removal shall be performed in accordance with New York State Industrial Code Rule 56 and the Contract Documents.

The project shall be conducted as follows:

**A. BASE BID – Family School 32– Various Locations**

Removal and disposal of approximately 16,000 LF of window Caulking & Glazing, 150 SF of TAR Paper on beam, 200 SF of Fire stopper, 100 LF of Vent Caulking, 10,800 SF of 12 x 12 floor tile & Mastic & 9 x 9 Floor tile & Mastic from various locations. Asbestos removal shall be conducted using full containment, exterior foam method & interior foam Method procedures in accordance with New York State Industrial Code Rule 56 and the contract documents. The contractor shall remove all asbestos and properly clean work area of all debris.

Note: 8000 LF of caulking and 8000 LF of glazing both contain asbestos and both needs to be abated. Window caulking is around the window frame and window glazing is around the glass.

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NOTE:

- 1) The abatement areas shown on the drawings are provided for guidance only and no claims are made as to their accuracy. **The Contractor is alone responsible for determining the actual abatement quantities. If quantities differ the Contractor is responsible for bringing the discrepancy to the Construction Manager/Engineer's attention before any removal work proceeds.**
- 2) **In the event that clearance samples do not pass, the Asbestos Abatement Contractor will be responsible for all costs associated with resampling until acceptable clearance levels have been obtained.**
- 3) Removal of the asbestos containing materials from this building will be conducted in accordance with NYS Industrial Code Rule 56 and the contract documents. The contractor may use project specific variances from NYS ICR 56 to perform the asbestos abatement work. To utilize a project specific variance, the contractor shall submit a copy of the proposed variance that outlines the removal procedures to the engineer for review and approval before the commencement of any work.
- 4) Removal of the asbestos containing materials from this building will be conducted in accordance with NYS Industrial Code Rule 56, applicable variances, a site-specific variance (if required) and the contract documents.
- 5) During the project, other trades will be working in the building, the Asbestos Contractor shall coordinate all of his work with the other trades as required.
- 6) The Contractor is responsible for using " standard of care " when applying or removing tape, spray adhesive or any other type of bonding material from the walls, floors or ceilings. If damage is sustained to an area during the work procedure directly related to the negligence of the contractor, then that Contractor is responsible for returning the area to its original condition unless otherwise noted.
- 7) Critical barriers and the doorways shown on the drawing shall be covered with three layers of at least six-mil polyethylene sheeting sealed with tape.
- 8) The Contractor shall be responsible for all utility cable protection within the Work Zone Limits.
- 9) The Contractor is required to abide by the most current Prevailing Wage Rates at the time of the abatement project.
- 10) The Contractor shall furnish all labor, materials, services, insurance, patents, and equipment necessary to carry out the removal operation. All work will be conducted in compliance with EPA, OSHA, and NYS regulations, and any other applicable federal, state, and local regulations and in accordance with these specifications. In the event, there is a conflicting point between these provisions, the most stringent one shall apply.

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**1.02 Definitions**

- A. ABATEMENT: Procedures to control fiber release from Asbestos-Containing Materials. This includes encapsulation, enclosure, and removal.
- B. AIRLOCK: A system for permitting egress without permitting air movement between a contaminated area and an uncontaminated area, typically consisting of two Curtained Doorways at least 3 feet apart.
- C. AIR MONITORING: The process of measuring the fiber content of a specific volume of air in a stated period of time.
- D. AREA MONITORING: Sampling of asbestos fiber concentrations within the asbestos control area and outside the asbestos control area, which is representative of the airborne concentrations of asbestos fibers in the breathing zone.
- E. AMENDED WATER: Water containing a wetting agent or surfactant.
- F. ASBESTOS: Any hydrated mineral silicate separable into commercially usable fibers, including but not limited to chrysotile (serpentine), amosite (cumington-grunerite), crocidolite (riebeckite), tremolite, anthophyllite, and actinolite.
- G. ASBESTOS CONTAINING MATERIAL (ACM): Any Asbestos or any material containing more than one percent of Asbestos by weight or volume.
- H. ASBESTOS CONTAMINATED OBJECTS: Any object which has been contaminated by Asbestos or Asbestos Containing Material. This shall include all unprotected porous materials in an Asbestos Work Area.
- I. ASBESTOS CONTROL AREA: An area where Asbestos Abatement operations are performed, which is isolated by physical boundaries to prevent the spread of asbestos dust, fibers, or debris.
- J. ASBESTOS WASTE: Any Asbestos Containing Material or Asbestos Contaminated Objects requiring disposal.
- K. AUTHORIZED VISITOR: The Owner, the Engineer, or a representative of any regulatory or other agency having jurisdiction over the project.
- L. CLEAN ROOM: An uncontaminated area or room which is part of the Worker Decontamination Enclosure System, with provisions for storage of workers' street clothes and protective equipment.
- M. COMPETENT PERSON: One who is capable of identifying existing asbestos hazards in the Work place and who has the authority to take prompt corrective measures to eliminate them as specified in 29 CFR 1926.32(f); Reference 29 CFR 1926.58(b) for duties and responsibilities.
- N. CRITICAL BARRIER: Any windows, HVAC diffusers (exhaust or return), pipe sleeves, penetrations, doorways or any other openings leading to an occupied area of the building or to the outside.

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- O. CURTAINED DOORWAY: A device to allow egress from one room to another while permitting minimal air movement between the rooms, typically constructed of three overlapping sheets of plastic over an existing or temporary door frame. Attach a weight to each sheet and seal at alternating edges so as to produce a zig-zag pattern of entrance or exit.
- P. ENCAPSULANT: A liquid material which can be applied to Asbestos-Containing Material and which controls the possible release of Asbestos fibers from the Asbestos Containing Material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together (penetrating encapsulant). This may also be used to seal surfaces from which asbestos containing materials have been removed.
- Q. ENCAPSULATION: All herein specified procedures necessary to coat materials with an encapsulant to control the possible release of Asbestos fibers into the ambient air.
- R. ENCLOSURE: All herein specified procedures necessary to complete enclosure of Asbestos Containing Materials behind an airtight and impermeable barrier.
- S. EQUIPMENT ROOM: A contaminated area or room which is part of the Worker Decontamination Enclosure System, with provisions for the storage of contaminated clothing and equipment.
- T. FIXED OBJECT: A unit of equipment or furniture in the Work Zone which cannot be removed from the Work Zone.
- U. FRIABLE ASBESTOS MATERIAL: An Asbestos Containing Material that can be crumbled, pulverized, or reduced to powder when dry, by hand pressure or will crumble, be pulverized or produce powder when subjected to specific mechanical operation.
- V. HEPA FILTER: A high efficiency particulate air (HEPA) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 micrometers in diameter.
- W. HEPA VACUUM EQUIPMENT: High efficiency particulate air (absolute) filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall be of 99.97% efficiency for retaining fibers of 0.3 micrometers or larger.
- X. HOLDING AREA: A chamber between the Washroom and an uncontaminated area in the Waste Decontamination Enclosure System. The Holding Area comprises an airlock.
- Y. MOVABLE OBJECT: A unit of equipment or furniture in the Work Zone which can be removed from the Work Zone.
- Z. NEGATIVE PRESSURE SYSTEM: A local exhaust system equipped with HEPA filtration that is capable of maintaining a minimum pressure differential of minus 0.05 inch of water column relative to adjacent unsealed areas.
- AA. NON-FRIABLE ASBESTOS MATERIAL: An Asbestos Containing Material in which the fibers have been locked in by a bonding agent, coating, binder, or other material so that the Asbestos is well bound and that when dry cannot be crumbled, pulverized or reduced to powder by hand pressure and will not be subject to mechanical operations.

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- BB. PERSONNEL DECONTAMINATION ENCLOSURE SYSTEM: A Decontamination Enclosure System for Workers, typically consisting of an Airlock, an Equipment Room, a second Airlock, a Shower room, a third Airlock, and a Clean Room.
- CC. PERSONAL MONITORING: Sampling of airborne asbestos fiber concentrations within the breathing zone of an employee.
- DD. REMOVAL: All herein specified procedures necessary to strip all Asbestos Containing Materials from the designated areas.
- EE. SHOWER ROOM: A room between the Clean Room and the Equipment Room in the Worker Decontamination Enclosure System, with hot and cold running water and suitably arranged for complete showering during decontamination. The Shower Room comprises an airlock between the Equipment Room and the Clean Room.
- FF. SURFACTANT: A chemical wetting agent added to water to improve penetration of water into the Asbestos Containing Materials.
- GG. TIME WEIGHTED AVERAGE (TWA): An 8-hour time weighted average of airborne fiber concentration per cubic centimeter of air. Three samples are required to establish the 8-hour time weighted average.
- II. WASHROOM: A room between the Work Zone and the Holding Area in the Waste Decontamination Enclosure System. The Washroom comprises an airlock.
- JJ. WASTE DECONTAMINATION ENCLOSURE SYSTEM: A Decontamination Enclosure System for materials and equipment, typically consisting of an Airlock, a Washroom, a second Airlock, and a Holding Room.
- KK. WET CLEANING: The process of eliminating Asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as Asbestos Waste.
- LL. WORK SITE: Premises where Asbestos Abatement is taking place. The Work Site includes, but is not limited to the Work Zone, the Personnel and Waste Decontamination Systems, the staging area, the disposal route and the loading dock.
- MM. WORK ZONE: Any area indicated on the Drawings as Asbestos Abatement areas or as areas with Asbestos Containing Material.

**1.03 Submittals**

- A. Submit the following items to the Engineer for review twenty (20) days prior to the commencement of Work associated with this section:
1. EPA Notification: The form required by the Environmental Protection Agency in accordance with the National Emission Standard for Asbestos, 40 CFR Part 61.

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2. New York State Department of Labor Notification: The form required by the State of New York Asbestos Control Program in accordance with Article 30 of the New York State Labor Law.
3. Any proposed project specific variance to any of the applicable regulations.

Upon return of submittals from the Engineer with an action stamp indicating that the submissions have been reviewed and comply with the contract documents, file all notifications with the appropriate agencies in accordance with all applicable regulations and these specifications. Pay the appropriate fees. All filing fees and associated costs shall be borne by the Contractor.

B. Submit the following items to the Engineer for review ten (10) days prior to the commencement of Work associated with this section. No Work shall begin until ALL submittals are returned with an action stamp indicating that the submission is in accordance with these specifications.

1. NOTIFICATIONS: Stamped received copies of the notifications (EPA only) and variances listed above in item A, as well as copies of the canceled checks used to pay all associated fees.
2. CONTRACTOR'S CERTIFICATION: Documentation confirming licensing by New York State Commission of Labor for asbestos Work in accordance with Industrial Code Rule 56.
3. WORKER DOCUMENTATION: Current copies of the AHERA certificates, New York State Department of Labor Asbestos Handling Certificates, Medical Exams and Respirator Fit Tests for all employees performing the Work of this Section.
4. EMPLOYEE RELEASE FORM: Prior to allowing an employee to perform any Work on the project, submit the properly executed Employee Release Form for each employee. A copy of this form is included herein.
5. CONTINGENCY PLANS: A copy of emergency, security, and contingency plans as follows:
  - a. A plan to provide for emergency and fire evacuation of personnel from the Work Zone in an emergency. File a copy of this plan with the local fire and/or ambulance unit;
  - b. A plan for maintaining the security of the Work Zone. The security plan shall provide a means of preventing accidental or unauthorized entry. Provide security to the decontamination facility and all points of potential access to the Work Zone 24 hours per day during abatement. Submit the form of security and safety log that will be maintained on the project;
  - c. A contingency plan addressing emergencies, equipment failures, and barrier failure. Include the telephone numbers of at least three (3) responsible persons who shall be in the position to dispatch men and equipment to the project in the event of an emergency.

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6. LANDFILL: Written evidence that the landfill to be used for disposal of asbestos is approved for disposal of asbestos by the New York State Department of Environmental Conservation (NYS Part 360 Permit) and by the US EPA. In the event the landfill is not located in New York State, approval from the agency having jurisdiction over the landfill must be received. Documentation that the proposed hauler and landfill have the proper permits and are willing to accept the asbestos waste.

The hauler must have a Waste Transporter Permit pursuant to Article 27, Titles 3 and 15, of the Environmental Conservation Law from the New York State DEC, Division of Hazardous Substance Regulations (NYS Part 364 Permit).

7. MATERIAL SAFETY DATA SHEETS: For all products intended to be used on the project, a Materials Safety Data Sheet in accordance with the OSHA Hazard Communication Standard 29 CFR 1910.1200. Include a separate attachment indicating the specific worker protection equipment required for each material.
8. PRESSURE MONITORING DEVICES: Manufacturer's data on type of equipment to be used to provide a continuous record of pressure differentials. Provide a drawing showing locations and number of units to be used.
9. AIR FILTRATION DEVICES: Manufacturer's data on type of equipment to be used to remove airborne asbestos.
10. ROOM INSPECTION: Inspect all areas in which Work is to be performed. Inspection shall occur in the presence of representatives of the Owner and Engineer. Record any existing damage to components, such as walls, doors, windows, carpeting, fixtures, and equipment. Any damaged components found after completion of the Work will be repaired at the Contractor expense. Make arrangements for the inspection, notify the participants, record the findings, and issue minutes of the inspection to all participants.
11. SCHEDULES: A copy of construction, staffing, and equipment schedules:
- a. A construction schedule stating critical dates of the job including start and completion of mobilization, activation, deactivation, and demobilization of all Work activities (including mobilization, Work Zone preparation, asbestos abatement, inspection and clearance monitoring, each phase of refinishing, and final inspections). Update schedule with each partial payment request. Changes in schedule are subject to the Engineer's approval and require three (3) days prior notice.
  - b. A schedule of staffing stating number of workers per shift, name and number of supervisor(s) per shift, hours per shift, shifts per day, and total days to be worked;
  - c. A schedule of equipment to be used including numbers and types of all major equipment such as high efficiency particulate absolute (HEPA) air filtration units, HEPA vacuums, and airless sprayers.

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12. INSURANCE POLICIES: A copy of all Insurance policies required by this contract, including the *Asbestos Abatement General Liability Occurrence Insurance*, without a sunset clause, in amounts not less than \$1,000,000, each occurrence, naming the Owner as the Certificate Holder. Also, include insurance policies of any subcontractor, including the Sudden and Accidental Pollution Liability Insurance required of the Hauler. The following list of Additionally Insured must be included under insurance policies held by the Contractor on this project:

- a. Yonkers Public Schools District and its employees
- b. Fuller & D'Angelo P.C. and its employees
- c. Warren & Panzer Engineers and its employees
- d. Barile & Gallagher Associates and its employees

13. AIR SUPPLY SYSTEM: Manufacturer's product information for each component used in the Type "C" supplied air respiratory system, including NIOSH and MSHA Certifications for each component in an assembly and/or the entire assembly. Provide a notarized certification that the system is capable of providing Grade "D" breathable air. Submit a copy of the manufacturer's operations manual for the air purification system and the carbon monoxide monitor.

Prepare a drawing showing the assembly of components into a complete supplied air respiratory system. Document the number and size of electric air pumps and/or air supply tanks to be kept at the site at all times to ascertain that sufficient air is being supplied to the maximum number of users. Prepare a diagram showing the location of the electric air pumps, the air supply tanks and the hose line connections. The use of gas compressors will not be allowed. Submit complete operating and maintenance instructions for all components and systems as a whole. Bind manual in a form suitable for field use.

C. Daily during the conduct of abatement activities, submit to the Engineer the following:

Printouts from pressure differential monitoring equipment marked with date and Work start/stop times for each day. Use printout paper that indicates elapsed time in intervals no greater than one hour. Indicate on each day recording times of starting and stopping abatement Work, type of Work in progress, breaks, and filter changes. Cut printout into segments by day and label with project name, Contractor's name and date;

D. Within thirty (30) days of removal from the premises, submit to the Owner the disposal certificate(s) from the landfill receiving the Asbestos Waste stating dates and quantities received.

E. Within seven (7) days of completion of all Work associated with this Section submit to the Owner, the following:

1. A bound copy of the job log book showing sign in and sign out of all persons entering the Work Zone, including name, date, time, and position or function and a general description of daily activity. Keep these records on file for the duration of employment plus 30 years;
2. A notarized statement attesting that all personnel performing any work under this Contract were compensated in accordance with the prevailing wage rates contained herein.



**1.04 Special Reports**

- A. Except as otherwise indicated, submit special reports directly to the Owner and the Engineer within one (1) day of the occurrence requiring the special report, with copies to all others affected by the occurrence.
- B. When an event of unusual and significant nature occurs at the site (examples: failure of negative pressure system, rupture of temporary enclosures, unauthorized entry into Work Zone), prepare and submit a special report listing date and time of event, chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.
- C. Report any accidents, at the site and anywhere else Work is in progress related to this project. Record and document data and actions. Comply with industry standards.

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**1.05 Quality Assurance**

- A. Where methods or procedures are specified, they shall constitute minimum measures and shall in no way relieve the Contractor of sole responsibility for the means, methods, techniques, sequences, or safety measures in connection with the Work.
- B. Provide foremen who speak fluent English to supervise all abatement activities. Foremen shall be certified as handler supervisors in accordance with Section 902 of the New York State Labor Law Article 30, and have experience in this field and can furnish a record of satisfactory performance on at least three (3) projects for Work of comparable type.
- C. Any proposed Subcontractor performing any Work under this Section "Asbestos Removal and Disposal" shall have similar qualifications. Submit qualifications with the BID for any proposed Subcontractor. Submit Subcontractor qualifications in the same form and quantity as required for the Contractor.

**1.06 Applicable Standards and Regulations**

- A. Perform all Work in compliance with the most current version of all pertinent laws, rules, and regulations, existing at the time of Work, including, but not limited to:
  - 1. Code of Federal Regulations
    - a. Title 29 CFR Parts 1910.1001, 1910.1200, 1910.134 1926.58 and 1926.1101;  
[The Occupational Safety and Health (OSHA) Standards]
    - b. Title 30 CFR Part 61, Subpart G;  
[The Transport and Disposal of Asbestos Waste]
    - c. Title 40 CFR, Part 61, Subparts A and M;  
[The EPA National Emission Standard for Hazardous Air Pollutants, and the National Emission Standard for Asbestos]
    - d. Title 40 CFR, Part 763,  
[Asbestos Containing Materials in Schools; Final Rule and Notice]
    - e. Title 49 CFR Parts 106, 107, and 171-179.  
[The Transportation Safety Act of 1974 and the Hazardous Material Transportation Act]
    - f. Public Law 101-637  
[ASHARA]
  - 2. New York State Official Compilation of Codes, Rules and Regulations.
    - a. Title 12 Part 56

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- b. Title 10 Part 73
  - c. Title 6 Parts 360-364
  - d. Labor Law - Article 30 and Sections 900-912.
  - e. All applicable Additions, Addenda, Variances and Regulatory Interpretation Memoranda.
3. Applicable Standards
- a. The American National Standard Institute (ANSI) Practices for Respiratory Protection ANSI Z88.2-1980.
  - b. The American National Standard Institute (ANSI) Fundamentals Governing the Design and Operation of Local Exhaust Systems.
  - c. UL 586 Test Performance of High Efficiency Particulate Air-Filter Units.
- B. In the event, there is a conflicting point between these provisions, the most stringent one shall apply.

**1.07 Air Monitoring**

- A. Conduct personnel air monitoring in accordance with OSHA requirements. Collect a sufficient number of samples to determine the Time Weighted Average exposure of twenty percent (20%) of the work force.
- B. The Owner will provide area air monitoring as follows:

<u>Sample Type</u>	<u>Analysis Method</u>
Pre-abatement	PCM
During abatement activities	PCM
Clearance air monitoring	PCM & TEM

The Contractor shall cooperate with the Owner's designated representatives with regard to air monitoring and project monitoring procedures. Ensure that employees and Subcontractors do the same.

- C. If analysis of any of the air samples collected during abatement indicates that the airborne asbestos concentration outside the Work Zone is greater than or equal to 0.01 f/cc or the background level, whichever is greater:
  - 1. Stop Work immediately;
  - 2. Inspect the integrity of the barriers;
  - 3. Wet clean and vacuum the location where elevated fiber counts were reported; and

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4. Do not resume Work until such time when the airborne asbestos concentration outside the Work Zone is once again less than the above limit.
  
- D. In order to pass PCM clearance testing, the analysis of each and every sample collected shall indicate that the airborne fiber concentration is less than 0.01 fibers per cubic centimeter or the background level whichever is greater.
  
- E. In order to pass TEM clearance testing, each and every sample collected shall indicate that the airborne structure concentration is less than 0.01 structures per cubic centimeter or the background level whichever is greater and the average structure concentrations inside the Work Zone shall not be statistically larger than the average of ambient levels as determined by the Z-test.
  
- F. The method of sampling shall be aggressive or nonaggressive depending on the requirements of applicable regulations. The method of analysis for pre-abatement and during abatement shall be NIOSH 7400 using Phase Contrast Microscopy (PCM). Post-abatement samples shall be analyzed by Transmission Electron Microscopy (TEM) for AHERA compliance projects, in accordance with Appendix A to Subpart E-Interim TEM Analytical Methods. For non-AHERA projects, the decision of testing with either PCM or TEM for final air clearance monitoring will be made by the Engineer. The testing laboratory will be a member of the Environmental Laboratory Approval Program (ELAP).
  
- G. In case of failure of the initial final air clearance monitoring, the work zone will be retested following immediate relearning. This process will be repeated as necessary until final air clearance is obtained. All costs and expenses resulting from the additional relearning and retesting (including sampling and analysis) due to failure of the initial final air clearance shall be borne by the Contractor. The expenses thereby incurred will be deducted from any monies due or that may become due to the Contractor.
  
- H. The Contractor shall provide security personnel to watch the decontamination facility and all points of potential access to the Work Zone.

- END OF PART 1 -

## **PART 2 - PRODUCTS**

### **2.01 Air Filtration Unit**

- A. Use only Air Filtration Units in compliance with ANSI Z9.2 (1979), Local Exhaust Ventilation. The final filter in each unit shall be of the HEPA type. Use only Air Filtration Units certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3 micron dioctylphthalate (DOP) particles.
- B. Equip the system with the following:
  - 1. An automatic shutdown that will stop the fan in the event of a rupture in the HEPA filter or blocked air discharge;
  - 2. Warning lights and/or alarms to indicate an excessive pressure drop across the filters or an insufficient pressure drop across the filters;
  - 3. A non-resettable elapsed time meter to indicate the total accumulated hours of operation;
  - 4. A gauge or manometer to measure the pressure drop across the filter.

### **2.02 Asbestos Caution Signs**

- A. Use Asbestos Caution Signs as specified in OSHA Title 29 CFR 1910.1001(j) and 1926.58(k). Posting of warning signs in and around the work site should be in cooperation with the Department of Correction and with approval by the Department of Correction.

### **2.03 Asbestos Caution Labels**

- A. Use Asbestos Caution Labels as specified in OSHA Title 29 CFR 1910.1001(j) and 1926.58(k).

### **2.04 Disposal Bags**

- A. Use Disposal Bags which are a minimum six (6) mil in thickness, clear in color and preprinted with the Asbestos Caution Label.

### **2.05 Encapsulating Material**

- A. All Encapsulating Materials shall be approved by UL for use in class 1A buildings and shall have composite fire and smoke hazard ratings as tested under procedure ASTM E- 84, NFPA 255 and UL 723

Flame Spread	25
Smoke Developed	50

- B. If the removal of fireproofing materials is included in this Contract, select an encapsulant from those approved by UL for use with the new fireproofing. If Retro-Guard Type RG or RG-1 manufactured by W.R. Grace & Co. is to be applied, use American Coatings 22P & 22 Power lock, or Fiber lock

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Fiber set FT and Fiber set PM, or Certane 909 and 1000, or H.B. Fuller 32-60 and 32-61, or IPC Serpliflex and Serpiloc.

**2.06 Equipment**

- A. Temporary lighting, heating, hot water heating units, ground fault interrupters, and all other equipment on site shall be UL listed and shall be safe, proper, and sufficient for the purpose intended.
- B. All electrical equipment shall be in compliance with the National Electric Code. Attention is specifically called to Article 305 Temporary Wiring.

**2.07 First Aid Kits**

- A. Maintain adequately stocked first aid kits in the Clean Room and Work Zone, in accordance with OSHA requirements.

**2.08 High Efficiency Particulate Air (HEPA) Filters**

- A. Employ filters which have been individually tested and certified by the manufacturer to have an efficiency of not less than 99.97 percent when challenged with 0.3 micron dioctylphthalate (DOP) particles, in accordance with Military Standard Number 282 and Army Instructional Manual 136-300-175A. Each filter shall bear a US 586 label to indicate ability to perform under the specified conditions.
- B. Each HEPA filter shall be marked with the name of the manufacturer, serial number, air flow rating, efficiency and resistance, and the direction of air flow.

**2.09 Glove bags**

- A. Use only commercially available Glove bags. Use Glove bags constructed of clear fire retardant plastic, which have a minimum thickness of six (6) mil.
- B. Use Glove bags appropriately sized for the pipe. Use Glove bags, the dimensions of which exceed the pipe insulation diameter by a factor of four (4).

**2.10 Plastic**

- A. Use only new fire-retardant plastic sheets of polyethylene, which has a minimum thickness of 6 mil, true grade.
- B. For the initial floor, protective layer use only new reinforced plastic sheets of polyethylene, which has a minimum thickness of ten (10) mil, true grade. As an alternative, apply a ten (10) mil thick layer of "Spray-Poly" by Isotek or as approved.

**2.11 Plywood**

- A. Use only fire-rated CDX plywood, which is at minimum one half inch (1/2") in thickness.

### **2.12 Respirators**

- A. Use only respirators approved by the Mine Safety and Health Administration (MSHA), Department of Labor, or the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

### **2.13 Sealants**

- A. Use a combination fire stop foam and fire stop sealant. Use Dow Corning Fire Stop Foam and Dow Corning Fire Stop Sealant or as approved. Apply in accordance with manufacturer's recommendations.

### **2.14 Studs**

- A. Use only 2" x 4" fire-rated CDX or metal studs.

### **2.15 Supplied Air System**

- A. At all times, air supplied to the type "C" respirators shall be Grade "D" Breathable Air as described by OSHA Regulation 29 CFR 1910.134(d)(1), containing less than the following:

Carbon Monoxide :	20 parts per million
Carbon Dioxide :	1,000 parts per million
Condensed Hydrocarbons:	5 milligrams per cubic centimeter
Objectionable odors:	None

- B. Provide a minimum of one (1) hour of reserve air for emergency evacuation. Post, in the Work Zone, emergency evacuation procedures to be followed in the event of breathing air system failure. Explain procedures to all workers prior to commencement of the Work.
- C. Water content shall be less than 66 parts per million in order to protect the air purification unit. Certify the air quality of the system prior to beginning asbestos abatement Work and every two weeks during asbestos abatement Work by an independent laboratory certified by the American Board of Industrial Hygiene. Collect samples under the supervision of a Certified Industrial Hygienist. Submit copies of certified test results to the Engineer within five (5) days of the sample collection.

### **2.16 Vacuums**

- A. Use only vacuums equipped with HEPA filters.

### **2.17 Wetting Agents**

- A. The wetting agent shall be water amended with one (1) oz. of a chemical surfactant per five (5) gallons of water. The composition of the surfactant shall be approximately 50% polyoxyethylene ether and 50% polyoxyethylene esters.

### **PART 3 - EXECUTION**

#### **3.01 Personnel Protection**

- A. Satisfy all applicable Worker protection requirements.
- B. Provide protective equipment for use by Workers and designated representatives of the Owner including disposable full body coveralls, respirators and approved cartridges, gloves, hard hats, and goggles. Maintain on site, two (2) sets of protective equipment for the exclusive use of representatives of the owner.
- C. At all times, provide all persons with personally issued and marked respiratory equipment suitable for the asbestos exposure level in the Work Zone. Ensure that all persons properly use this equipment at all times.
- D. As a minimum, half face negative pressure type respirators must be worn by all personnel during Work Zone preparation. If airborne concentrations of asbestos inside the Work Zone exceed 0.1 fibers per cubic centimeter, employ either PAPR or type "C" respiratory protection whichever is appropriate.
- E. PAPRs (Powered Air Purifying Respirators) shall constitute the minimum level of respiratory protection for all persons entering that Work Zone from the time the Work Zone is activated until acceptance.
- F. Should airborne concentrations of asbestos inside the Work Zone exceed 2.0 fibers per cubic centimeter, supply all personnel with personally issued and marked Type "C" supplied air respirators operated in the positive pressure demand mode.
- G. If the permissible respirators fail to provide sufficient protection against volatile substances emitted by any sealants or other chemicals used, the services of a certified industrial hygienist will be procured, at the Contractor's expense, to determine proper respiratory protection. The Owner will not be liable for the cost of increased respiratory protection.
- H. Maintain surveillance of heat stress conditions in the Work Zone. The prevailing Threshold Limit Values (TLVs) for heat stress and the method of heat stress measurement adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) shall govern worker exposure to heat stress.

#### **3.02 Decontamination**

- A. Construct and operate the Personnel and Waste Decontamination Enclosure Systems in conformance with all applicable rules and regulations. Locate decontamination units outside of the Work Zone.
- B. Construct the Personnel Decontamination Enclosure System (PDES) as a series of six (6) completely enclosed and connected rooms: An Airlock, an Equipment Room, a second Airlock, a Shower, a third Airlock, and a Clean (locker) Room. Separate rooms with curtained doorways.



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1. Ensure that all egress from the Work Zone is through the PDES.
  2. Ensure that all persons leaving the Work Zone vacuum themselves of asbestos in the Work Zone and disrobe in the Equipment Room, shower (including washing of hair) with respirator on, and redress in the Clean Room.
  3. Ensure that all persons entering the Work Zone wear clean and new protective clothing and equipment prior to entrance.
  4. Equip the Shower with hot and cold water adjustable at the tap, liquid soap, shampoo and disposable towels.
  5. Leave all contaminated clothing and equipment in the Equipment Room in barrels or bags. Sanitize respirators in the showers. Equip with fresh cartridges in the Clean Room.
  6. No more than one curtained doorway shall be opened at the same time.
- C. Remove all asbestos containing waste materials, equipment, or any other materials through the Waste Decontamination Enclosure System (WDES). The WDES shall consist of a series of four (4) completely enclosed and connected rooms: An Airlock, a Washroom, a second Airlock, and a Holding Area. Separate rooms with curtained doorways. Remove materials, waste and equipment as follows:
1. No more than one curtained doorway shall be opened at the same time.
  2. Before removing any equipment or asbestos from the Work Zone,
    - a. Containerize (or bag) all asbestos;
    - b. Wet clean all equipment and packaged asbestos.
  3. Place equipment and asbestos in the first Airlock. Workers in the Work Zone shall not enter the Airlock and the Curtained Doorway between the Airlock and the Washroom shall remain closed during this procedure.
  4. Uncontaminated Workers in clean new protective equipment shall enter the WDES from outside the Work Zone and enter the Washroom.
  5. While in the Washroom:
    - a. Remove Waste and Equipment from the first Airlock;
    - b. Wet clean all equipment and all packaged asbestos containing waste;
    - c. Place bags and other containers into an additional completely clean bag or wrap in plastic. Bags and plastic used for this purpose shall not enter the Work Zone;

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- d. Place equipment and asbestos in the second Airlock. Workers in the Work Zone shall not enter the Airlock and the Curtained Doorway between this Airlock and the Holding Area shall remain closed during this procedure.
6. Uncontaminated Workers in clean new protective equipment shall enter the Holding Area from the outside area and remove containerized materials from the airlock.
7. All workers shall proceed into the Work Zone for exiting by way of the PDES. Ensure that personnel do not leave the Work Zone through the WDES.

### **3.03 Work Zone Preparation**

- A. Electrical Power: Unless otherwise indicated, shut down all electric power within the Work Zone, as follows:
  1. Lock all circuits, which have been shut off, in the off position and label with a printed tag which reads as follows:

"TEMPORARY DISCONNECT  
Due to Asbestos Removal Project  
DO NOT ACTIVATE THESE CIRCUITS"
  2. Provide temporary power and lighting and ensure safe installation of temporary power sources and equipment per applicable electrical code requirements. Provide all equipment which must remain operable, as well as all temporary ground-fault interrupter circuits for lights and electrical equipment. Individually protect all power equipment used inside each Work Zone with in-line ground fault interrupters. Locate ground-fault interrupter outside of the Work Zone.
  3. Provide all electrical tie-ins and extensions. Provide a temporary panel board, connected to an electric panel designated by the Owner.
- B. Heating Ventilation and Air Conditioning (HVAC): Employ all means necessary to prevent contamination and fiber dispersal to other areas of the structure, as follows:
  1. Thoroughly clean all HVAC Equipment and ductwork in the Work Zone. Seal all vents within the Work Zone with tape and plastic. Seal all HVAC duct seams. Wrap all ductwork in two (2) layers of plastic.
  2. Remove all HVAC filters. Pack disposable filters in sealable double plastic bags for disposal at the approved landfill. Replace with new filters after final cleanup. Wet-clean permanent filters; reinstall after final cleanup.
  3. Remove all heating and ventilating equipment grills, diffusers, returns, and other items located on the asbestos bearing surfaces. Wet clean all such items, seal in two (2) layers of plastic and remove from the Work Zone. Reinstall all displaced items after satisfactory clearance air testing.

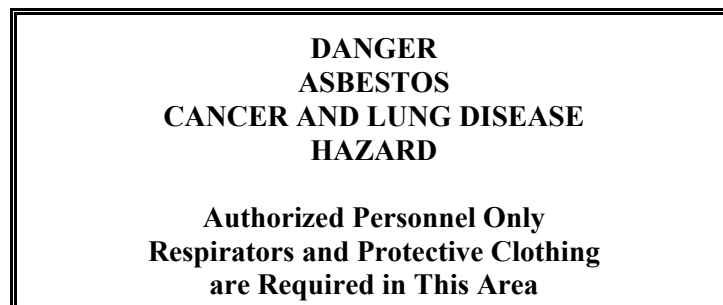
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4. HVAC systems shall be treated as follows:
    - a. Unless otherwise indicated, shutdown and lockout all heating, ventilating and air conditioning systems. Isolate system at points of entry to the Work Zone; use two (2) layers of plastic.
    - b. In cases where the HVAC system serving the Work Zone also serves other areas of the building which must remain in operation,
      - i. Isolate the ductwork entering the Work Zone from the remainder of the system. Cap all ductwork where it passes in or out of the Work Zone with galvanized steel ASTM 5261 in accordance with SMACNA HVAC Duct Construction Standards. Cover with two (2) layers of plastic.
      - ii. Operate the affected HVAC system twenty-four (24) hours per day from the initiation of Work Zone activation until successful final air clearance. Maintain a positive pressure within the operational portion of the HVAC system of 0.05-inch water gauge or greater with respect to the ambient pressure outside of the Work Zone. Install pressure monitoring devices.
    - c. In cases where it is necessary for ductwork passing through the Work Zone to remain active, the following conditions are to be maintained:
      - i. Maintain a positive pressure within the HVAC system of 0.05-inch water gauge (or greater) with respect to the ambient pressure outside of the Work Zone: the conditions for this system shall be maintained and be operational twenty-four (24) hours per day from the initiation of Work Zone preparation until successful final air clearance.
      - ii. Test, inspect and record the positive pressure in the duct both at the beginning and at the end of each shift.
      - iii. Monitor the positive pressurization of the duct using instrumentation that will trigger an audible alarm, if the static pressure falls below the set value.
      - iv. Place the supply air fan and the supply air damper for the active positive-pressurized duct in the manual "on" position to prevent shutdown by fail safe mechanisms.
      - v. Shut down and lock out the return air fan and the return air dampers.
      - vi. Cover all active HVAC ducts that pass through the Work Zone with two (2) layers of plastic.
- C. Steam Systems: Unless otherwise noted on the Drawings, shut down all steam systems passing through the Work Zone prior to activation.

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- D. Utilities: Provide all water, electrical and waste facility connections, as well as all sanitary drains. The Contractor will not be charged for water used, electricity consumed, or discharges made to sanitary sewers as a part of this project.
- E. Temporary Service Lines: Upon completion of abatement activities, remove all temporary service lines and restore to their original conditions, in a manner acceptable to the Engineer. Repair any part of the permanent service lines, equipment and building facilities disturbed or damaged as a result of the installation or removal of the temporary service lines.
- F. Temporary Heating: Provide temporary heating in the Work Zone, as needed to maintain a minimum temperature of 50°F. Heating equipment shall be approved by the Engineer.
- G. Movable Objects: Before Work is initiated, clean all items which can be removed without disrupting any asbestos material. Pre-clean movable objects within the proposed areas using HEPA filtered vacuum equipment an/or wet cleaning methods as appropriate; remove such objects from Work Zones to a temporary location, as directed by the Engineer.
- H. Fixed Objects: Pre-clean non-removable objects within the proposed Work Zones, using HEPA filtered vacuum equipment and wet cleaning methods as appropriate prior to abatement activities, and enclose with two (2) layers of plastic sealed with tape.
- I. Openings: Prior to placing plastic on walls, floors and ceilings, seal off all openings, including, but not limited to corridors, doorways, windows, skylights, ducts, grills, diffusers, and any other penetrations of the Work Zones, with two (2) layers of plastic sealed with tape.
- J. Floor, Wall and Ceiling Penetrations: Prior to any abatement activities fire stop all openings or penetrations that have not already been sealed. This includes both empty holes, expansion joints and holes accommodating items such as cables, pipes, ducts, conduit, etc.
- K. Fire Exits: Maintain emergency and fire exits from the Work Zones, or establish alternative exits satisfactory to the local fire officials. Provide panic exit devices for security and egress. Establish this exit in accordance with all applicable codes and regulations.
- L. Signs: Outside of the perimeter barrier and at all entrances and exits to the Work Zone, post signs in English, Spanish and any other language spoken at the project location.

- 1. The signs shall read:



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2. Demarcate the regulated area. Post signs at such a distance from the area that an employee will read these signs before entering the area.
- M. All of the above procedures shall be completed prior to the disturbance of any asbestos containing material.

**3.04 Engineering Controls**

- A. Maintain the Work Zone at an air pressure that is lower than that in any surrounding space in the building, or at any location in the immediate proximity outside of the building envelope. This pressure differential when measured across any physical or critical barrier must equal or exceed a static pressure of 0.05 inches of water.
- B. From the start of abatement activities:
1. Operate air filtration units continuously during the project, twenty-four (24) hours a day, from the start of abatement through successful clearance air monitoring, in accordance with "Specifications and Operating Procedures for the Use of Negative Pressure Systems for Asbestos Abatement", Guidance for Controlling Asbestos-Containing Materials in Buildings, EPA Report Number 560/5-85-024 (1985).
  2. Install the air filtration units in quantities and locations as required in order to achieve the required negative pressure.
  3. Provide a minimum of one air change every ten (10) minutes for the area under negative pressure. Assume Air Filtration Units will operate at 50% of their rated capacity. Maintain on site, one (1) spare air filtration unit for every five (5) in use.
  4. Locate the exhaust unit(s) so that makeup air enters the Work Zone primarily through the Decontamination Systems and traverses the Work Zone as much as possible. Provide the specified number of air changes throughout the Work Zone. Place the end of the unit or its exhaust duct through an opening in the plastic barrier or wall covering. Seal the plastic around the unit or exhaust duct with tape.
  5. Whenever possible, exhaust air filtration units to the outside of the building away from occupied areas in such a manner so that the air intake ports, louvers, or entrances for the building or adjacent buildings will not be adversely affected. In cases where it is impossible to exhaust outside of the building, provide a second air filtration unit in series. For runs longer than 150 feet install additional air filtration units every 150 feet.
  6. Use ducting, of equivalent or larger dimension as that of the air filtration unit exhaust port, to exhaust to the outside of the structure. Ducts shall exhaust, at minimum fifty (50) feet from all intakes or entrances to the building or adjacent buildings. Seal and brace all ductwork. Maintain airtight joints. Prevent fiber release into uncontaminated building areas.
  7. Place the air filtration system exhaust ducts overhead in an inconspicuous, non-restricting fashion. Connect the ducts to a 14" flange, as shown on the Drawings.

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8. All filters shall be accessible from the Work Zone or contaminated side of the barrier. Prior to initial use, replace all filters in air filtration units in the presence of the Engineer with new and unused filters.
9. Use a dedicated power supply for the air filtration units.
10. In the event of loss of negative pressure or electric power to the negative pressure ventilating units, stop all abatement Work immediately. Do not resume Work until power is restored and negative pressure equipment is operational. Under no circumstances shall any Asbestos abatement take place without having the negative air pressure system fully operational.
11. When loss of negative pressure equipment lasts, or is expected to last longer than one-half hour:
  - a. Seal airtight all auxiliary make-up air inlets;
  - b. Seal all Decontamination Systems airtight after the evacuation of all personnel from the Work Zone;
  - c. All adjacent areas will be monitored by the Engineer at the Contractor's expense for asbestos fiber concentration.
12. Use ventilation smoke tubes to check the system performance.
13. Monitor and record the pressure differential between the Work Zone and the outside of the Work Zone with a monitoring device incorporating a continuous recorder (e.g. strip chart). Equip with an audible alarm which will signal if the pressure differential drops below 0.05 inches of water.

### **3.05 Asbestos Removal**

#### **Modified Containment Procedures (Floor Tile and Mastic)**

Work in this part shall be performed in accordance with ICR 56, Applicable Variances AV-120 and the contract documents.

The sequence of abatement activities shall be as follows:

- A. Modified Containment, completely isolate the Work Zone as shown on the Drawings. Extend the Work Zone to such limits as to permit the removal of all asbestos containing materials within the Work Zone. Isolate the Work Zone as follows:
  1. Construct the Remote Decontamination Units for personnel and waste, as shown on the Drawings. Use studs, sixteen inches on center, covered with plywood and two (2) sheets of plastic.
  2. Construct isolation barriers. Where feasible, use existing walls and partitions. Where necessary, frame temporary partitions with studs sixteen (16) inches center on center. To support plastic for all areas larger than thirty-two (32) square feet, except where one of the

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dimensions is less than one (1) foot, reinforce temporary partitions with plywood. Test the negative pressure system to ensure that the 0.05-inch differential is present.

3. Construct an entrance/exit airlock chamber, a minimum of 5' X 5' in size, at the entrance to each work zone so as to allow each worker to remove their outer suit, wipe off their inner suit and don a clean suit before proceeding to the remote decontamination enclosure system. ACM shall be bagged and brought to the Decontamination Enclosure System. At the Decontamination Enclosure, the bags will be wet wiped and the waste double bagged.
4. Cover the floor of the decontamination unit and airlock with reinforced polyethylene sheeting.
5. Cover interior surfaces of the Work Zone with a layer of plastic sealed with tape. Cover the walls with plastic from the floor level to a height of 4' minimum. Overlap seams in plastic 12'' minimum and seal with tape. In areas where floor carpet is to remain, cover the floor with an additional layer of reinforced polyethylene sheeting. The plastic shall be attached with adhesives, furring strips and screws, tape, staples, etc., sufficient to prevent collapse or sagging of any plastic covering. **Inspect all plastic three times a day for sagging and repair all such sags or failures immediately.**
6. Install a second layer of plastic on all interior Work Zone Surfaces. Repeat procedure detailed above in 3.05. A.5.
7. Where required, electrical, telephone equipment, ductwork, etc. shall be covered with three (3) layers of six (6) mil polyethylene sheeting. Energized circuits will be posted with signs warning 'CAUTION - ELECTRICALLY ENERGIZED', in three-inch-high letters.
8. Secure a source of water within the Work Zone (other than the Shower within the Decontamination Zone) for wetting and cleaning.
9. Test the negative pressure system prior to any abatement actions to ensure that the 0.05-inch differential is present. Wait twelve (12) hours. Test system again. If the test results are acceptable to the Engineer, the Work Zone will be activated. Do not disturb Asbestos containing materials prior to activation.
10. Wet all Asbestos prior to removal using a wetting agent. Maintain asbestos wet until packaged for disposal.
11. Upon removal of the floor tile and mastic, directly bag or drop into a flexible catch basin all asbestos containing waste material.

ALL ACM shall be bagged immediately and brought to the Waste Decontamination Enclosure System. At the Decontamination Enclosure, the bags will be wet wiped and the waste double bagged.

### **3.06 Encapsulation**

- A. Apply Encapsulating material using an airless sprayer. Comply with manufacturer's recommendations. The Encapsulating material shall be mixed with contrasting color paint to assure proper application.

### **3.07 Disposal Practices**

- A. Wet and properly package all Asbestos prior to removal from the Work Zone via the Waste Decontamination Enclosure System. Remove all residual asbestos from the exterior of any package, drum, bag, or other container of Asbestos prior to removal from the Work Zone. Affix the ASBESTOS CAUTION label, the name of the Owner, the name of the Contractor, the name of any Tenant and the location where generated to all packages, drums, bags or other containers used for Asbestos disposal.
- B. Store all Asbestos Waste in a totally secure manner. Transport all Asbestos Waste to the disposal site within seven (7) days after completing the Work of this section or thirty (30) days after removal, whichever comes first.
- C. Transport Asbestos Waste through the building at the direction of the Engineer at times designated by the Owner. Use sealed carts.
- D. During the transport of Asbestos Waste, on or across public thoroughfares, employ a hauler bearing all required permits for the hauling of asbestos. The haulers shall carry insurance in the same types and amounts as the Contractor. In addition, the hauler shall carry "Sudden and Accidental Pollution Liability Insurance in an amount not less than \$1,000,000.
- E. Dispose of Asbestos Waste at approved landfill bearing all appropriate licenses and permits for asbestos disposal and operated in compliance with all applicable rules and regulations. The Landfill used shall be dedicated for asbestos materials only and shall not accept any other hazardous substances.
- F. Within thirty (30) days of removal from the premises, the Contractor shall provide the Owner with disposal certificate(s) from the approved waste disposal site. Final payment will not be approved until all disposal certificates have been provided.

### **3.08 Clean-up Procedures**

- A. Daily, during abatement activities:
  - 1. Clean-up visible accumulations of loose Asbestos Waste whenever a sufficient amount of Asbestos Containing Material to fill a single asbestos waste bag has been removed. Removal all waste materials from the Work Zone at the end of each work shift. Maintain visible material wet until after clean up.
  - 2. Place visible accumulations of Asbestos Waste in containers utilizing non-metallic dust pans and non-metallic squeegees or vacuums.



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3. Do not use metal shovels.
  4. Wet clean and vacuum all surfaces of the Work Zone on a daily basis.
  5. Upon completion of waste removal, wet clean the WDES twice. When the PDES Shower Room alternates as a Washroom, wash the Shower Room immediately with cloths or mops saturated with a detergent solution prior to wet cleaning.
  6. Wet clean and vacuum the WDES as appropriate, as a minimum after each shift change and meal break.
  7. If excess water accumulates in the Work Zone, stop Work until the water is collected and disposed of properly.
  8. If Asbestos Waste is spilled in an elevator shaft:
    - a. Immediately evacuate, shut down and isolate all of the elevators in the affected elevator bank.
    - b. Place all spilled visible accumulations of Asbestos Waste in clean and unused containers.
    - c. Vacuum and wet clean all of the contaminated surfaces in the elevator car and shaft in repetitive cycles until clearance air levels are achieved in the car and at each terminus of the shaft.
- B. Final Clearance, The Work Zone will be considered acceptable when it has passed both visual inspections and air testing performed by the Engineer according to the criteria and sequence below:
1. In order to pass each of the visual inspections, the Work Zone and adjacent areas shall be free of all visually apparent asbestos. Any disputes over the results of any visual inspection shall be resolved by the Contractor submitting the results of bulk sample analysis demonstrating the contents of the material in question. Remove all Asbestos materials and all asbestos contaminated materials; non-asbestos materials may remain. The laboratory performing such analyses shall be a regular participant in the ELAP Quality Assurance Program for bulk sample analyses with performance results satisfactory to the Engineer. The Engineer reserves the right to independently verify the bulk results.
  2. If the Work Zone is not suitable for acceptance for any reason, promptly perform the Work requested by the Engineer.
  3. Keep each Work Zone isolated and posted with ASBESTOS CAUTION and CAUTION KEEP OUT signs until after acceptance.
  4. Typical acceptance sequence shall be as follows:
    - a. After removal of visible accumulations of Asbestos Waste, vacuum all surfaces;
    - b. Remove all bagged materials from the Work Site;

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- c. Wet clean and vacuum all objects and surfaces in the Work Zone;
- d. Visual inspection by the Engineer;
- e. Encapsulate all plastic within the Work Zone limits, do not encapsulate surfaces from which asbestos was removed;
- f. Remove, bag, and remove from the Work Site the first layer of plastic;
- g. Vacate the Work Zone for four (4) hours;
- h. Wet clean and vacuum all objects and surfaces in the Work Zone for a second time;
- i. Visual inspection by the Engineer;
- j. Vacate the Work Zone for four (4) hours;
- k. Remove, bag and remove from the Work Site the second layer of plastic;
- l. Wet clean and vacuum all surfaces in the Work Zone for a third time;
- m. Vacate the Work Zone for four (4) hours;
- n. Visual inspection by Engineer to verify the absence of Asbestos Waste, dust and or debris;
- o. Clearance Air Monitoring;  
Clearance air monitoring shall consist of five air samples taken inside of the work area and five air samples taken outside of the work area.
- p. Upon successful clearance air testing, encapsulate surfaces from which Asbestos was removed;
- q. Wait for encapsulant to dry;
- r. Final Acceptance will be granted provided that items a thru n have been met to the satisfaction of the Engineer;
- s. Shut down air filtration units (demobilization);
- t. Remove the isolation barriers in conjunction with the use of HEPA vacuums;
- u. After all Work and decontamination is complete, relocate and secure objects moved to temporary locations in the course of the Work to their former positions and assure that they are in working order.

- END OF PART 3 -

KEY			
ITEM	ASBESTOS CONTAINING MATERIAL	APPROXIMATE QUANTITY	LEGEND
1	FLOOR TILE & MASTIC	1,800 SF	
2	FIRE STOPPER	100 SF	
3	TAR PAPER ON BEAM	75 SF	
4	EXTERIOR VENT CAULKING	100 LF	

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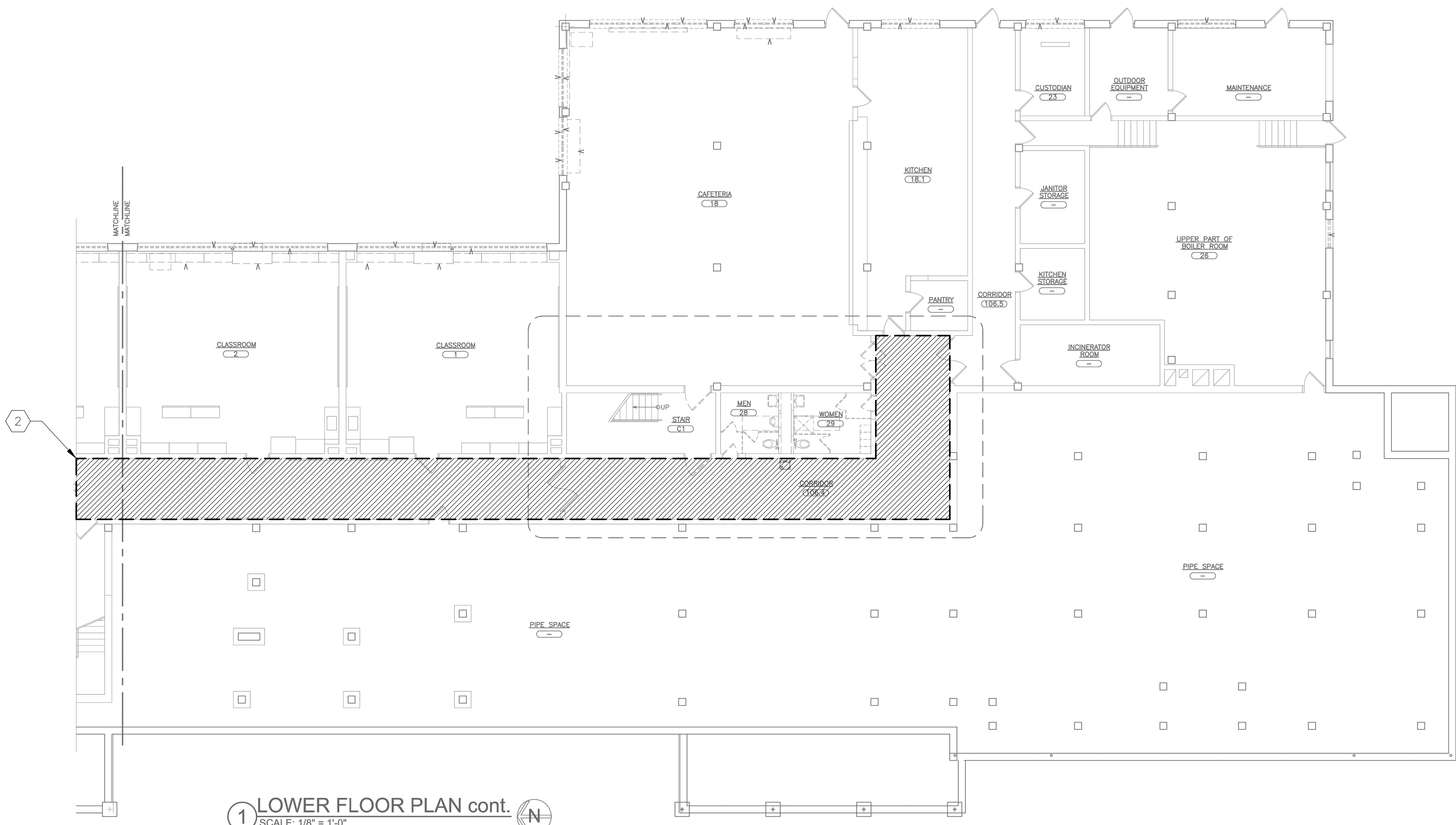
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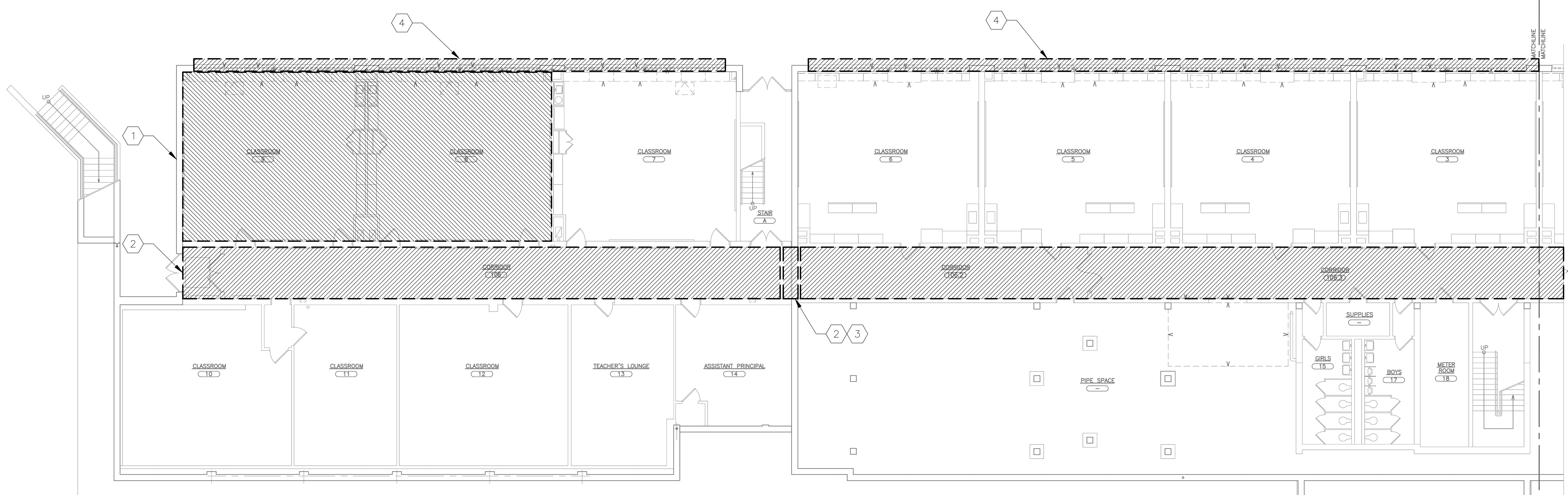
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PROJECT TITLE:  
 YONKERS SCHOOL DISTRICT  
 PS32 - WINDOW REPLACEMENT, MASONRY & SITE IMPROVEMENTS  
 FLOOR PLAN/SPACE, YONKERS NEW YORK 10710  
 DRAWING TITLE:  
 1ST FLOOR  
 ASBESTOS CONTAINING MATERIAL  
 LOCATION DRAWING

DATE	ISSUED TO
SHEET SIZE 30"x42"	DRAWING NO. <b>PS32</b>
SCALE AS NOTED	<b>ASB-100</b>
DRAWN BY WP	FILE NO. <b>258.19.15</b>



1 LOWER FLOOR PLAN cont.  
 SCALE: 1/8" = 1'-0"



1 LOWER FLOOR PLAN  
 SCALE: 1/8" = 1'-0"

KEY			
ITEM	ASBESTOS CONTAINING MATERIAL	APPROXIMATE QUANTITY	LEGEND
1	EXTERIOR WINDOW CAULKING AND GLAZING	16,000 LF	
2	FLOOR TILE & MASTIC	9,000 LF	
3	FIRE STOPPER	100 SF	
4	TAR PAPER ON BEAM	75 SF	

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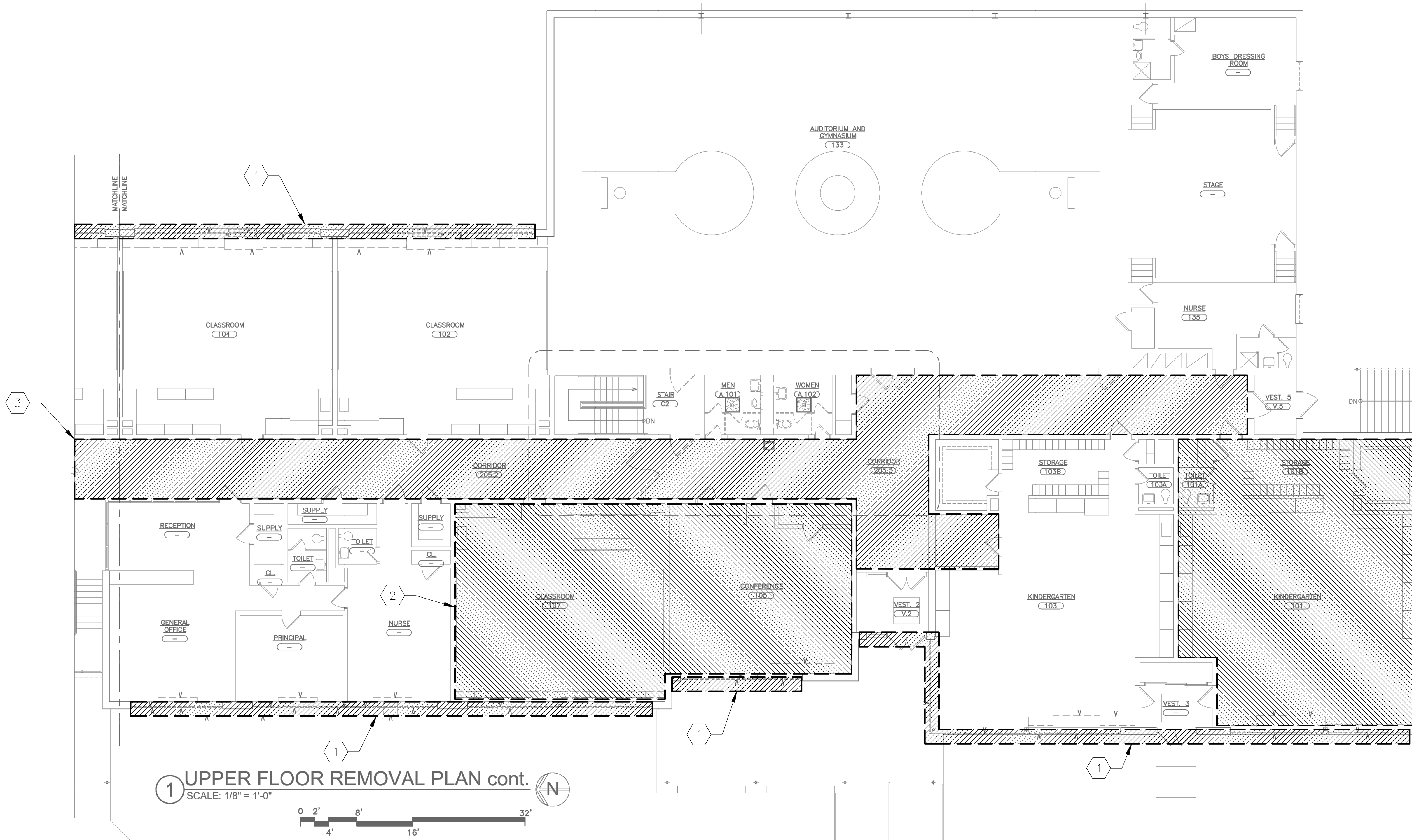
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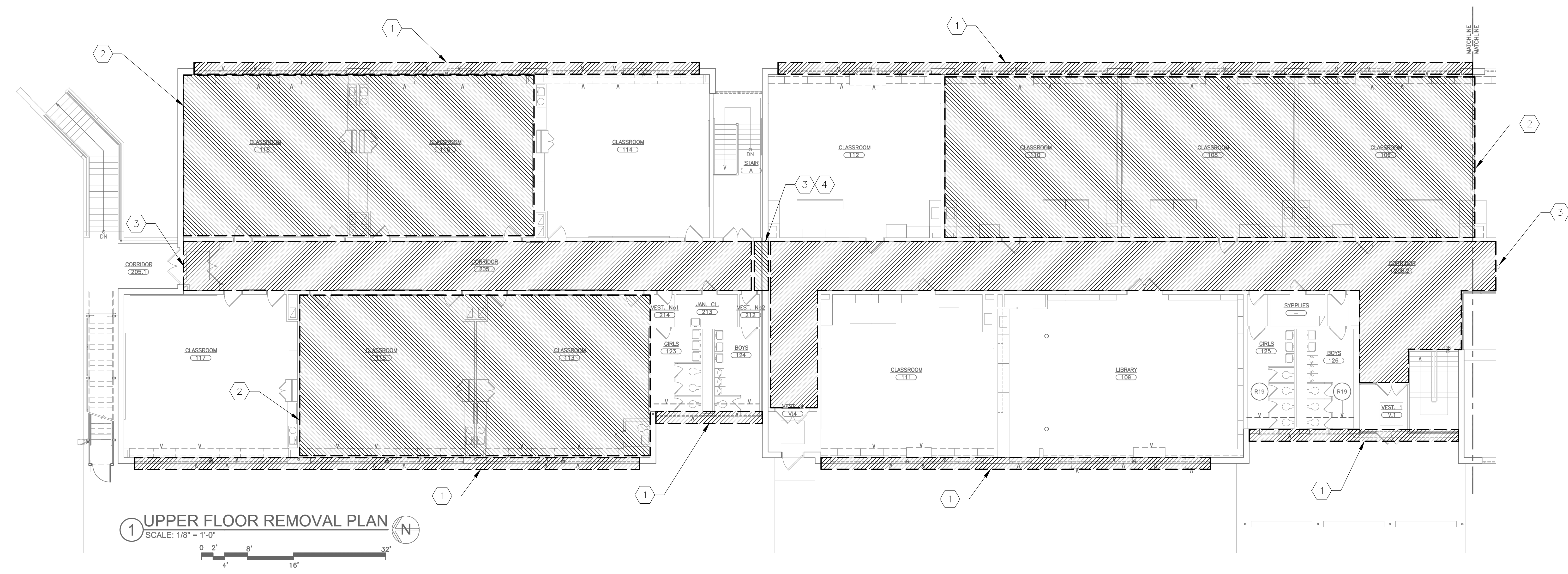
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 YONKERS SCHOOL DISTRICT  
 PS 32 - WINDOW REPLACEMENT, MASONRY &  
 SITE IMPROVEMENTS  
 1500 CLYBURN PLACE, YONKERS NEW YORK 10710

DRAWING TITLE:  
 1ST FLOOR  
 ASBESTOS CONTAINING MATERIAL  
 LOCATION DRAWING

DATE	ISSUED TO
SHEET SIZE 30"x42"	DRAWING NO. PS32
SCALE AS NOTED	FILE NO. ASB-101
DRAWN BY WP	FILE NO. 258.19.15



1 UPPER FLOOR REMOVAL PLAN cont.  
 SCALE: 1/8" = 1'-0"



1 UPPER FLOOR REMOVAL PLAN  
 SCALE: 1/8" = 1'-0"

**SECTION 03 3000**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Slabs on grade.
- B. Miscellaneous concrete elements, including equipment pads.

**1.3 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- B. Section 32 1313 - Concrete Paving: Sidewalk and curbs.
- C. Section 31 2316 - Excavation.

**1.4 REFERENCE STANDARDS**

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete; 2016.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- D. ACI 305R - Guide to Hot Weather Concreting; 2010.
- E. ACI 306R - Guide to Cold Weather Concreting; 2016.
- F. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).
- G. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- H. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2017.
- I. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.
- J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- N. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.
- O. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- P. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- Q. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.

- R. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- S. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.
- T. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2015.
- U. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

#### **1.5 MATERIAL EVALUATION/QUALITY CONTROL**

- A. Require concrete supplier to provide delivery tickets for each truckload of concrete. Tickets shall be presented to and reviewed by YPS Office of Facilities Management or Testing Agency prior to discharging concrete into structure.
  - 1. Tickets shall contain project identification name, name of Contractor, name of concrete supplier, location of batch plant, date and time of concrete batching, truck number, delivery ticket number, concrete type and class, concrete mix number, design compressive strength at 28 days, concrete mix proportions and materials, and amount of total mix design water that can be added at site prior to discharging into structure if total mix design water was not used when batched.
- B. Testing Agency will visit construction site at appropriate intervals to determine if work is in general conformance with Contract Documents and specifications. Notify Owner's Representative 48 hours before anticipated time of completion of reinforcement for a given section of work so they may determine if site observations are required. If site observations are required, do not place concrete until Owner's Representative or Testing Agency have had opportunity to observe reinforcement.

#### **1.6 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions for each product indicated.
- C. Mix Design: Submit proposed concrete mix design.
  - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
  - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
  - 3. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Test Reports: Submit report for each test or series of tests specified.
- E. Qualification Data: For installer, testing agency, and concrete supplier.

#### **1.7 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.
- D. Manufacturer/Supplier Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- E. Installer Qualifications: The work of this section shall be performed by a qualified installer, with a minimum of five (5) years experience, approved by the YPS Office of Facilities Management. The term "installer" used herein, shall mean a firm of established reputation which is regularly engaged in and which maintains a regular force of workmen skilled in the installation of the type of work specified in this section.

- F. Concrete Testing Service: YPS may hire a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures. Coordinate with testing agency to provide required samples for testing.
- G. Delivery Records: Each delivery to the site of concrete shall be accompanied by weigh master's certification. Retain all copies for inspection by the Testing Agency.
  - 1. Indicate water added to mix a job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements

#### **1.8 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals.

#### **1.9 DELIVERY, STORAGE AND HANDLING**

- A. Store materials so as to preserve their quality and fitness for work.
- B. Store reinforcement and formwork in manner to prevent bending, damage (including damage to coatings), and accumulation of dirt.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- D. All packed materials shall be delivered to the site in original unopened containers, clearly indicating manufacturer's name, brand name, and other identifying information.

#### **1.10 PROJECT CONDITIONS**

- A. Coordinate with the work of all other sections and/or separate contracts.
- B. Locate and protect existing and new utilities in the areas of work. Cooperate with the Architect, Owner's Representative, and Construction Manager in keeping respective services in operation.
- C. Contractor shall be responsible for correction of concrete work not conforming to specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by Architect, Owner's Representative, and Construction Manager.

### **PART 2 PRODUCTS**

#### **2.1 FORMWORK**

- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

#### **2.2 CONCRETE MATERIALS**

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type.
  - 1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
  - 1. Acquire aggregates for entire project from same source.
  - 2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
- C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

#### **2.3 ADMIXTURES**

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.

#### **2.4 ACCESSORY MATERIALS**

- A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
2. Manufacturers:
  - a. Henry Company; Moistop Ultra 10: [www.henry.com/#sle](http://www.henry.com/#sle).
  - b. ISI Building Products; Viper VaporCheck II 10-mil (Class A): [www.isibp.com/#sle](http://www.isibp.com/#sle).
  - c. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
  - d. Substitutions: See Section 01 2500 Substitution Procedures

## 2.5 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
  1. Manufacturers:
    - a. Euclid Chemical Company; AKKRO-7T: [www.euclidchemical.com/#sle](http://www.euclidchemical.com/#sle).
    - b. W. R. Meadows, Inc; ACRY-LOK-: [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

## 2.6 CURING MATERIALS

- A. Moisture-Retaining Sheet: ASTM C171.
  1. Polyethylene film, clear, minimum nominal thickness of 4 mil, 0.004 inch (0.102 mm).
- B. Membrane Curing Compound: ASTM C 309 Type 1 - Clear or translucent, Class A.
- C. Water: Potable, not detrimental to concrete.

## 2.7 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
  1. For trial mixtures method, employ independent testing agency acceptable to YPS Office of Facilities Management for preparing and reporting proposed mix designs.
- C. Identify sources of all products used in design mixes.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- E. Normal Weight Concrete:
  1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch (27.6 MPa).
  2. Water-Cement Ratio: Maximum 40 percent by weight.
  3. Total Air Content: 4 percent, determined in accordance with ASTM C173/C173M.
  4. Maximum Slump: 4 inches (100 mm).
  5. Maximum Aggregate Size: 3/4 inch (19 mm).

## 2.8 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.
- B. Do not proceed with work until unsatisfactory conditions are corrected.



### 3.2 PREPARATION

- A. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347 and ACI 117.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Clean and coat forms before erection. Do not coat forms in place.
- D. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for concrete placement. Securely brace temporary openings, and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- E. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- F. Chamfer exposed corners and edges as indicated using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Fit corners and joints with gaskets or tape to prevent leakage.
- H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- I. Sleeves: Provide sleeves in concrete formwork for plumbing, electrical, and mechanical penetrations. Coordinate size and location of sleeves with Contractors and mechanical, electrical, and plumbing drawings.
  - 1. Accurately place and secure in forms.
  - 2. Coordinate sleeve locations with reinforcing bars.
- J. Penetrations shall not occur through footings, piers, columns, beams, joists, grade beams, or supported slabs unless shown in structural drawings
- K. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
  - 1. Use latex bonding agent only for non-load-bearing applications.
- L. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- M. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

### 3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Notify YPS Office of Facilities Management not less than 24 hours prior to commencement of placement operations.
- C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
  - 1. Slabs on Grade: Use strip pour methods and mechanical vibratory screed whenever possible.
  - 2. Consolidate concrete during placing operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Bring slab surfaces to correct level with a straightedge and strike off. Uniformly slope to drains. Use darbies to smooth surface, leaving it free of humps or hollows. Do not sprinkle water or portland cement on plastic surface. Do not disturb slab surfaces before beginning finishing operations.
- E. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in manner to avoid inclined construction joints.
- F. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
- G. Do not use vibrators to transport concrete inside formwork.

### 3.4 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
  1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
  2. Place joint filler in floor slab pattern placement sequence. Set top to required elevations.
  3. Install joint devices in accordance with manufacturer's instructions.
  4. Apply sealants in joint devices in accordance with 07 9200 - Joint Sealants.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Hand tooled or Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

### 3.5 MISCELLANEOUS CONCRETE ITEMS

- A. Equipment Bases and Foundations: Provide equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

### 3.6 CONCRETE FINISHING

- A. Repair surface defects, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
  1. Broom Finish: Apply a broom finish to exterior concrete platforms and elsewhere as indicated.
    - a. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.7 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  1. Normal concrete: Not less than seven days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:

1. Final Curing: Begin after initial curing but before surface is dry.
  - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) and seal with waterproof tape or adhesive; secure at edges.
  - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

### **3.8 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

### **3.9 DEFECTIVE CONCRETE**

- A. Test Results: The testing agency shall report test results in writing to YPS Office of Facilities Management and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the YPS Office of Facilities Management. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Fuller and D'Angelo, P.C. for each individual area.

### **3.10 PROTECTION**

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

**END OF SECTION**



**SECTION 04 0100  
MAINTENANCE OF MASONRY**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Removal and rebuilding of exterior brick units where indicated on drawings.
- B. Repointing mortar joints where indicated and/or required.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 5000 - Temporary Facilities and Controls.
- B. Section 04 2000 - Unit Masonry: Block masonry units.
- C. Section 04 2000 - Unit Masonry: Mortar and grout.
- D. Section 05 5000 - Metal Fabrications.
- E. Section 07 9200 - Joint Sealants.

**1.4 REFERENCE STANDARDS**

- A. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- B. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- C. IMIABC (CW) - Recommended Practices & Guide Specifications for Cold Weather Masonry Construction; International Masonry Industry All-Weather Council; 1993.
- D. IMIABC (HW) - Recommended Practices & Guide Specifications for Hot Weather Masonry Construction; International Masonry Industry All-Weather Council; current edition.
- E. New York State Parks, Recreation & Historic Preservation Brief #2 Guidelines.

**1.5 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
  - 1. Require attendance of parties directly affecting work of this section.

**1.6 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all material, including recommended installation procedures.
- C. Samples: Submit four samples of face brick units to illustrate matching color, texture and extremes of color range.
  - 1. For each type of mortar provide 6 inch long by 1/2 inch wide sample strips set in metal or plastic channels.
- D. Manufacturer's Instructions: For cleaning materials, indicate special procedures, conditions requiring special attention.

**1.7 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Qualification: The sub-contractor with a minimum of five years experience, experienced masonry restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in

material, design, and extent to that indicated for this Project with a record of successful in-service performance.

1. The Installer shall directly employ the personnel performing the work of this section
- C. Source Limitations: Obtain each type of material for masonry restoration (face brick, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

### **1.8 MOCK-UP**

- A. Restore and repoint an existing masonry wall area sized 4 feet (120 m) long by 2 feet (60 m) high; include in mock-up area instances of mortar, accessories, and flashings.
- B. How flashings will be built into the masonry.
- C. Locate where directed.
- D. Acceptable panel and procedures employed will become the standard for work of this section.
- E. Mock-up may remain as part of the Work.
- F. Allow samples to cure at least three days (or longer, if possible) before obtaining YPS Office of Facilities Management and Fuller and D'Angelo, P.C.'s approval for color match. Mortar colors will continue to lighten as they cure and are exposed to the weather, so samples should be installed as far in advance as possible. Samples should be viewed from a minimum distance of 12 feet.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Carefully pack, handle, and ship masonry units and accessories strapped together in suitable packs or pallets or in heavy cartons.
- B. Deliver material to the site in the Manufacturer's original and unopened containers and packaging, bearing labels which identify the type and names of the products and Manufacturers. Unload and handle to prevent chipping and breakage.
- C. Protect masonry materials and aggregates during storage and construction from excess wetting by rain, snow or ground water, and from staining or inter mixture with earth or other types of materials.
- D. Protect grout, mortar and cement products from deterioration by moisture and temperature. Store in a dry location or in waterproof containers. Protect liquid components from freezing.
- E. Do not overload the structure when storing materials on he roof.

### **1.10 FIELD CONDITIONS**

- A. Repoint mortar joints and repair masonry only when air temperature is between and 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of work.
- B. Erect temporary covers over pedestrian walkways and at building entrances and exits which will remain active as the work progresses.
- C. Prevent mortar from staining the face of surrounding masonry and other building surfaces, immediately remove any which falls or spills. Protect sills, ledges and projections from mortar droppings.
- D. Coordinate masonry removal and restoration with the installation of new metal and membrane flashings

### **1.11 GUARANTEE**

- A. Provide a Contractor's written Guarantee which warrants that all work will remain free of material and workmanship defects and in a watertight condition for a two year period beginning upon Final Completion:

## **PART 2 PRODUCTS**

### **2.1 CLEANING MATERIALS**

- A. Cleaning Agent: ProSoCo; Sure Klean Light-Duty Restoration Cleaner Cathedral Stone.Syra G. by Cathedral Stone® Products, Inc
  1. Application: General Cleaning of existing masonry units.

- B. Cleaning Agent: ProSoCo; Sure Klean 600 Detergent
  - 1. Application: General Cleaning of new masonry units.

## 2.2 MORTAR MATERIALS

- A. Use only factory premixed packaged dry materials for mortar and grout, with addition of water only at project site.
- B. Mortar Color: Match existing.
- C. Mortar Mix Designs: ASTM C270, Property Specification.
  - 1. Exterior Masonry Veneer: Type N.
  - 2. Type N for setting mortar.
  - 3. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

## 2.3 MASONRY MATERIALS

- A. Brick shall be clay or shale, ASTM C216, Type FBS, solid. Brick shall be tested for efflorescence in accordance with ASTM Test Methods C67 and the rating shall be "Not Effloresce".
  - 1. Use 100% solid brick over exterior relieving angles/lintels or other brick projections on exterior face of building. (Use of solid brick with cores is acceptable if cores are filled solid with mortar and the cores are not visible to view.)
- B. Include special bricks for corners, and other special shapes, to match the color, surface texture, shape and size of existing adjacent brick.
- C. Provide units with colors, surface texture, and physical properties to match existing units in size and shape.
  - 1. Provide special shapes as indicated and required to match existing.

## 2.4 MASONRY ANCHORS

- A. All reinforcement and anchors located in exterior walls shall be stainless steel.
- B. Strap Anchors: Bent steel shapes configured as required for specific situations, 1/-1/2 in (\_\_\_ mm) width, 0.105 in (2.7 mm) thick, lengths as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage from masonry face, corrugated for embedment in masonry joint, stainless steel.
  - 1. Length: Verify in field.
  - 2. Hohmann & Barnard weld on ties #345.
  - 3. #340-A by Heckman Building Products

## 2.5 ACCESSORIES

- A. Weeps: Cellular, honeycomb design, polypropylene weep vents for embedding in masonry wall mortar joints;
  - 1. Material: High density polyethylene and impervious to water and resistant to UV degradation.
  - 2. Hohmann & Barnard, Inc. #QV - Quadro-Vent.
- B. Paint: Refer to Section 09 9113 - Exterior Painting.
- C. Joint Filler: Closed cell neoprene; 3/8" inch (\_\_\_ mm) wide x 3" wide x by maximum lengths available. Provide tear strip to permit sealant joint.
  - 1. Manufacturers:
    - a. Hohmann & Barnard, Inc; Product MS: [www.h-b.com](http://www.h-b.com).

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing Membrane - For Steel Lintel Flashing
  - 1. Self adhered Flashing Membrane with Drip Edge: Standard type, elastomeric and thermal plastic polymers combined with Dupont Elvaloy, reinforced with synthetic fibers and calendared into 40

mil thick sheets with rubberized adhesive, 1-1/2 inch sealant compatible drip edge and disposable silicone release sheet adhered to the bottom adhesive side.

2. Drip Edge: 3/8".
3. Provide primers, adhesives, pre-formed inside and outside corners and dams as recommended by the manufacturer.
4. Verify sealants specified in Section 07 9200 - Joint Sealants are compatible with flashing.
5. Termination Bars: 1/8" stainless steel with foam seal. Use at top of all flashing.
6. Manufacturers:
  - a. Hyload Inc.; 5020 Enterprise Pkwy., Seville, OH 44273. ASD. Toll Free: 800-457-4056. Phone: 330-769-3546. Fax: 330-769-4153. Web: www.hyload.com. Email: info@hyload.com.
  - b. Substitutions: See Section 01 2500 - Substitution Procedures.

## 2.7 CAVITY WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: Rigid, cellular, polystyrene thermal insulation with closed cells and integral high-density skin; formed by the expansion of polystyrene base resin with a carbon-black filler in an extrusion process to comply with the following characteristics:
  1. Aged thermal resistance (R-value) for 1-inch thickness of 5.0, deg F x h x sq. ft./Btu at 75 deg F at 5 years.
  2. Compressive strength: 25 as per ASTM D-1621
  3. Water Absorption: 0.10 as per ASTM C-272.
  4. Dimensional Stability: 2.0 as per ASTM D-2126.
  5. Flame Spread: 5 as per ASTM E-84.
  6. Smoke Developed: 45-175 as per ASTM E-84.
  7. Thickness: Match Existing.

## 2.8 MORTAR MIXES

- A. Comply with ASTM C 270, Proportion Specification
  1. Brick Replacement Mortar: Type N .
  2. Pointing mortar Type N.
    - a. Verify strength of existing mortar. New mortar shall not exceed strength of existing mortar.
- B. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  1. Mix to match existing.
- C. Do not use admixtures of any kind in mortar, unless otherwise indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces to be cleaned are ready for work of this section.

### 3.2 PREPARATION

- A. Protect surrounding elements from damage due to restoration procedures.
- B. Separate areas to be protected from restoration areas using means adequate to prevent damage.
- C. Cover existing landscaping with tarpaulins or similar covers.
- D. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures, including:
  1. Windows.
  2. Soft joints and sealants.
  3. Door frames.
  4. Vents, louvers and grills



- E. Close off adjacent occupied areas with dust proof partitions.
- F. When using cleaning methods that involve water or other liquids, install drainage devices to prevent runoff over adjacent surfaces unless those surfaces are impervious to damage from runoff.
- G. Do not allow cleaning runoff to drain into sanitary or storm sewers.

### **3.3 BRICK REMOVAL AND REPLACEMENT**

- A. Carefully remove bricks on a piece by piece basis. Cut out full units from joint to joint and to permit replacement with full size units. Clean the edges of remaining bricks, to remove all mortar, dust, and loose debris in preparation for rebuilding
- B. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to any adjacent remaining materials.
- C. Simultaneously remove limited sections of existing masonry; support and protect masonry remaining next to and above the removal areas
- D. Support structure as necessary in advance of cutting out units.
- E. The Contractor is responsible for performing Work in a safe manner. Provide temporary shoring or other supports as required to prevent displacement of existing masonry that is to remain. Perform the removal Work with such care as may be required to prevent failure of the masonry or damage to adjoining masonry that is to remain
- F. Cut away loose or unsound adjoining masonry and mortar to provide firm and solid bearing for new work. Do not use impact type tools, use only rotary type grinders.
- G. Use power tools only after test cuts determine no damage to masonry units will result. Provide vacuum attachment for all grinding/cutting equipment for dust control purposes.
- H. Do not damage masonry units.
- I. Build in new units following procedures for new work. .
- J. Mortar Mix: Colored and proportioned to match existing work.
- K. Ensure that anchors, ties, reinforcing, and flashings are correctly located and built in.
- L. Install built in masonry work to match and align with existing, with joints and coursing true and level, faces plumb and in line. Build in all openings, accessories and fittings. Use a motor driven diamond blade saw to cut bricks with clean, sharp, unchipped edges.
- M. Wet brick which have initial rates of absorption (suction) of more than 30 grams per 30 square inches per minute, (in accordance with ASTM C 67), to ensure the bricks are nearly saturated with water, but surface dry when laid
- N. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid. Maintain joint width for replacement units to match existing joints.
- O. Install metal wall tie mesh in each joint.
- P. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area
- Q. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brick work

### **3.4 REPOINTING**

- A. Perform repointing prior to cleaning masonry surfaces.
- B. Repointing of existing joint where joint reinforcing is exposed, shall be as indicated and detailed on drawings.

- C. Cut out loose or disintegrated mortar in joints to minimum 3/4" inch (19 mm) depth or until sound unweathered mortar is reached. Use power chisels die grinder, circular grinder or other power equipment approved by the YPS Office of Facilities Management.
  - 1. Test mock-up shall be performed in area directed by the YPS Office of Facilities Management. Contractor shall not proceed until mock-up and methods are approved.
  - 2. Use power tools only after test cuts determine no damage to masonry units will result.
  - 3. Provide vacuum attachment for all grinding/cutting equipment for dust control purposes.
- D. Do not damage masonry units. Do not spall the edges of adjoining masonry or widen the joints. Replace any masonry which is damaged.
- E. When cutting is complete, remove dust and loose material brushing and with water jet.
- F. Pack tightly in maximum 1/2 inch (12.5 mm) layers. Form a smooth, compact concave joint to match existing.
- G. Slightly recess pointing mortar from the faces of the masonry units where the units have rounded edges. Do not spread mortar on the edges or faces of the masonry. Do not featheredge the mortar.
- H. Tool repointed joints to match the appearance of adjoining joints when the mortar is thumbprint hard. Remove excess mortar from the edges of the joints with a soft bristle brush
- I. Moist cure for 72 hours.
- J. Clean repointed area minimum 24" each side of repointed joints.
  - 1. Immediately after the mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter using stiff nylon or bristle brushes and clean water, spray applied at low pressure.
  - 2. Do not use metal scrapers or brushes. Do not use acid or alkali cleaning agents
- K. Remove efflorescence by dry brushing followed by wet brushing.

### **3.5 REINFORCEMENT AND ANCHORAGE - GENERAL**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place continuous joint reinforcement in first and second joint below top of walls.
- C. Lap joint reinforcement ends minimum 6 inches (150 mm).

### **3.6 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY**

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as shown on the drawings.

### **3.7 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Install flashing entire face of the exterior face of the interior CMU unit.
  - 2. Extend flashings full width at such interruptions and at least 4 inches (100 mm) into adjacent masonry or turn up at least 8 inches (200 mm) to form watertight pan at non-masonry construction.
  - 3. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 4. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend plastic flashings down and under masonry to within 1/4 inch (6 mm) of exterior face of masonry.
- C. Lap end joints of flashings at least 4 inches (100 mm) and seal watertight with mastic or elastic sealant.

### **3.8 GENERAL CLEANING AND PROTECTION PROCEDURES**

- A. Protect persons and surrounding surfaces of building being restored from harm resulting from masonry restoration work.

1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.
  2. Comply with cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical cleaning solutions from coming into contact with pedestrians, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  3. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  4. Mask immediately adjacent surfaces with material that will withstand cleaning and restoration procedures, including:
    - a. Windows.
    - b. Soft joints and sealants.
    - c. Door frames.
    - d. Vents, louvers and grills
  5. Keep wall wet below area being cleaned to prevent streaking from runoff.
  6. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
  7. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
  8. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Prevent mortar from staining face of surrounding masonry and other surfaces.
1. Cover sills, ledges, and projections to protect from mortar droppings.
  2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
  3. Immediately remove mortar in contact with exposed masonry and other surfaces.
  4. Clean mortar splatters from scaffolding at end of each day
- C. Apply all material in strict accordance with the manufacturer's instructions.
- D. Protect people, vehicles, property, plants, non masonry surfaces from product splash, residue, wind drift and fumes.
- E. Do not apply when surface and air temperature falls below 50 degrees.
- 3.9 CLEANING NEW BRICK MASONRY**
- A. Test surface for cleaning effectiveness.
  - B. Clean surfaces and remove large particles with wood scrapers, brass or nylon wire brushes.
  - C. Protect area below cleaning operation and keep masonry soaked with water and flushed free of acid and dissolved mortar continuously for duration of cleaning.
  - D. Before solution dries, rinse and remove acid solution and dissolved mortar, using clean, pressurized water.
    1. Apply 400-1000 psi pressure, water flow rate of 6-8 gallons per minute, to masonry surfaces, maintaining uniform depth and surface texture throughout. Use 15-45 degree fan spray. If required heat water to 150-180 degree.
    2. Let dwell 3 to 5 minutes. Do not let cleaner dry on the surface. Fresh water rinse the surfaces below areas being cleaned to prevent streaking.
    3. Repeat steps as required

**3.10 FIELD QUALITY CONTROL**

- A. Inspectors: YPS Office of Facilities Management may engage qualified inspectors to perform inspections and prepare test reports. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.
- B. Notify YPS Office of Facilities Management in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

**3.11 CLEANING**

- A. Immediately remove stains, efflorescence, or other excess resulting from the work of this section.
- B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.
- C. Clean surrounding surfaces.

**END OF SECTION**

**SECTION 04 2000**  
**UNIT MASONRY**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Concrete Masonry Unit (CMU)
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Lintels.

**1.3 RELATED REQUIREMENTS**

- A. Section 04 0100 - Maintenance of Masonry. For modifications to existing masonry.
- B. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

**1.4 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018, with Editorial Revision (2018).
- C. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2016, with Editorial Revision (2018).
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2018a.
- E. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.
- F. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- H. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- J. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2016.
- K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.
- L. UL (FRD) - Fire Resistance Directory; Current Edition.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

**1.6 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

- B. Fire Rated Assemblies: Comply with applicable code for UL (FRD) Assembly No. \_\_\_\_.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

## **PART 2 PRODUCTS**

### **2.1 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
  2. Special Shapes: Provide non-standard blocks configured for corners, lintels, and other detailed conditions.
    - a. Provide bullnose units for outside corners.
  3. Load-Bearing Units: ASTM C90, normal weight.
    - a. Both hollow and solid block.
    - b. Exposed Faces: Manufacturer's standard color and texture.
  4. Non-Loadbearing Units: ASTM C129.
    - a. Both hollow and solid block, as indicated.

### **2.2 BRICK UNITS**

- A. Refer to Section 04 0100 - Maintenance of Masonry.

### **2.3 MORTAR AND GROUT MATERIALS**

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- C. Water: Clean and potable.
- D. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Type: Type N.
  2. Color: Standard gray.

### **2.4 REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers:
1. Hohmann & Barnard, Inc; X-Seal Anchor: [www.h-b.com](http://www.h-b.com).
- B. Single Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Ladder.
  2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B.
  3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.
- C. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M, Class B.
- D. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch (16 mm) of mortar coverage from masonry face.

### **2.5 LINTELS**

- A. Steel Lintels:
1. Steel: ASTM A36 Shapes

2. Size and Configuration: See drawing details.

## **2.6 MORTAR AND GROUT MIXING**

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  1. Interior, loadbearing masonry: Type N.
  2. Interior, non-loadbearing masonry: Type N.
- B. New Mortar for Old Brick: Proportion by volume only; no more than 20 percent of the total volume of Portland cement and lime combined to be Portland cement.
  1. Repointing Mortar: Use proportions from 1 part lime to 2 parts sand with no Portland cement, up to 2 parts Portland cement to 3 parts lime to 6 parts sand.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.

### **3.2 PREPARATION**

- A. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### **3.3 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### **3.4 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  1. Bond: Match existing.
  2. Mortar Joints: Match existing.

### **3.5 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

### **3.6 REINFORCEMENT AND ANCHORAGE - GENERAL and SINGLE WYTHE MASONRY**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Lap joint reinforcement ends minimum 6 inches (150 mm).

- D. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches (900 mm) horizontally and 24 inches (600 mm) vertically.

### **3.7 LINTELS**

- A. Install loose steel lintels over openings. See drawing details for configuration and sizes.
- B. Maintain minimum 8 inch (200 mm) bearing on each side of opening.

### **3.8 TOLERANCES**

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

### **3.9 CUTTING AND FITTING**

- A. Cut and fit around pipes, conduit, and existing structural members. Coordinate with other sections of work to provide correct size, shape, and location.

### **3.10 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

### **3.11 PROTECTION**

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

**END OF SECTION**



**SECTION 05 5000  
METAL FABRICATIONS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Shop fabricated steel items.
- B. Steel framing and supports for windows and mechanical roof support systems, and similar items indicated on drawings.
- C. Loose lintels.
- D. Metal bollards.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 4000 - Quality Requirements for testing requirements and procedures.
- B. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- C. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.
- D. Section 09 9000 - Paints and Coatings.

**1.4 REFERENCE STANDARDS**

- A. ALI A14.3 - Ladders - Fixed - Safety Requirements; 2014.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2014.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- K. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).
- L. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).

**1.5 PERFORMANCE REQUIREMENTS**

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces

## 1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For the following:
  - 1. Lintels
  - 2. Metal bollards.
  - 3. Paint products.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
  - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer, licensed in the State of New York responsible for their preparation
- D. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide for trimming and fitting at site.

## 1.8 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, hot-dip galvanized finish.
- E. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, galvanized to ASTM A 153/A 153M where connecting galvanized components.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## 2.2 FABRICATION

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work
- D. Fit and shop assemble items in largest practical sections, for delivery to site.
- E. Fabricate items with joints tightly fitted and secured.
- F. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Do not use ferrous material and equipment on stainless steel components.
  - 3. Obtain fusion without undercut or overlap.
  - 4. Remove welding flux immediately.
  - 5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes es where water may accumulate
- H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.
- B. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- C. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5
  - 2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594

## 2.4 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; galvanized finish.
  - 1. Fixed Bollards
  - 2. Diameter: 6 inches
  - 3. Material: Schedule 40 steel pipe galvanized
  - 4. Cap bollards with prefabricated 1/4-inch-thick steel cone cap.
  - 5. Concrete filled for fixed bollards.
  - 6. Product: Reliance Foundry Company; 1-8877-789-3245. [www.reliance-foundry.com](http://www.reliance-foundry.com).
  - 7. Use where shown on drawings.
- B. Lintels: As detailed
  - 1. prime paint; interior, Galvanized exterior wall.
  - 2. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated
  - 3. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
  - 4. Galvanize loose steel lintels located in exterior walls.
  - 5. Refer to drawings for sizes and configurations.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

## 2.7 FINISHES - STEEL

- A. Refer to Section 09 9123 Interior Painting for top coat finish on shop primed items.
- B. Prime paint steel items. (Interior Steel and enclosed roof dunnage)
  - 1. Prime paint all steel items except:
    - a. Galvanize exterior exposed dunnage and lintels in exterior walls.
    - b. Do not prime surfaces in direct contact with concrete, where field welding is required.
- C. Prepare surfaces to be primed in accordance with SSPC-SP2.
- D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- E. Prime Painting: One coat.
  - 1. Interior ferrous metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664.
    - a. Refer to Section Section 09 9123 Interior Painting for preparation, prime coats and finish coats for all exterior exposed ferrous metal.
- F. Galvanized Steel Items: (Exterior Steel Roof Dunnage and Loose lintels in exterior walls)
  - 1. Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft (530 g/sq m) galvanized coating.

## 2.8 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

#### **3.2 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

#### **3.3 INSTALLATION**

- A. Install fabricated items as per approved shop drawings.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Field weld components as indicated on shop drawings.
- E. Perform field welding in accordance with AWS D1.1/D1.1M.
- F. Obtain approval prior to site cutting or making adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed.
- H. Provide 2 coats of zinc top coat on all field welds on galvanized finished metal.

#### **3.4 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

**END OF SECTION**



**SECTION 05 5133  
METAL LADDERS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Prefabricated ship ladders.

**1.2 REFERENCE STANDARDS**

- A. 29 CFR 1926.1053 - Ladders; Current Edition.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019.
- E. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- G. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata.

**1.3 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 2. Verify all dimensions by field measurement before fabrication.
  - 3. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

**PART 2 PRODUCTS**

**2.1 MATERIALS - ALUMINUM**

- A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

**2.2 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

**2.3 PREFABRICATED LADDERS**

- A. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
  - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.

2. Materials: Aluminum; ASTM B211/B211M, 6063 alloy, T52 temper.
3. Incline: 60 degrees.
4. Finish: Mill finish aluminum.
5. Manufacturers:
  - a. O'Keeffe's Inc; Model 520 A: [www.okeeffes.com/#sle](http://www.okeeffes.com/#sle). Customized to project details and dimensions indicated on drawings.

#### **2.4 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Field verify all dimensions before fabrication.

#### **3.2 PREPARATION**

- A. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

#### **3.3 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Obtain approval prior to site cutting or making adjustments not scheduled.

#### **3.4 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

**END OF SECTION**



**SECTION 06 1000  
ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Concealed wood blocking, nailers, and supports windows, toilet accessories, casework, and hardware.

**1.3 RELATED REQUIREMENTS**

- A. Section 08 5113 - Aluminum Windows.
- B. Section 10 2800 - Toilet And Bath Accessories.
- C. Section 12 2940 - Roller Shades.
- D. Section 12 3200 - Plastic Laminated Casework.

**1.4 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- B. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- C. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- E. PS 20 - American Softwood Lumber Standard; 2015.
- F. WWPA G-5 - Western Lumber Grading Rules; 2017.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on lumber, plywood, fasteners, and application instructions .
- C. Shop drawings, or 2 foot long on-site samples which show the size, shape, configuration and method of fastening for all wood blocking assemblies, and which show how the blocking assemblies will relate to other adjoining work.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Material Safety Data Sheets

**1.6 QUALITY ASSURANCE**

- A. A firm (Installer) with not less than 5 continuous years experience performing carpentry work comparable to that required for this project, employing personnel skilled in the work specified.
- B. The Installer shall directly employ the personnel performing the work of this section.
- C. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.
  - 1. Acceptable Lumber Inspection Agencies: Any agency with rules approved by American Lumber Standards Committee.
  - 2. Material Quality: Obtain each type of material from a single source to ensure consistent quality, color, pattern, and texture.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Deliver and store materials dry at all times.

### **1.8 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a two (2) year period after Date of Substantial Completion.

### **1.9 WARRANTY**

- A. Provide a Contractor's written Guarantee which warrants that all work will remain free of material and workmanship defects and in a watertight condition for a two (2) year period beginning upon Final Completion:
  - 1. Defective work includes but is not limited to the following types of failure: leakage, delamination, lifting, loosening, splitting, cracking, and undue expansion.
  - 2. The Contractor's Guarantee shall provide that the Contractor will make the repairs and modifications necessary to enable the work to perform as warranted at his own expense.
  - 3. The Guarantee shall include the removal and replacement of items or materials installed as part of the original work, if removal is needed to affect guaranteed repairs.
- B. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Wood, including shims, nailers, blocking, furring and similar members, in the sizes indicated, worked into the shapes shown.
  - 2. Acceptable Lumber Inspection Agencies: Any agency with rules approved by American Lumber Standards Committee.
  - 3. Material Quality: Obtain each type of material from a single source to ensure consistent quality, color, pattern, and texture.
  - 4. Pre-Work Conference: Attend the pre-roofing meeting to discuss how carpentry work will be performed and coordinated with other work.
  - 5. Species: Douglas Fir, unless otherwise indicated, construction grade solid lumber free of splits, large knots and other imperfections.

### **2.2 DIMENSION LUMBER**

- A. Grading Agency: Western Wood Products Association; WWPA G-5.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: Kiln-dry or MC15.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.

### **2.3 CONSTRUCTION PANELS**

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

### **2.4 ACCESSORIES**

- A. Fasteners and Anchors:

1. General: Provide fasteners of size and type that comply with requirements specified in this article by the authority having jurisdiction, International Building Code, International Residential Code, Wood Frame Construction manual, and National Design Specification
2. Metal and Finish: Hot-dipped galvanized steel as per ASTM A153/A153M for exterior, wet areas, and high humidity areas and unfinished steel for other wood locations.
3. Use screws wherever possible, minimum size diameter #12. If nails are used they shall be annular ring shank type. Do not use dry wall screws to secure wood blocking assemblies.
4. Anchors: Toggle bolt type for anchorage to hollow masonry.

## **2.5 FACTORY WOOD TREATMENT**

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate installation of rough carpentry members specified in other sections.

#### **3.2 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

#### **3.3 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Provide the following specific non-structural framing and blocking:
  1. Cabinets and shelf supports.
  2. Toilet and bath accessories.
  3. Windows.

#### **3.4 INSTALLATION OF CONSTRUCTION PANELS**

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
  1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  2. Where boards are indicated or required as full floor-to-ceiling height, install with long edge of board parallel to studs.
  3. Install adjacent boards without gaps.

#### **3.5 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.

#### **3.6 CLEANING AND PROTECTION**

- A. General: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
  1. Comply with applicable regulations.
  2. Do not burn scrap on project site.
  3. Do not burn scraps that have been pressure treated.
  4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.

- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**

**SECTION 07 5010  
MODIFICATIONS TO EXISTING ROOFING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Modification to existing EPDM membrane roofing system.
  - 1. The HVAC, Plumbing, and Electrical Contractor shall coordinate, provide and be responsible for their equipment and locations.
- B. The existing roof is under warranty. Coordinate with YPS Office of Facilities Management for further information.
  - 1. Contractor must notify and be authorized by the manufacturer to perform all work as per the manufacturer's instruction.
- C. Cut new openings and install curbs.
- D. Fill in abandoned equipment openings.
- E. Disposal of removal and debris construction waste and dispose in manner complying with all applicable federal, state, and local regulations.
- F. Install new isocyanurate insulation, cover board, fully adhered 60 mil thick fire rated EPDM roofing, and flashings as indicated or required.
- G. Clean all residual material from substrate surfaces and the flutes of any exposed steel deck - prior to installing new insulation and roofing. Install new insulation, roofing and flashings only on dry smooth surfaces.
- H. Provide any hoisting for their work as required as needed, to remove, adjust, modify, reset and reconnect all roof-mounted and roof-penetrating devices to enable new roofing and flashings to be installed. Coordinate with mechanical and electrical prime contractors.
- I. Roof top mechanical equipment work is specified in Division 22, 23, and 26 and shown on mechanical and electrical drawings Coordinate with the mechanical & electrical prime contractors to set new curbs and equipment, and/or make modifications to the existing curbs and equipment; prior to installing new roof flashings as indicated.
- J. Abandoned mechanical equipment and support curbs will be removed by the mechanical contractors.
- K. Maintain building watertight at all times.
- L. Install new support steel and decking; insulation to finish flush with existing the deck substrate, new insulation and roofing to make the building permanently watertight.
- M. Comply with the published recommendations and instructions of the roofing membrane manufacturer.
- N. Commencement of work shall constitute acknowledgement by Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing membrane manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

**1.3 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications. Roofing modifications required by miscellaneous roof supports.
- B. Section 06 1000 - Rough Carpentry:

- C. Section 07 7200 - Roof Accessories: Roof hatches, vents, and manufactured curbs.

#### 1.4 REFERENCE STANDARDS

- A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2018a.
- B. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2016.
- C. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- E. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System; 2016.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference: Before start of roofing work, General Construction Contractor, HVAC, and Installer shall hold a meeting to discuss the proper installation of materials, status of the existing warranty and requirements to maintain the existing warranty.
  - 1. Require attendance with all parties directly influencing the quality of roofing work or affected by the performance of roofing work.
  - 2. Notify YPS Office of Facilities Management well in advance of meeting.
  - 3. Review all locations required for modifications to existing roofing.

#### 1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data:
  - 1. Provide manufacturer's printed data sufficient to show that all components of roofing systems, including insulation and fasteners, comply with the specified requirements and with the roofing manufacturer's requirements and recommendations for the system type specified; include at least the following:
    - a. Technical data sheet for roof membrane.
    - b. Technical data sheets for splice tape and adhesives.
    - c. Technical data sheet for each insulation type.
    - d. Technical data sheet for each cover board type.
    - e. Technical data sheet for pavers.
  - 2. Where the existing roofing system is UL or FM approved provide documentation that shows that the modification installed is UL-Classified or FM-approved, as applicable; include data itemizing the components of the classified or approved system.
  - 3. Installation Instructions: Provide manufacturer's instructions to installer, marked up to show exactly how all components will be installed; where instructions allow installation options, clearly indicate which option will be used.
  - 4. Pre-Work Site and Building Inspection Report with photos to documents conditions before commencing work.
  - 5. Written certification from the manufacturer which states that the installer is acceptable or licensed to install the specified roofing; if not previously provided.
- C. Shop Drawings: Provide:
  - 1. The roof membrane manufacturer's standard details customized for this project for all relevant conditions, including flashings, base tie-ins, and penetrations.
  - 2. For tapered insulation, provide project-specific layout and dimensions for each board.
- D. Specimen Warranty: Submit manufacturer's certification that work installed will maintain the existing warranty prior to starting work.

- E. Installer Qualifications: Letter from manufacturer attesting that the roofing installer meets the specified qualifications for all systems under warranty.
- F. Pre-Installation Notice: Copy to show that manufacturer's required Pre Installation Notice has been accepted and approved by the manufacturer.
- G. Executed Warranty.

#### **1.7 CODE APPROVAL REQUIREMENTS**

- A. Install roofing and insulation system components to meet the following minimum requirements:
  - 1. New York State Uniform Fire Prevention and Building Code, which includes by reference the New York State Energy Conservation Code.
  - 2. Underwriters Laboratories Inc. Class A External Fire Rating for roof assemblies tested in accordance with ASTM E 108 or UL 790.
  - 3. Minimum wind uplift pressure calculated using ASCE 7 and a safety factor of 2:
    - a. Field Zone - 90 psf
    - b. Perimeter Zones - 135 psf
    - c. Corner Zone - 180 psf
- B. Provide written certification from the roof material Manufacturer, before beginning work, to confirm the roofing system meets these requirements.

#### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum twenty (20) years of documented experience.
- B. Installer Qualifications: Roofing installer shall have the following:
  - 1. A firm (Installer) with not less than five (5) continuous years experience performing EPDM roofing work similar to that required for this project, employing personnel skilled in the specified work.
  - 2. The Installer shall directly employ the personnel performing the work of this section.
  - 3. The Installer shall have a full time supervisor/foreman on the roof when roofing work is in progress. The Supervisor shall have a minimum of five (5) years experience in roofing work similar in nature and scope to this project, and speak fluent English.
  - 4. The Installer shall be acceptable to or licensed by the Manufacturer of the primary roofing materials, and provide written certification from the Manufacturer to confirm this prior to award if requested.
- C. Material Quality: Obtain each product, including the insulation, cover board, EPDM roofing and flashing, and cements, primers and adhesives produced by a single Manufacturer, which has manufactured the same products in the United States of America for not less than five (5) continuous years.
- D. Pre-Work Conference: Meet at the project site approximately one week prior to starting roof work, with the YPS Office of Facilities Management and other representatives concerned about the work, to discuss the following:
  - 1. How the building will be kept watertight as existing roofing is removed and the work progresses.
  - 2. How new roofing work will be coordinated with mechanical equipment work, replacement of deteriorated existing insulation and the installation of new insulation, cover board, flashings and other items to provide a watertight installation.
  - 3. Generally accepted industry practice, the Manufacturer's instructions for handling and installing his products, and project specific work requirements.
  - 4. The condition of the substrate (deck), curbs, penetrations and preparatory work needed by trades other than the roofer.
  - 5. Submittals, if any remain incomplete.

6. The construction schedule, weather forecast for the work period, availability of materials, personnel, equipment and facilities needed to proceed and complete the work in an expeditious manner and on schedule.
7. A schedule for Manufacturer and YPS Office of Facilities Management inspections.

#### **1.9 JOB CONDITIONS (CAUTIONS & WARNINGS)**

- A. Splice cleaner, primer, cements and bonding adhesives are flammable. Do not breathe vapors or use near fire or flame or in a confined or unventilated area. Dispense only from a UL listed or approved safety can.
- B. Remove empty adhesive and solvent containers and contaminated rags from the roof and legally dispose of them daily.
- C. Do not apply adhesives adjacent to open ventilation system louvers, or windows. Temporarily cover the louvers and windows with 6 mil fire retardant polyethylene and prevent adhesive odors from entering the building. Remove temporary covers at the end of each days work.

#### **1.10 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Deliver material to the site in the Manufacturer's original and unopened packaging, bearing labels which identify the type and names of the products and Manufacturers, with the labels intact and legible.
- B. Store all materials in accordance to manufacturer's instructions.
- C. Cover all stored materials, except rolls of EPDM and sealed cans of adhesives, with watertight tarpaulins installed immediately upon delivery.
- D. Immediately remove any insulation which gets wet from the job site.
- E. Do not overload the structure when storing materials on the roof.
- F. Store and install all material within the Manufacturer's recommended temperature range.

#### **1.11 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Existing Roof System Under Warranty
  1. The existing roofing system is under warranty and the General Construction Contractor or their subcontractor must notify and be authorized by the manufacturer to perform all work as per the manufacturer's instruction.
    - a. Guarantee/Warranty coverage shall remain in effect for gust wind speeds up to 72 miles per hour, measured at ground level at the site.
    - b. Manufacture's Warranty: Certification from manufacturer that the existing warranty covering membrane, roof insulation, and other indicated components of the system, shall remain the new and existing terms of the original warranty.
  2. Comply with all warranty procedures required by manufacturer, including notifications  
Manufacture's Warranty: Certification from manufacturer that the existing warranty covering membrane, roof insulation, and other indicated components of the system, shall remain the new and existing terms of the original warranty, scheduling, and inspections:
  3. Manufacture's Warranty: Certification from manufacturer that the existing warranty covering membrane, roof insulation, and other indicated components of the system, shall remain the new and existing terms of the original warranty Contractors warranty.
  4. Manufacturer's and Contractor's Guarantees/Warranties shall be issued no more than 30 days before the satisfactory completion of punch list work.
- C. Manufacturer's and Contractor's Guarantees/Warranties shall be issued no more than 30 days before the satisfactory completion of punch list work.



**PART 2 PRODUCTS**

**2.1 GENERAL**

- A. Acceptable Manufacturer - Roofing System: Match existing manufacturers roofing system.
  - 1. Roofing systems by other manufacturers are not acceptable if existing roof is under warranty.
- B. Substitutions: See Section 01 2500 - Substitution Procedures

**2.2 EPDM ROOFING**

- A. Unreinforced 60 mils thick, fire retardant, EPDM (Ethylene Propylene Diene Monomer) sheet membrane conforming to the following minimum physical properties.

1. PROPERTY	TEST METHOD	SPECIFICATION
2. Color- Gray/Black		
3. Elongation	ASTM D-412	300% min
4. Tear Strength	ASTM D-624	150 lb/in min
5. Ozone Resistance	ASTM D-1149	No cracks, 7 days/100 pphm/100°F/50% strain
6. Heat Aging	ASTM D-573	1200 psi min@ 200% elongation/4 wks/240°F
7. Brittleness Temperature	ASTM D-746	-49°F
8. Water Vapor Permanence	ASTM E-96	2.0 perm max
9. Thickness	ASTM D-412	60 mils plus/minus 6 mils
10. Fire Retardant		UL Class A

- B. Related Materials:
  - 1. Cleaners, adhesives, sealants, caulking and fasteners furnished by the EPDM system Manufacturer. Use low VOC adhesives and cleaners to comply with regulations in effect at the time of application.
    - a. Stripping: 90 mil thick 5 inch and 9 inch wide self adhering flashing, consisting of 45 mils of semi-cured EPDM factory laminated to 45 mils of cured seaming tape.
    - b. Bonding Adhesive: High strength contact adhesive.
    - c. Splice Adhesive: High strength synthetic polymer based contact cement formulated specifically to splice EPDM sheets.
    - d. Lap Sealant: EPDM rubber based gun grade sealant.
    - e. Water Block Seal: One component low viscosity butyl rubber sealant.
    - f. Pre-Molded Pipe Flashing: Pressure sensitive prefabricated flashings with pre-applied adhesive.
    - g. Pourable Sealer: Two component, solvent free polyurethane based sealant.
    - h. Reinforced Perimeter Fastening Strips: .030 inch thick reinforced cured EPDM.
    - i. Seam Tape Primer: Synthetic rubber polymer based primer designed to clean and prime seam tape splice areas prior to installing the tape.
    - j. Seam Splice Tape: Nominal 30 mil thick cured polymer self adhesive tape with release paper carrier, 6 inches wide.
    - k. Plates and Bars: Galvanized and corrosion resistant specialty products.
    - l. Fasteners: #14 Fluorocarbon polymer coated heavy duty screws.

**2.3 INSULATION:**

- A. Isocyanurate – Tapered rigid cellular polyisocyanurate boards with fibrous felt/fiberglass mat facers, sloping 1/8 inch per foot, (match existing) minimum starting thickness 1-1/2 inches, minimum compressive strength 20 psi, meeting ASTM C1289-01, Type II, Class I, Grade 2.

1. Tapered insulation sloping 1/4 inch per foot, minimum starting thickness as shown on the roof plan.
2. Crickets sloping 1/4 inch per foot.
3. At repairs to existing building match thickness of existing insulation.
4. Product: Firestone "ISO 95+ Isocyanurate Insulation" or approved equal.

#### **2.4 ACCESSORY MATERIALS**

- A. Concrete Pavers: Interlocking, with shiplap edges on all sides and integral radiused bearing pads.
  1. Size: Approximately 30 inches (750 mm) by 30 inches (750 mm) by 1-1/2 inches (38 mm) thick.

### **PART 3 INSTALLATION**

#### **3.1 GENERAL**

- A. Construct the new roofing system in a watertight, workmanlike manner, meeting the guarantee requirements specified herein; in strict accordance with the drawings and in conformance with the Manufacturer's requirements, except as enhanced in this specification.
- B. Clean the surface on which roofing system components will be applied, of all laitance, dirt, oil, grease or other foreign matter which would in any way affect the quality of the installation.
- C. Install roof system components on dry surfaces only. Do not install any items when weather conditions and outside temperatures are not suitable in accordance with the Manufacturer's recommendations.
- D. Complete all work in sequence as quickly as possible so that as small an area as practicable is in the process of construction at any one time. Complete the entire area of work begun each day, the same day, and make all exposed edges watertight at the end of each day's work.

#### **3.2 SUBSTRATE INSPECTION**

- A. Remove portions of existing roofing, insulation, and flashings, and carefully check the existing deck and new roof substrate. To be an acceptable surface for the new roofing system, the deck and substrate shall be well secured to the underlying structure, dry and not otherwise deteriorated.
- B. Immediately notify the YPS Office of Facilities Management in writing if defects in the substrate are discovered.
- C. Maintain the building watertight in the interim, but do not install new insulation or roofing until substrate defects have been corrected.

#### **3.3 NEW TO EXISTING INTERFACE**

- A. Remove and replace portions of existing roofing at the construction interface between new construction and existing roof areas.
  1. Install new isocyanurate insulation, mechanically fastened, to match existing insulation thickness and to maintain the slope of the existing insulation.
  2. Install 60 mil. fully adhered EPDM membrane to lap a minimum of 12 inches onto existing EPDM membrane.

#### **3.4 INSULATION AND COVER BOARD**

- A. Install tapered insulation and crickets, neatly cut at all miters and transitions.
  1. Do not lace corner boards.
  2. Install the crickets under the new insulation
- B. Install insulation with joints offset between rows and layers a minimum of 12 inches. Cut insulation to fit neatly at penetrations and joints. Fill any gap which is greater than 1/4 inch.
- C. Fasten new and replacement layers of insulation only to the top flute of the steel deck, with screws and discs which penetrate through the deck a minimum of 3/4 inch and a maximum of 1-1/2 inches.
  1. Provide number of fasteners as recommended by the manufacturer or the equivalent of:
    - a. Install 16 fasteners per 4 by 8 foot insulation board in the field of the roof.
    - b. Install 28 fasteners per 4 by 8 foot insulation board in 12 foot wide perimeter zones.

- c. Install 32 fasteners per 4 by 8 foot insulation board in 12 foot square corner zones.
2. Carefully choose the length and position of each screw to ensure the screws do not protrude through the underside of the deck where visible inside the school.
- D. Install gypsum cover board over the insulation with joints offset between rows and the insulation a minimum of 12 inches. Cut gypsum cover board to fit neatly at penetrations and joints. Fill any gap which is greater than 1/4 inch.
- E. Install all layers of insulation on deck areas and the gypsum cover board, in low rise polyurethane foam adhesive applied in accordance with the Manufacturer's recommendations and to achieve the specified minimum uplift resistance.
  1. Install 1/2 inch diameter adhesive beads spaced 12 inches on center in the field of the roof.
  2. Install 1/2 inch diameter adhesive beads spaced 6 inches on center in 12 foot wide perimeter zones.
  3. Install 1/2 inch diameter adhesive beads spaced 4 inches on center in 12 foot square corner zones.

### 3.5 PREPARATION

- A. Remove all of the existing roof system down to the roof deck including all existing composition base flashings. Dispose of all materials properly.
- B. Take appropriate measures to ensure that fumes from adhesive solvents are not drawn into the building through air intakes.
- C. Prior to proceeding, prepare roof surface so that it is clean, dry, and smooth, and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease and other materials that may damage the membrane.
- D. Wood Nailers: Provide wood nailers at all perimeters and other locations where indicated on the drawings, of total height matching the total thickness of insulation being used.

### 3.6 INSULATION AND COVER BOARD INSTALLATION

- A. Install insulation in configuration and with attachment method(s) specified in PART 2, under Roofing System.
- B. Neatly and tightly fit insulation to all penetrations, projections, and nailers, with gaps not greater than 1/4 inch (6 mm). Fill gaps greater than 1/4 inch (6 mm) with acceptable insulation. Do not leave the roofing membrane unsupported over a space greater than 1/4 inch (6 mm).
- C. Mechanical Fastening: Using specified fasteners and insulation plates engage fasteners through insulation into deck to depth and in pattern required by membrane manufacturer.

### 3.7 SINGLE-PLY MEMBRANE INSTALLATION

- A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax at least 30 minutes before attachment or splicing; in colder weather allow for longer relax time.
- B. Lay out the membrane pieces so that field and flashing splices are installed to shed water.
- C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
- D. Install membrane adhered to the substrate, with edge securement as specified.
- E. Fully adhere EPDM to the substrate with bonding adhesive, .
  1. Allow contact bonding adhesive to dry to the touch EPDM before joining the EPDM to the substrate. Roll the EPDM onto the bonding adhesive and immediately rub it vigorously with a soft bristle broom to ensure complete adhesion.
  2. Do not punch holes in cans of adhesive and use them in a "Better Spreader" without first opening the cans to mix them.
  3. Replace used roller covers each day; discard covers after each days use.
  4. Allow bonding adhesive to dry to the touch before joining the PVC to the substrate.
  5. Allow bonding adhesive to dry to the touch before joining the EPDM to the substrate.

- F. Roofing installed over improperly applied adhesive or with adhesive that wasn't stirred, and roofing installed with blisters, ridges, mole runs and similar deficiencies shall be removed and replaced at the Contractor's expense
- G. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.
- H. Edge Securement: Secure membrane at all locations where membrane terminates or goes through an angle change greater than 2 in 12 inches (1:6 ) using mechanically fastened reinforced perimeter fastening strips, plates, or metal edging as indicated or as recommended by roofing manufacturer.

### **3.8 FLASHING AND ACCESSORIES INSTALLATION**

- A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.
- B. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls and curbs and other vertical and sloped surfaces that the roofing membrane abuts to; extend flashing high above membrane surface or as shown on drawings.
  - 1. Use the longest practical flashing pieces.
  - 2. Evaluate the substrate and overlay and adjust installation procedure in accordance with membrane manufacturer's recommendations.
  - 3. Complete the splice between flashing and the main roof sheet with specified splice adhesive before adhering flashing to the vertical surface.
  - 4. Provide termination directly to the vertical substrate as shown on roof drawings.
- C. Flashing at Penetrations: Flash all penetrations passing through the membrane; make flashing seals directly to the penetration.
  - 1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings wherever practical; otherwise use specified self-curing elastomeric flashing.
  - 2. Structural Steel Tubing: If corner radii are greater than 1/4 inch (6 mm) and longest side of tube does not exceed 12 inches (305 mm), flash as for pipes; otherwise, provide a standard curb with flashing.

### **3.9 FINISHING AND WALKWAY INSTALLATION**

- A. Install walkways at access points to the roof, around rooftop equipment that may require maintenance, and where indicated on the drawings.
  - 1. Use specified walkway pads unless otherwise indicated.
- B. Walkway Pads: Adhere to the roofing membrane, spacing each pad at minimum of 1.0 inch (25 mm) and maximum of 3.0 inches (75 mm) from each other to allow for drainage.
  - 1. If installation of walkway pads over field fabricated splices or within 6 inches (150 mm) of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6 inches (150 mm) on either side.
  - 2. Prime the membrane, remove the release paper on the pad, press in place, and walk on pad to ensure proper adhesion.
- C. Pavers: Install butted tightly, not more than 1/2 inch (12 mm) apart.

### **3.10 FIELD QUALITY CONTROL**

- A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).
- B. Perform all corrections necessary for issuance of warranty.

### **3.11 CLEANING**

- A. Clean all contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.

- B. Repair or replace building components and finished surfaces damaged or defaced due to the work of this section; comply with recommendations of manufacturers of components and surfaces.
- C. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

**3.12 PROTECTION**

- A. Where construction traffic must continue over finished roof membrane, provide durable protection and replace or repair damaged roofing to original condition.

**END OF SECTION**



**SECTION 07 7200  
ROOF ACCESSORIES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Roof access hatches , including safety railings.
- B. Pipe Portals.

**1.3 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications for ship's ladder and roof equipment supports.
- B. Section 07 5010 - Modifications to Existing Roofing
- C. HVAC Division 23 for curb furnish by HVAC contractors and installed by General Contractor.

**1.4 REFERENCE STANDARDS**

- A. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
  - 1. Coordinate with other prime contractor (s) for roof accessories provided by them and installed by the General Contractor.
- D. Warranty Documentation:
  - 1. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.
  - 2. Submit certification from roofing manufacture that existing warranty remains in effect.

**1.6 QUALITY ASSURANCE**

- A. Standards: Comply with SMACNA "Architectural Sheet Metal Manual" fabrication details and "NRCA Roofing and Waterproofing Manual" installation details unless otherwise indicated.
- B. Manufacturer Qualifications: Provide each primary product, produced by a single Manufacturer, which has produced that type product successfully for not less than five (5) years.
- C. Installer Qualifications: A firm with not less than five (5) years of successful experience installing specialties similar to those required for this project.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

### 1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for that all work will remain free of material and workmanship defects and in a watertight condition for a five year period beginning upon Final Completion..
  - 1. Defective work includes but is not limited to the following types of failure: leakage, delamination, lifting, loosening, splitting, cracking, undue expansion, and failure of the clock mechanism to keep accurate time.
- C. The Guarantee shall provide that in the event the work installed fails to so perform, the Contractor will make the repairs and modifications necessary to enable the work to perform as warranted, at his own expense
- D. The Guarantee shall include the removal and replacement of items or materials installed with the roof specialties as part of the original work, if removal is needed to effect guaranteed repairs.

## PART 2 PRODUCTS

### 2.1 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
  - 1. Bilco Company; NB-50TB, by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.BILCO.com.
  - 2. Substitutions: See Section 01 2500 Substitution Procedures.
- B. Roof Hatches : Factory-assembled aluminum frame and cover, complete with operating and release hardware.
  - 1. Style: Provide flat metal covers unless otherwise indicated.
  - 2. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
  - 3. Thermally Broken Hatches: Added insulation to frame and cover; available in each manufacturer's standard, single leaf sizes; special sizes available upon request
  - 4. For Ships Ladder Access: Single leaf; 30 by 54 inches (762 by 1372 mm).
- C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
  - 1. Material: Mill finished aluminum, 11 gage, 0.0907 inch (2.3 mm) thick.
  - 2. Insulation: Manufacturer's standard; 1 inch (25 mm) rigid glass fiber, located on outside face of curb.
  - 3. Curb Height: 12 inches (305 mm) from surface of roof deck, minimum.
- D. Metal Covers: Flush, insulated, hollow metal construction.
  - 1. Capable of supporting 40 psf (1.92 kPa) live load.
  - 2. Material: Mill finished aluminum; outer cover 11 gage, 0.0907 inch (2.3 mm) thick, liner 0.04 inch (1.0 mm) thick.
    - a. Provide 5" (127mm) beaded flange with formed reinforcing members.
    - b. Interior and exterior surfaces shall be thermally broken with heavy extruded EPDM rubber gasket bonded to the cover interior.
  - 3. Insulation: Manufacturer's standard 3 inch (76 mm) rigid polyisocyanurate. R-value = 20.3 (U=0.279).
  - 4. Gasket: EPDM, continuous around cover perimeter.
- E. Hardware: Type 316 stainless steel, unless otherwise indicated or required by manufacturer.



1. Lifting Mechanisms: Compression spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf (475 kPa) load.
  2. Hinges: Heavy duty pintle type.
  3. Hold open arm with vinyl-coated handle for manual release.
  4. Latch: Upon closing, engage latch automatically and reset manual release.
  5. Manual Release: Pull handle on interior and exterior.
  6. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle.
    - a. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
  7. Locking: Padlock hasp on interior and exterior.
- F. Hatch Guardrail System:
1. Rail Height: 42" above roof surface.
  2. Rails: 1 1/4" sch. 40 pipe in T6 Aluminum alloy rails.
  3. Gate: Cast Aluminum with spring hinges and latch.
  4. Manufacturer: Bil-Guard 2.0; Bilco Co.

## 2.2 FACTORY FABRICATED PIPE CURB PORTALS

- A. Pipe Portals: Furnish and install the pipe portals:
1. Provide exit seals for all portal penetrations.
  2. Pipe Chase Housing:
    - a. .080" Aluminum Body and Lid
    - b. Size: 20.5" x 14.5"
    - c. U.V. Protected powder coated.
    - d. Thermal break construction with gaskets and insulation.
    - e. Stainless steel fasteners.
  3. Curb:
    - a. 0.80" Aluminum
    - b. 18" high
  4. Product:
    - a. Sigrist Exit Seal Portal; Alta Products, LLC Seattle Wash.; Altaproductsllc.com
    - b. Substitutions: Section 01 2500 Substitution Procedures.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Fuller and D'Angelo, P.C. of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with project details, manufacturer's instructions and approved submittals, in manner that maintains roofing system weather-tight integrity.
  1. Test units for proper function and adjust until proper operation is achieved.
  2. Repair finishes damaged during installation.
  3. Restore finishes so no evidence remains of corrective work.

**3.4 CLEANING**

- A. See Section 01 7000 - Execution for additional requirements.
- B. Clean installed work to like-new condition.

**3.5 PROTECTION**

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

**END OF SECTION**

**SECTION 07 8400  
FIRESTOPPING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.4 REFERENCE STANDARDS**

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2018c.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015.
- D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- E. ITS (DIR) - Directory of Listed Products; current edition.
- F. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- G. FM (AG) - FM Approval Guide; current edition.
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- J. UL (FRD) - Fire Resistance Directory; Current Edition.
- K. UL 2079 - Standard Test Method of Fire Resistant Joints

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

**1.6 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

### **2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

### **2.3 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS**

- A. Gypsum Board Walls:
  - 1. Wall to Wall Joints That Have Movement Capabilities (Dynamic):
    - a. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
  - 2. Top of Wall Joints at Concrete Over Metal Deck:
    - a. 2 Hour Construction: UL System HW-D-0034; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
    - b. 2 Hour Construction: UL System HW-D-0043; Specified Technologies Inc. AS200 Elastomeric Spray.
  - 3. Top of Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
    - a. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.

### **2.4 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION**

- A. Penetrations Through Floors or Walls By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 1 & 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 1 & 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 3. Electrical Cables Not In Conduit:
    - a. 1 & 2 Hour Construction: UL System W-J-3199; Hilti CFS-SL SK Firestop Sleeve Kit.
  - 4. Insulated Pipes:
    - a. 1 & 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX intumescent Firestop Sealant.
  - 5. HVAC Ducts, Uninsulated:
    - a. 1 & 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- B. Penetrations Through Floors By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 1 & 2 Hour Construction: UL System F-A-8012; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
  - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:

- a. 1 & 2 Hour Construction: UL System F-A-1016; Hilti CP 680-P/M Cast-In Device.
- 3. Insulated Pipes:
  - a. 2 Hour Construction: UL System F-A-5015; Hilti CP 680-P/M Cast-In Device.
- C. Penetrations Through Walls By:
  - 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Electrical Cables Not In Conduit:
    - a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 3. Insulated Pipes:
    - a. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 4. HVAC Ducts, Uninsulated:
    - a. 1 & 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant or CP 606 Flexible Firestop Sealant.
  - 5. HVAC Ducts, Insulated:
    - a. 1 & 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

## 2.5 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
- B. Penetrations By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 3. Electrical Cables Not In Conduit:
    - a. 1 Hour Construction: UL System W-L-3393; Hilti CFS-SL RK Retrofit Sleeve Kit for existing cables.
  - 4. Insulated Pipes:
    - a. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - 5. HVAC Ducts, Insulated:
    - a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

## 2.6 MATERIALS

- A. Firestopping Sealants: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.

- B. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant; conforming to the following:
  - 1. Manufacturers:
    - a. 3M Fire Protection Products; Product CP-25WB: [www.3m.com/firestop](http://www.3m.com/firestop).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Fiber Firestopping: Mineral fiber insulation used in conjunction with elastomeric surface sealer forming airtight bond to opening; conforming to the following:
  - 1. Density: 4 lb/cu ft (\_\_\_\_\_ kg/cu m).
  - 2. Manufacturers:
    - a. Thermafiber, Inc; Product \_\_\_\_: [www.thermafiber.com](http://www.thermafiber.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

#### **3.2 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

#### **3.3 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

#### **3.4 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

**SECTION 07 9200  
JOINT SEALANTS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Acoustical sealant.
- D. Joint backings and accessories.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 07 2500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- C. Section 07 8400 - Firestopping: Firestopping sealants.
- D. Section 08 8001 - GLAZING: Glazing sealants and accessories.

**1.4 REFERENCE STANDARDS**

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012 (Reapproved 2017).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- F. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
  - 5. Substrates for which use of primer is required.
  - 6. Sample product warranty.
  - 7. Certification by manufacturer indicating that product complies with specification requirements.

- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: Where custom sealant color is specified, obtain directions from Fuller and D'Angelo, P.C. and submit at least two physical samples for verification of color of each required sealant.
- F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- I. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
  - 1. Identification of testing agency.
  - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
    - a. Test date.
    - b. Copy of test method documents.
    - c. Age of sealant upon date of testing.
    - d. Test results, modeled after the sample form in the test method document.
    - e. Indicate use of photographic record of test.
- E. Field Quality Control Plan:
  - 1. Visual inspection of entire length of sealant joints.
  - 2. Field testing agency's qualifications.
  - 3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- F. Field Adhesion Test Procedures:
  - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
  - 2. Have a copy of the test method document available during tests.
  - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
  - 4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
  - 5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Yonkers Public Schools.



6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Fuller and D'Angelo, P.C..
- G. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
  1. Sample: At least 18 inches (457 mm) long.
  2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
  3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

### 1.7 MOCK-UP

- A. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution:
  1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.
- B. Construct mock-up with specified sealant types and with other components noted.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

### 1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
  1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  2. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
  3. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  4. W.R. Meadows, Inc: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
  1. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  2. W.R. Meadows, Inc: [www.wrmeadows.com](http://www.wrmeadows.com).

### 2.2 JOINT SEALANT APPLICATIONS

- A. Scope:
  1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.
    - d. Openings below ledge angles in masonry.
    - e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
  - a. Joints between door, window, and other frames and adjacent construction.
  - b. Other joints indicated below.
3. Do not seal the following types of joints.
  - a. Intentional weepholes in masonry.
  - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
  - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
  - d. Joints where installation of sealant is specified in another section.
  - e. Joints between suspended panel ceilings/grid and walls.
- B. Vertical Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
  1. Type \_\_\_ - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.
- C. Interior Vertical Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
  1. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
- D. Exterior and Interior Horizontal Joints: Single component, self-leveling, premium-grade polyurethane sealant

### 2.3 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.

### 2.4 NONSAG JOINT SEALANTS

- A. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
  1. Movement Capability: Plus and minus 25 percent, minimum.
  2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
  3. Color: To be selected by Fuller and D'Angelo, P.C. from manufacturer's standard range.
  4. Cure Type: Single-component, neutral moisture curing
  5. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
  6. Manufacturers:
    - a. Sika Corporation; Sikasil 728NS: [www.usa-sika.com](http://www.usa-sika.com).
    - b. Substitutions: 01 2500 - Substitution Procedures
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
  1. Color: White.
  2. Applications: Use for:
    - a. Use for all perimeter joints of toilet fixtures, cabinets, casework, countertops and similar locations..
  3. Manufacturers:
    - a. 786 Mildew Resistant; Dow Corning.
    - b. Pecora Corporation; 898 Silicone Sanitary Sealant: [www.pecora.com](http://www.pecora.com).
    - c. Sika Corporation; Sikasil GP: [www.usa-sika.com](http://www.usa-sika.com).
    - d. Sanitary 1700; GE Silicones..
  4. Substitutions: 01 2500 - Substitution Procedures
- C. Type Acoustical Sealant: - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-hardening, non-sagging; not intended for exterior use.

1. Color: To be selected by Fuller and D'Angelo, P.C. from manufacturer's standard range.
2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
3. Manufacturers:
  - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant: [www.pecora.com](http://www.pecora.com).
4. Applications: Use for:
  - a. Use for all interior joints of where acoustical sealant indicated.
5. Substitutions: 01 2500 - Substitution Procedures

## 2.5 SELF-LEVELING SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
  1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
  2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
  3. Color: To be selected by Fuller and D'Angelo, P.C. from manufacturer's standard range.
  4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
  5. Manufacturers:
    - a. Sika Corporation; Sikaflex 1c SL: [www.usa-sika.com](http://www.usa-sika.com).
    - b. Use for all horizontal exterior joints and Interior joints in wet areas..
- B. Type \_\_\_ - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
  1. Movement Capability: Plus and minus 25 percent, minimum.

## 2.6 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
  1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
  2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type C - Closed Cell Polyethylene.
  3. Open Cell: 40 to 50 percent larger in diameter than joint width. (Not to be used in flat or horizontal joints)
  4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width. (Use for flat and horizontal joints)
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
  1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.

2. Notify Fuller and D'Angelo, P.C. of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Fuller and D'Angelo, P.C..
5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

### **3.2 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

### **3.3 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Self-leveling joints: Recess joint depth as recommended by the sealant manufacturer.

### **3.4 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION**

**SECTION 08 1113  
HOLLOW METAL DOORS AND FRAMES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Fire-rated hollow metal doors and frames.
- B. Accessories, including glazing.

**1.3 RELATED REQUIREMENTS**

- A. Section 04 2000 - Unit Masonry.
- B. Section 08 7100 - Door Hardware.
- C. Section 09 9123 - Interior Painting.

**1.4 ABBREVIATIONS AND ACRONYMS**

- A. HMMA: Hollow Metal Manufacturers Association.
- B. SDI: Steel Door Institute.
- C. UL: Underwriters Laboratories.

**1.5 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2003 (R2009).
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- G. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
- I. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- J. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2018.
- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.
- L. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus

- M. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- O. ITS (DIR) - Directory of Listed Products; current edition.
- P. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- Q. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- R. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2019.
- S. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2017.
- U. UL (BMD) - Building Materials Directory; current edition.
- V. UL (DIR) - Online Certifications Directory; Current Edition.
- W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- X. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes..
- C. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- D. Shop Drawings: Details of each opening, showing elevations.
  - 1. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 3. Locations of reinforcement and preparations for hardware.
  - 4. Details of anchorages, joints, field splices, and connections.
  - 5. Details of accessories.
  - 6. Details of moldings, removable stops, and glazing.
- E. Samples: If requested by YPS Office of Facilities Management and Fuller and D'Angelo, P.C. Submit two samples of metal, 2 by 2 inches (51 by 51 mm) in size, showing factory finishes, colors, and surface texture.
- F. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- G. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five (5) years documented experience and SDI Certified.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.

1. Temperature-Rise Limit: At vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- E. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

#### **1.9 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### **1.10 COORDINATION**

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

#### **1.11 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

### **PART 2 PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Hollow Metal Doors and Frames:
  1. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com).
  2. Curries, an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com).
  3. Substitutions: See Section 01 2500 Substitution Procedures..

#### **2.2 PERFORMANCE REQUIREMENTS**

- A. Requirements for Hollow Metal Doors and Frames:
  1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
  4. Door Edge Profile: Beveled.
  5. Typical Door Face Sheets: Flush.
  6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
    - a. Provide 14 gauge channel reinforcing for all door closers.

7. Galvanizing including all doors and frames: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.

### 2.3 STEEL DOORS

- A. Fire-Rated Doors:
  1. Grade: ANSI A250.8 Level 4, physical performance Level A, Model 1, full flush continuous welded.
    - a. Level 4 - Maximum-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 14 gage, 0.067 inch (1.7 mm), minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
    - a. Temperature-Rise Rating (TRR) Across Door Thickness: 250 degrees F (121 degrees C) maximum.
    - b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    - c. Attach fire rating label to each fire rated unit.
  3. Door Core Material: Vertical steel stiffeners. 22ga., 6" o.c., Welded to face sheets 5" o.c.
  4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
  5. Door Face Sheets: Flush.
  6. Door Finish: Factory primed and field finished.
  7. Product:
    - a. Ceco Door, an Assa Abloy Group company; Medallion Maxim: [www.assaabloydss.com](http://www.assaabloydss.com).

### 2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Interior Door Frames, Fire Rated: Full profile/continuously welded type.
  1. Frame Metal Thickness: 12 gage, 0.093 inch (2.36 mm), minimum.
  2. Frame Finish: Factory primed and field finished.
  3. Product:
    - a. Curries, an Assa Abloy Group Company; M Series; MK for doors over 4'-0" wide: [www.assaabloydss.com](http://www.assaabloydss.com).
    - b. Ceco Door, an Assa Abloy Group company; SU Series: [www.assaabloydss.com](http://www.assaabloydss.com).

### 2.5 FINISHES

- A. Refer to Section 09 9123 Interior Painting for final field painting.
- B. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

### 2.6 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  1. Size: As indicated on drawings.
  2. Frame Material: 18 gage, 0.0478 inch (1.21 mm), galvanized steel.
  3. Metal Finish: Match door finish .
  4. Glazing: 3/4 inch (20 mm) thick, Fire rate glazing.
    - a. Fire Rating: 45 min.
    - b. Impact safety rated in accordance with ANSI Z97.1 and CPSC 16 CFR1201 Cat. I and II
    - c. Hose Stream Tested.



- d. Heat TRansfer Rated in accordance with ASTM E-119 / UL 263
- e. Product:
  - a) Pilkington Pyrostop; Technical Glass Products; fireglass.com.
  - b) Substitutions: See Section 01 2500 Substitution Procedures
- B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- D. Frame Anchors: Minimum of six wall anchors and two base anchors.
  - 1. T anchors for masonry.
  - 2. Spacers and expansion anchors for existing masonry wall installations. Provide countersunk recess for all anchors.
- E. Frame Repairs:
  - 1. Repair dents, patch rust holes, fill in chips etc., and fill of expansion anchor counter sink.
  - 2. Body Filler With Hardener.
  - 3. Color: Light Gray.
  - 4. Manufacturer: 3M Product "Bondo Body Filler 265".

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected

#### **3.2 PREPARATION**

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware
- E. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

#### **3.3 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated and NAAMM HMMA 840.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Expansion anchor frames to existing masonry wall locations.
- F. Install door hardware as specified in Section 08 7100.
- G. Comply with glazing installation requirements of the glazing manufacturer.
- H. Fill any frame damage or defects with repair filler.

- I. Fill all expansion anchor countersink with repair filler.
- J. Touch up damaged factory finishes.
- K. Fiels paint all doors and frames in accordance with Specification section 09 9113

### **3.4 TOLERANCES**

- A. Non-Fire-Rated Standard Steel Doors:
  - 1. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
  - 2. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
  - 3. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
  - 4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch
- B. Fire-Rated Doors: Install doors with clearances according to NFPA 80
- C. Field Glazing: Comply with installation requirements of glazing manufacturer and with hollow metal manufacturer's written instructions

### **3.5 ADJUSTING AND CLEANING**

- A. Adjust for smooth and balanced door movement. Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

### **3.6 SCHEDULE**

- A. Refer to Door and Frame Schedule on the drawings.

**END OF SECTION**

**SECTION 08 7101  
DOOR HARDWARE**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY**

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
- C. Related Sections:
  - 1. Section 06 1000 - Rough Carpentry.
  - 2. Section 08 1113 - Hollow Metal Doors and Frames.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. Section 01 4100 - Regulatory Requirements: State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series
  - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

**1.3 SUBMITTALS**

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  - 3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

- e. Explanation of abbreviations, symbols, and codes contained in schedule.
  - f. Mounting locations for door hardware.
  - g. Door and frame sizes and materials.
  - h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

#### **1.4 QUALITY ASSURANCE**

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum five (5) years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum three (3) years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum five (5) years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Building Information Modeling (BIM) Qualifications: BIM software tools and processes are used to produce and support data integration of product and technical information used in specifications, submittals, project reviews, decision support, and quality assurance during all phases of Project design,

construction, and facility management. Door and hardware schedules and the associated product data parameters are to be derived, updated, and fully integrated with the coordinated Building Information Modeling as required under Division 01

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. At completion of installation, provide hardware supplier and installer shall inspect and written documentation to YPS Office of Facilities Management and Fuller and D'Angelo, P.C. that all components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to YPS Office of Facilities Management via registered mail or overnight package service. Instructions for delivery to the YPS Office of Facilities Management shall be established at the "Keying Conference".

#### **1.6 COORDINATION**

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### **1.7 WARRANTY**

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Seven years for heavy duty cylindrical (bored) locks and latches.
  - 2. Five years for exit hardware.
  - 3. Twenty five years for manual surface door closer bodies.

## 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for YPS Office of Facilities Management's continued adjustment, maintenance, and removal and replacement of door hardware. Refer to Section 01 7900 - Demonstration and Training.

## PART 2 PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Section 01 2500 - Substitution Procedures. Approval of requests is at the discretion of the YPS Office of Facilities Management and Fuller and D'Angelo, P.C.
  - 1. Fuller and D'Angelo, P.C. will not review or approve substitutions during the bidding phase.

### 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Three Hinges: For doors with heights 61 to 90 inches.
  - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. 5" heavy weight as specified.
  - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Interior Doors: Heavy weight, steel, ball bearing hinges.
  - 4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
    - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed.
  - 5. Acceptable Manufacturers:
    - a. McKinney Products (MK). ASSA ABLOY Architectural Door Accessories (MK) - TA Series.
    - b. Bommer Industries (BO) - LB Series.
    - c. Hager Companies (HA) - CB Series.

### 2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
  - 1. Manufacturers:
    - a. Corbin Russwin Hardware (RU).
- C. Cylinders: Original manufacturer cylinders complying with the following:
  - 1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.

2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Match Facility Standard
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (6 pin large format) as specified in Hardware Sets.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. Existing System: Field verify and key locks to match Owner's existing system.
- F. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Three (3).
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
  4. Construction Control Keys (where required): Two (2).
  5. Permanent Control Keys (where required): Two (2).
- G. Construction Keying: Provide temporary keyed construction cores.
- H. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified.
1. Furnish with solid cast levers, standard 2 3/4" backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt.
  2. Locks are to be non-handed and fully field reversible.
  3. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA 156.2 requirements to 2 million cycles.
  4. Manufacturers:
    - a. Corbin Russwin Hardware (RU) – CL3300 Series.
    - b. Sargent Manufacturing (SA) – 10 Line.

## 2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:
  - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
  - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
  - 4. Dustproof Strikes: BHMA A156.16.

## 2.6 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
  - 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  - 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  - 3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  - 4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  - 5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  - 6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  - 7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  - 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  - 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  - 10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.
  - 1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    - b. Sargent Manufacturing (SA) - 80 Series.

## 2.7 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
  - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
  - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
    - a. All closer covers shall be metal.



3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
  4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
  5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DC8000 Series.
    - b. Sargent Manufacturing (SA) - 351 Series.
    - c. Norton Door Controls (NO) - 7500 Series.

## 2.8 ARCHITECTURAL TRIM

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
  2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
  3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
  4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
    - a. Stainless Steel: 300 grade, 050-inch thick.
  5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
  6. Manufacturers:
    - a. Hiawatha, Inc. (HI).
    - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    - c. Trimco (TC).

## 2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
1. Acceptable Manufacturers:

- a. Hiawatha, Inc. (HI).
  - b. Rockwood Manufacturing (RO).
  - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
1. Manufacturers:
    - a. Rixson Door Controls (RF).
    - b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
    - c. Sargent Manufacturing (SA).

## **2.10 ARCHITECTURAL SEALS**

- A. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- B. Acceptable Manufacturers:
1. National Guard Products (NG).
  2. Pemko Manufacturing (PE).
  3. Reese Enterprises, Inc. (RS).

## **2.11 FABRICATION**

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## **2.12 FINISHES**

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify YPS Office of Facilities Management of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### **3.2 PREPARATION**

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

### **3.3 INSTALLATION**

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 3. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07 9200 - Joint Sealants.
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### **3.4 FIELD QUALITY CONTROL**

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

### **3.5 ADJUSTING**

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

### **3.6 CLEANING AND PROTECTION**

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### **3.7 DEMONSTRATION**

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware. Refer to Section 01 7900 - Demonstration and Training for additional requirements.

### **3.8 DOOR HARDWARE SETS**

- A. The hardware sets represent the design intent and direction of the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. They are a guideline only and should not be considered a detailed hardware

schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate selection for the material and application.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RU - Corbin Russwin
3. SA - SARGENT
4. MC - Medeco
5. RF - Rixson
6. NO - Norton
7. RO - Rockwood
8. PE - Pemko

**3.9 HARDWARE SETS**

**Set: 1.0**

2	Hinges, Anchor, Hvy Wt (Sq. Edge Door) TA792 5" x 4-1/2"	US26D	MK	
4	Hinges, Hvy Wt (Sq. Edge Door) TA786 5" x 4-1/2"	US26D	MK	
1	Pair Flush Bolts FB 457	US32D	Ives	
1	Dust Proof Strike DP-1	US32D	Ives	
1	Lockset -Storage CL3357 PZD CT6B	US32D	SA	
1	Permanent Core CR8000	626	RU	
1	Kick Plate K1050 - 10" x 2" LDW 4BE x CSK	US32D-316	RO	x
2	Surface Closer CLP7500	689	NO	
1	Gasketing S773BL		PE	
1	Astragal S772BL		PE	

**Set: 2.0**

Doors: 01, 101

1	Hinges, Anchor, Hvy Wt (Sq. Edge Door) TA792 5" x 4-1/2"	US26D	MK	
2	Hinges, Hvy Wt (Sq. Edge Door) TA786 5" x 4-1/2"	US26D	MK	
1	Lockset -Storage CL3357 PZD CT6B	US32D	SA	
1	Permanent Core CR8000	626	RU	
1	Conc Overhead Stop 6-336	630	RF	
12	Door Closer 7500 / P7500	689	NO	
1	Kick Plate K1050 - 10" x 2" LDW 4BE x CSK	US32D-316	RO	x

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**DOOR HARDWARE**

1	Gasketing	S773BL		PE
1	Astragal	S772BL		PE

**Set: 3.0**

Doors: 05, 100, 105

1	Hinge, Anchor, Hvy Wt (Sq. Edge Door)	TA792 5" x 4-1/2"	US26D	MK
2	Hinges, Hvy Wt (Sq. Edge Door)	TA786 5" x 4-1/2"	US26D	MK
1	Rim Exit Device, Passage	12 8815 ETP	US32D	SA
1	Permanent Core	CR8000	626	RU
1	Cylinder	As Required x Temp Core	626	RU
1	Door Closer	7500 / P7500	689	NO
1	Kick Plate	K1050 - 10" x 2" LDW x 4BE x CSK	US32D-316	RO
1	Wall Stop	400 / 441CU	US26D	RO
1	Gasketing	S773BL		PE

**Set: 4.0**

3	Hinges, Hvy Wt (Sq. Edge Door)	TA786 Exist. x 4-1/2"	US26D	MK
1	Reinforcing Pivot	MK5540	US32D	MK
1	Door Closer	P7500	689	NO
2	Electromechanical mortise lockset	ML20906xSEC PZD CT6B	626	RU
1	Permanent Core	CR 8000	626	RU
1	Wall Stop	400 / 441CU	US26D	RO
1	Gasketing	S773BL		PE
1	Kick Plate	K1050 - 10" x 2" LDW x 4BE x CSK	US32D-316	RO
1	Power transfer cable	TSB-C		MK

**Set: 5.0**

1	Electric Strike	9600	628	HES
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(Install in exsisting frame. Extend wares through frame to door head.)

**END OF SECTION**



**SECTION 08 9100**  
**LOUVERS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Louvers, frames, and accessories.
- B. Foam sealant for filling perimeter of louver space..

**1.3 RELATED REQUIREMENTS**

- A. Section 04 0100 - Maintenance of Masonry
- B. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section .
- D. Section 23 0400 - Sheet metal Work and Related Accessories: Ductwork attachment to louvers, and blank-off panels.

**1.4 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- B. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum; 2017a.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- E. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum five (5) years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- D. Welding: Qualify procedures and personnel according AWS D1.2, "Structural Welding Code--Aluminum."
- E. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

### 1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
1. Finish: Include twenty year coverage against degradation of exterior finish.

## PART 2 PRODUCTS

### 2.1 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf (1.2 kPa) without damage or permanent deformation.
  2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft (3.1 g/sq m) water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
  3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
  4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
- B. Stationary Louvers, Type 4": Horizontal blade, extruded aluminum construction.
1. Free Area: 8.67 sf., minimum.
  2. Static Pressure Loss: 0.14 maximum per square foot (square meter) of free area at velocity of 961 fpm, when tested in accordance with AMCA 500-L.
  3. Blades: Drainable.
  4. Frame: 4 inches (100 mm) deep, channel profile; corner joints mitered and, with continuous recessed caulking channel each side.
  5. Aluminum Thickness: Frame 0.081" minimum; blades 0.081" minimum.
  6. Product: Use the following : AiroLite K6774 with flange at wall louvers.
    - a. Substitutions: See Section 01 2500 Substitution Procedures.

### 2.2 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T-5 temper.

### 2.3 FINISHES

- A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch (0.030 mm).
1. Manufacturers:



- a. PPG Metal Coatings; Duranar: [www.ppgmetalcoatings.com](http://www.ppgmetalcoatings.com).
  - b. Sherwin-Williams Company; SHER-NAR 5000: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - c. Substitutions: See Section 01 2500 Substitution Procedures
- B. Color: As selected from manufacturer's standard colors.

## 2.4 ACCESSORIES

- A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch (38 mm) thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct. Coordinated with HVAC Contractor.
- B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
- C. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch (1.63 mm) diameter wire, 1/2 inch (13 mm) open weave, diagonal design.
- D. Window and Door Joint Seal: Polyurethane-based joint filler:
  - 1. UL Classified.
  - 2. Product: "Great Stuff" as manufactured by Dow Chemical.
    - a. "Gaps and Cracks: for joints less than 1".
    - b. "Big Gap Filler" for joint over 1".
  - 3. Use for all filling all spaces and joints around louvers located on exterior walls.
- E. Sealant: Type, as specified in Section 07 9200 - Joint Sealants.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### 3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Coordinate with installation of flashings by others.
- C. Install louvers level and plumb.
- D. Set sill members and sill flashing in continuous bead of sealant.
- E. Align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- F. Secure louver frames in openings with concealed fasteners.
- G. Fill all exterior spaces and joint between windows and doors solid with foam in accordance with manufacture's instructions.
  - 1. Cut back to permit application of joint sealant.
- H. Install perimeter sealant and backing rod in accordance with 07 9200 - Joint Sealants.
- I. Coordinate with installation of mechanical ductwork.

### 3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

**END OF SECTION**



**SECTION 09 2116**  
**GYPSUM BOARD ASSEMBLIES**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Metal stud soffit/ceiling framing.
- B. Metal Trim.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 5100 - Acoustical Ceilings.

**1.4 REFERENCE STANDARDS**

- A. AISI S220 - North American Standard for Cold-Formed Steel Framing - Nonstructural Members; 2015.
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015.
- C. ASTM C473-19 - Standard Test Methods For Physical Testing Of Gypsum Panel Products.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2018.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- G. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2018b.
- J. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- N. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
- O. UL (FRD) - Fire Resistance Directory; Current Edition.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum Ten (10) years of experience.
- B. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of experience.

## PART 2 PRODUCTS

### 2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:

### 2.2 METAL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
- B. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. Marino: [www.marinoware.com](http://www.marinoware.com).
- C. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
  - 1. Studs: "C" shaped.
    - a. Minimum Base Metal Thickness: 0.0312 (20 gauge), unless noted otherwise.
    - b. Depth: As indicated.
  - 2. Runners: U shaped, sized to match studs.
  - 3. Ceiling Channels: C-shaped.
- D. Soffit Framing:
  - 1. Components, General: Comply with ASTM C 754 for conditions indicated.
  - 2. Hangers:
    - a. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
  - 3. Steel Studs: ASTM C 645.
    - a. Minimum Base Metal Thickness: As indicated.
    - b. Depth: As indicated on drawings.
  - 4. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
    - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      - a) Manufacturer's standard furring systems.
    - b. Main Beam: Shall be double-web construction (minimum 0.0179 inch prior to protective coating), hot dipped galvanized (per ASTM A653).
      - a) HD8901: 1-1/2 inch web height, prefinished 15/16 inch flange with minimum G40 hot dipped galvanization.
    - c. Primary Cross Tees: Shall be double-web steel construction (minimum 0.0179 inch prior to protective coating), hot dipped galvanized (minimum G40 or G90 per ASTM A653), web height 1-1/2 inch with rectangular bulb and prefinished 1-1/2" knurled flange.
    - d. Screws for wallboard application shall be bugle head screws in accordance with thickness of material used.
  - 5. Structural Classification:

- a. Main Beam shall be heavy duty per ASTM C 635.
- b. Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals and horizontal loads shall have a maximum deflection of 1/360 of the span.

### 2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  1. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
  2. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  3. USG Corporation: [www.usg.com](http://www.usg.com).
  4. Substitutions: See Section 01 2500 Substitution Procedures
- B. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  1. Application: Soffits and ceilings, unless otherwise indicated.
  2. Thickness: 5/8 inch (16.25 mm).
  3. Edges: Tapered.
  4. Products:
    - a. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board: [www.gpgypsum.com](http://www.gpgypsum.com).
    - b. USG Corporation; 5/8 Inch Sheetrock Brand UltraLight Panels: [www.usg.com](http://www.usg.com).
    - c. Substitutions: See Section 01 2500 Substitution Procedures

### 2.4 GYPSUM WALLBOARD ACCESSORIES

- A. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel, unless noted otherwise.
  1. Corner Beads: Low profile, for 90 degree outside corners.
  2. L-Trim with Tear-Away Strip: Sized to fit the thickness gypsum wallboard.
- B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  1. Mold resistant and asbestos free.
  2. Joint Compound: Drying type, vinyl-based, ready-mixed.
  3. Joint Compound: Setting type, field-mixed.
- C. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

### 3.2 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Soffit Framing: Space framing and furring members as indicated.
  1. Level soffit system to a tolerance of 1/1200.
  2. Laterally brace entire suspension system.
- C. Studs: Space studs at 16 inches (400 mm) on center, unless shown otherwise
- D. Suspended Ceiling and Soffits: Space framing and furring members as indicated.

### 3.3 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Installation on Metal Framing: Use screws for attachment of gypsum board.

### **3.4 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
  - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

### **3.5 JOINT TREATMENT**

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with setting type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
  - 2. Taping, filling, and sanding are not required at base layer of double-layer applications.

### **3.6 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

### **3.7 FINISH LEVEL SCHEDULE**

- A. Level 1: Above finished ceilings concealed from view.
- B. Level 4: Walls and ceilings scheduled to receive flat or eggshell paint finish.

**END OF SECTION**

**SECTION 09 5100**  
**ACOUSTICAL CEILINGS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. New and Replacement of acoustical panels and suspended grid indicated on drawings.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 9200 - Joint Sealants.
- C. Divisions 23 and 26 for air outlets and inlets, light fixtures, and fire alarm.

**1.4 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- E. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- G. CHPS (HPPD) - High Performance Products Database; Current Edition at [www.chps.net/](http://www.chps.net/).
- H. Ceilings and Interior Systems Construction Association (CISCA): Code of Practices.

**1.5 ADMINISTRATIVE REQUIREMENTS**

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

**1.6 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples 12 x 12 inch (300 by 300 mm) in size illustrating material and finish of acoustical units.
- E. Samples: Submit two samples each, 12 inches (300 mm) long, of suspension system main runner.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

### **1.7 QUALITY ASSURANCE**

- A. Fire Performance: ASTM E84 surface burning characteristics. Flame Spread index 25 or less. Smoke development index 50 or less. (UL Labeled) Class A in accordance to ASTM E1264
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.
- D. Installers Qualifications: Company specializing in the installation of acoustical ceilings specified in this section with minimum 5 years documented experience.
- E. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by YPS Office of Facilities Management and Fuller and D'Angelo, P.C..
  - 2. Do not proceed with remaining work until workmanship, material, color, and sheen are approved by YPS Office of Facilities Management and Fuller and D'Angelo, P.C..
  - 3. Refinish mock-up area as required to produce acceptable work.
- F. Pre-installation Conference: Conduct conference at Project site minimum one week before removal and installation. Agenda shall include project conditions, coordination with work of other trades, and layout of items which penetrate ceilings.

### **1.8 EXTRA MATERIALS**

- A. See Section 01 6000 - Product Requirements.
- B. Deliver extra acoustical units for YPS Office of Facilities Management's use in maintenance. Label and store where directed by the YPS Office of Facilities Management including codes used on the Drawings. Do not deliver to the Project site until the YPS Office of Facilities Management is prepared to receive and store maintenance materials.
  - 1. Panels: Furnish 5 percent of total acoustic unit area of extra panels to YPS Office of Facilities Management.
  - 2. Suspension System Components: Furnish 5 percent of each exposed component of the quantity installed.

### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet conditions such as concrete, plaster, paint, and adhesives have been completed and cured.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Protect system components from excessive moisture in shipment, storage, and handling

### **1.10 WARRANTY**

- A. Warranty: Provide manufacturer's standard warranty against manufacturing defects in material or workmanship when installed in accordance with the current CISCA Handbook and ASTM C367.
  - 1. Warranty Period: 30 years.

### **1.11 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

## **PART 2 PRODUCTS**

### **2.1 ACOUSTICAL UNITS**

- A. Acoustical Panels, Type ACT-1 : Painted wet formed mineral fiber, with the following characteristics:
  - 1. Classification: ASTM E1264 .



- a. Type III, Form 1, Pattern E I, Fire Class A.
2. Size: 24 by 24 inches (610 by 610 mm) and 24 by 48 inch (610 by 1219 mm) as indicated on drawings
3. Thickness: 7/8 inches (2.1875 mm).
4. Light Reflectance: 0.85 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.75, determined in accordance with ASTM E1264.
6. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
8. Panel Edge: Square.
9. Tile Edge: Square.
10. Color: White.
11. Suspension System Type Prelude XL: Exposed grid.
12. Products:
  - a. Armstrong World Industries, Inc: [www.armstrongceilings.com](http://www.armstrongceilings.com).
  - a) Cirrus High NRC 563 for 24 x 24.
  - b. Substitutions: See Section 01 2500 - Substitution Procedures..

## 2.2 SUSPENSION SYSTEM(S)

- A. Manufacturers:
  1. Armstrong World Industries, Inc; Product Prelude XL 15/16": [www.armstrong.com](http://www.armstrong.com).
  2. Structural Classification: Intermediate duty, ASTM C 635.
- B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.

## 2.3 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch (2 mm) galvanized steel wire.
- C. Perimeter Moldings: Same metal and finish as grid.
  1. Minimum 7/8" horizontal flange
- D. Acoustical Sealant For Perimeter Moldings: Specified in Section 07 9200 - Joint Sealants.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

### 3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Repair and Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

### **3.4 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
  - 1. Cut to fit existing grid, tile and provide new units as required at new windows.
  - 2. Make field cut edges of same profile as factory edges.
- F. Install seismic clips or stabilizer bars as per code requirements.

### **3.5 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

### **3.6 ADJUSTING AND CLEANING**

- A. Replace damaged or broken material, Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with mfg., touch up procedures using Armstrong Item #5760 8 oz, touch up paint as required for small nicks and minor scratches in the surface, Remove and replace any work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.
  - 1. Provide touch up kit for YPS Office of Facilities Management's use.

### **3.7 SCHEDULE**

- A. As indicated on drawings.

**END OF SECTION**

**SECTION 09 6500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Removals.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

**1.3 RELATED REQUIREMENTS**

- A. Section 02 2080 - Asbestos Removal and Disposal.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.4 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2017.
- B. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2006 (Reapproved 2018).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.
- E. ASTM F925: Standard Test Method for Resistance to Chemicals of Resilient Flooring.
- F. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2013a.
- G. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.
- H. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- I. ASTM F-1869 Test Method for Measuring Moisture Vapor Emissions in Concrete.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.
- K. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs.
- L. ASTM F2420 - Standard Test Method for Determining Relative Humidity on the Surface of Concrete

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 12" x 12" in size illustrating color and pattern for each resilient flooring product specified.
- D. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- G. MSDS (Material Safety Data Sheets) should be submitted for all adhesives used:
  - 1. Membrane, primer, patch, leveler, heat weld rod, cold weld, liquid wax and cleaning agents
- H. Maintenance Materials: Furnish the following for Yonkers Public Schools's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Materials: Furnish one box of tile for each fifty boxes or fraction thereof, for each type, color, pattern and size of the tile installed, from same manufactured lot as materials installed.
    - a. Deliver extra tile to Owner after completion of work.
    - b. Furnish tiles in protective packaging with identifying labels.

#### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum 10 years documented experience, with resilient flooring of types equivalent to those specified.
  - 1. Manufacturers proposed for use, which are not named in this section, shall submit evidence of ability to meet performance requirements specified not less than 10 days prior to bid date.
    - a. Color Matching: Provide resilient flooring products, including wall base and accessories, from one manufacturer to ensure color matching.
    - b. Manufacturer capable of providing technical training and field service representation.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions

#### **1.8 MOCK UP**

- A. Field Samples per Section 001 4000 - Quality Requirements. Provide field samples, dry laid, to demonstrate aesthetic effects of materials in place.

#### **1.9 FIELD CONDITIONS**

- A. Store materials for not less than 48 hours before, during, and 72 hours after installation, in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

#### **1.10 PRE-INSTALLATION TESTING**

- A. Conduct pre-installation testing as follows:
  - 1. ASTM F-1869 Test Method for Measuring Moisture Vapor Emissions in Concrete Maximum: 3 lbs/1000 SF
  - 2. ASTM F-2170 Test Method for Determining Relative Humidity in Concrete: Maximum RH: 55%.

#### **1.11 WARRANTY**

- A. Provide manufacturer's non-prorated ten (10) year limited warranty to be free from defects in material and workmanship, under normal use and service, to repair or replace all defective tiles including reasonable labor.

## **PART 2 PRODUCTS**

### **2.1 TILE FLOORING**

- A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
  - 1. Manufacturers:
    - a. Armstrong Flooring, Inc; Standard Excelon Imperial Texture: [www.armstrongflooring.com](http://www.armstrongflooring.com).
    - b. Substitutions: 01 2500 - Substitution Procedures.
  - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648.
  - 3. Fire Test Data – Smoke Evolution ASTM E 662: 450 or less.
  - 4. Size: 12 by 12 inch (305 by 305 mm).
  - 5. VOC Content Limits: As specified in Section 01 6116.
  - 6. Squareness: ASTM F 2055: 0.010 in. maximum.
  - 7. Chemical Resistance: ASTM F 925: No more than slight change in surface dulling, attack or staining.
  - 8. Static Load Resistance: ASTM F 970: <0.005 in.
  - 9. ADA Standards for Accessible Design: Floor surfaces shall be stable, firm and slip-resistant.
  - 10. Pattern: Match Existing
  - 11. Color: To be selected from manufacturer's standards to match existing.

### **2.2 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and Style A straight for carpet installation as follows:
  - 1. Manufacturers:
    - a. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
  - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  - 3. Height: 4 inch (100 mm) and 2-1/2 inch (62 mm).
  - 4. Thickness: 0.125 inch (3.2 mm).
  - 5. Length: Roll.
  - 6. Color: To be selected from manufacturer's standards to match existing.

### **2.3 ACCESSORIES**

- A. Adhesive for Vinyl Tile Flooring:
  - 1. Adhesive shall be as recommended by the manufacturer, compatible with tile and substrate.
    - a. Note that recommendations shall be made which reflect and are compatible with the results of moisture level tests in the concrete substrate.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
  - 1. Test as Follows:
    - a. Internal Relative Humidity: ASTM F2170.
    - b. Moisture Vapor Emission: ASTM F1869.

2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Moisture Testing: Moisture testing shall be performed using ASTM test method ASTM F 2170 in situ Relative Humidity Test. The acceptable test result when using test method F 2170 should not exceed seventy five per cent (75%) AND pH readings should not exceed 9.0.
- E. Verify that existing concrete sub floor do not containing curing compound by placing 1/4 cup of water on surface. If water beads up scarify surface.
- F. Verify that required floor-mounted utilities are in correct location.

### **3.2 PREPARATION**

- A. Existing flooring shall be removed by Asbestos sub-contractor. Refer to Section 02 2080.
  1. Do not proceed until removal is completed and clearances authorized.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Concrete substrate that fully conforms to the requirements of ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring is required, or as detailed in the manufacturer's Installation Guide.
- D. Crack and Joint Repair: Concrete must be structurally sound, solid, dry, and free of laitance, dirt, debris, coatings, sealers, solvent base adhesives and any contaminant that may act as a bond breaker.
  1. Dry diamond blade may be used to prepare cracks and create a clean surface for bonding.
  2. Do not use sweeping compounds, solvents or acid etching to prepare the surface.
  3. Cracks or joints should be free of dust, dirt, oils and any other debris.

### **3.3 INSTALLATION GENERAL**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.

Adhesive-Applied Installation:

  1. Spread only enough adhesive to permit installation of materials before initial set as recommended by the manufacturer.
  2. Fit joints and butt seams tightly.
  3. Set flooring in place, press with heavy roller to attain full adhesion.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  1. Resilient Strips: Attach to substrate using adhesive.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- F. Do not mix manufacturing batches of a color within the same area.
- G. Do not install resilient flooring over building expansion joints.
- H. Do not install defective or damaged resilient flooring.
- I. Install resilient flooring without voids at seams. Lay seams together without stress.
- J. Remove excess adhesive immediately

### **3.4 INSTALLATION TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install square tile to pattern to match existing tiles. Allow minimum 1/2 full size tile width at area perimeter.

- D. Lay out tiles to match existing.

### **3.5 INSTALLATION RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### **3.6 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.
- C. Cleaning of Vinyl Composition Tile
  1. Sweep or dust mop to remove dirt and grit. Do not use treated dust mops.
  2. Add heavy duty cleaner to cool water following the manufacturer's instructions.
  3. Remove the solution with a wet-dry vacuum or auto scrubber until floor is dry and free of residue.
  4. Rinse the floor with clean water. Repeat the rinse process as necessary to remove all haze and residue.
  5. Apply three to five coats of high gloss or matte floor finish following the manufacturer's instructions.

### **3.7 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation and 72 hours heavy rolling loads.

**END OF SECTION**





**SECTION 09 9000  
PAINTING AND COATING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Surface preparation.
- B. Interior painting and coating systems.
- C. Exterior painting and coating systems.
- D. Scope:
  - 1. Finish all newly installed surfaces, existing surfaces disturbed by construction activities, or areas and surfaces noted to be painted in the finish schedule. Finish all exposed to view surfaces, unless fully factory-finished and unless otherwise indicated, including the following:
    - a. Exterior:
      - a) Metal, Miscellaneous: Iron, ornamental iron, structural iron and steel, and other ferrous metal.
    - b. Interior:
      - a) Concrete Masonry Units: Concrete, split face, scored, smooth, high density, low density, and fluted.
      - b) Metal: New ductwork; galvanized.
      - c) Metal: Miscellaneous structural steel, new doors and frames, and other ferrous metal.
      - d) Drywall: Walls, ceilings, gypsum board, and similar items.
      - e) Concrete: Floors, non-vehicular.
  - 2. Do not paint or finish the following:
    - a. Exterior galvanized steel..

**1.2 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications: Shop-primed items.

**1.3 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- C. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).
- D. SSPC-SP 3 - Power Tool Cleaning; 1982, with Editorial Revision (2004).
- E. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Product characteristics.
  - 2. Surface preparation instructions and recommendations.
  - 3. Primer requirements and finish specification.
  - 4. Storage and handling requirements and recommendations.
  - 5. Application methods.
  - 6. Clean-up information.

**1.5 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

## 1.7 FIELD CONDITIONS

- A. Do not apply materials when environmental conditions are outside the ranges required by manufacturer.
- B. Follow manufacturer's recommended procedures for producing the best results, including testing substrates, moisture in substrates, and humidity and temperature limitations.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide Sherwin-Williams Company (The) products indicated; [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).
- B. Comparable Products: Products of approved manufacturers will be considered in accordance with 01 6000 - Product Requirements, and the following:
  - 1. Products that meet or exceed performance and physical characteristics of basis of design products.

### 2.2 PAINTINGS AND COATINGS

- A. General:
  - 1. Provide factory-mixed coatings unless otherwise indicated.
  - 2. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application.
  - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless specifically indicated in manufacturer's instructions.
- B. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
- C. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

### 2.3 Paint Systems - Exterior

- A. Metal, Miscellaneous: Structural iron and steel, ferrous metal.
  - 1. Alkyd Systems, Water-Based:
    - a. Low Sheen Finish:
      - a) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).  
(a) 5 mils wet, 2 mils dry per coat.
      - b) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane Enamel Low Sheen, B53-1250 Series: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).  
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.

### 2.4 Paint Systems - INTERIOR

- A. Masonry CMU: Smooth, high density or low density.

1. Latex Systems:
  - a. Eg-Shel Finish Scuff Resistant Waterbase Enamel:
    - a) 1st Coat: Sherwin-Williams PrepRite Block Filler, B25W25:  
www.sherwin-williams.com/#sle.  
(a) 75 to 125 sq ft/gal (1.8 to 3.1 sq m/L).
    - b) 2nd and 3rd Coat: Sherwin-Williams Scuff Tuff Interior Waterbased Enamel,  
Eg-Shel, S24-50 Series: www.sherwin-williams.com/#sle.  
(a) 4 mils wet, 1.2 mils dry per coat.
- B. Metal: Ductwork; galvanized.
  1. Alkyd Systems, Water-Based:
    - a. Semi-Gloss Finish:
      - a) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310  
Series: www.sherwin-williams.com/#sle.  
(a) 5 mils wet, 2 mils dry per coat.
      - b) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane  
Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.  
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.
- C. Metal: Structural steel, miscellaneous and ornamental iron, new doors and frames, and ferrous metal.
  1. Alkyd Systems, Water-Based:
    - a. Semi-Gloss Finish:
      - a) 1st Coat: Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer, B66-1310  
Series: www.sherwin-williams.com/#sle.  
(a) 5 mils wet, 2 mils dry per coat.
      - b) 2nd and 3rd Coat: Sherwin-Williams Pro Industrial Water Based Alkyd Urethane  
Enamel Semi-Gloss, B53-1150 Series: www.sherwin-williams.com/#sle.  
(a) 4 to 5 mils wet, 1.4 to 1.7 mils dry per coat.
- D. Drywall: Walls, ceilings, gypsum board, and similar items.
  1. Latex Systems:
    - a. Eg-Shel Finish Scuff Resistant Waterbase Enamel:
      - a) 1st Coat: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer,  
B28W2600: www.sherwin-williams.com/#sle.  
(a) 4 mils wet, 1.5 mils dry per coat.
      - b) 2nd and 3rd Coat: Sherwin-Williams Scuff Tuff Interior Waterbased Enamel,  
Matte, S24-50 Series: www.sherwin-williams.com/#sle.  
(a) 4 mils wet, 1.2 mils dry per coat.
- E. Concrete: Floors, non-vehicular.
  1. Latex Systems:
    - a. Semi-Gloss Finish:
      - a) 1st and 2nd Coat: Sherwin-Williams Tread-Plex Acrylic Floor Coating, B90 Series:  
www.sherwin-williams.com/#sle.  
(a) 3.5 mils wet, 1.5 mils dry per coat.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Masonry: Remove efflorescence and chalk.
- D. Gypsum Board: Fill minor defects with filler compound; sand smooth and remove dust prior to painting.
- E. Concrete Floors and Traffic Surfaces: Prepare concrete according to SSPC-SP 13. Mechanical or Chemical preparation methods as recommended by paint manufacturer.
- F. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  - 2. Prepare surface according to SSPC-SP 2.
- G. Ferrous Metal:
  - 1. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Prime bare steel surfaces.
  - 2. Existing and Previously painted surfaces: Remove rust, loose mill scale, and other foreign substances using methods recommended by paint manufacturer and Hand tool clean in accordance with SSPC-SP 3. Protect from corrosion until coated.

### **3.3 APPLICATION**

- A. Apply products in accordance with manufacturer's written instructions.
- B. Apply coatings at spread rate required to achieve manufacturer's recommended dry film thickness.
- C. Regardless of number of coats specified, apply additional coats until complete hide is achieved.

### **3.4 Priming**

- A. Apply primer to all surfaces unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.
- B. Primers specified in painting schedules may be omitted on items factory primed or factory finished items if acceptable to top coat manufacturers.

### **3.5 Cleaning**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. Clean surfaces immediately of overspray, splatter, and excess material.
- C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

### **3.6 PROTECTION**

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**

**SECTION 22 0100**

**GENERAL CONDITIONS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 GENERAL CONDITIONS**

- A. Before submitting a proposal, Bidders shall examine all Drawings related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.
- B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.
- C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, fire Underwriters requirements applicable to work herein specified without additional expense to the Owner. (Also, local building code requirements.).
- D. It is specifically intended that anything (whether material or labor) which is usually furnished as a part of such equipment as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail on the Drawings or described in the Specifications.
- E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.
- F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, but it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.
- G. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working on the project.
- H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein or indicated on the accompanying Drawings.

**END OF SECTION**



**SECTION 22 0125**

**SCOPE OF WORK**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 SCOPE OF WORK**

- A. The work under this section includes all labor, materials, equipment, tools, transportation, cutting and patching, excavation and backfill and the performance of all work necessary and required for the furnishing and installation complete of all Plumbing and Drainage work as shown on Contract Drawings, as specified herein and as otherwise required by job conditions or reasonably implied, including but not necessarily limited to the following:
1. Provide complete new and altered sanitary piping from all new plumbing fixtures connecting to existing sanitary system.
  2. Provide complete new and altered hot and cold water piping to all new plumbing fixtures, equipment, etc. as indicated.
  3. Provide complete new piping and final connections to equipment furnished under other Divisions.
  4. Provide all demolition, removal disconnecting, capping, sealing of all existing plumbing piping, apparatus, equipment, fixtures, specialties, accessories, etc. which are not included or incorporated in the new layout.
  5. Provide all required temporary connections to maintain all plumbing services without interruption.
  6. Pipe insulation.
  7. Tests and adjustments.
  8. This Contractor shall obtain all permits, bonds, approvals, etc. at no additional cost to the Owner.
  9. This Contractor shall provide shop drawings for all plumbing, piping, valves, insulation, equipment, etc.
  10. Furnish minimum 18" x 18" access doors for all valves, cleanouts, etc. in all inaccessible walls, ceilings, etc. Installation by General Contractor.
  11. Cutting and Patching: See Front End Specifications for Trade Responsibilities.
  12. Excavation and Backfill: See Front End Specifications for Trade Responsibilities.
  13. Fire stopping per FM/UL and NFPA. Refer to Division 1.
- B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".

**1.2 ALTERATION WORK**

- A. All equipment, piping, plumbing, fixtures, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without Owners approval.
- B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.
- C. No dead ends shall be left on any piping upon completion of job.
- D. The existing systems shall be left in perfect working order upon completion of all new work.
- E. Location and sizes of existing piping are approximate. Exact sizes and locations of all existing piping shall be verified on the job.
- F. All removals shall be removed from the site.

**END OF SECTION**



**SECTION 22 0130**

**WATER SUPPLY SYSTEM**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 DESCRIPTION OF WORK**

- A. Furnish and install a complete cold-water distribution system to supply water to all new fixtures, water consuming equipment, and valved outlets for the use of other trades and connect to existing piping.
- B. The water supply system shall be complete with all pipe, fittings, valves, mains, risers, branches, shock absorbers, air chambers, hangers, anchors, expansion loops, connections to existing piping, covering, tests, etc. all as shown on the Drawings, as hereinafter specified.
- C. Furnish and install a complete hot water distribution system to supply water to all new fixtures and equipment requiring heated water.

**PART 2 - PRODUCTS**

**2.1 PIPING, FITTINGS AND MATERIALS**

- A. All components of water supply system shall confirm to all "No Lead" requirements including NSF/ANSI-372.
- B. The domestic water systems shall be of the following material and shall be in accordance with the latest ASTM and ASME Standards.
- C. Domestic water piping within the buildings shall be seamless drawn or extruded tubing type "L" copper. Both shall be of Chase, Anaconda, Revere, and approved equal, hard temper ASTM B88 with solder joint sweat end fittings. Fittings for use with copper tubing shall be cast brass of Muellers "Streamlin" pattern or approved equal.
- D. Joints for copper tubing shall be made with 95-5 (lead and antimony free) solder. Flanges where required shall be cast brass. Provide dielectric adapters between ferrous and non-ferrous pipe joints.

**2.2 VALVES**

- A. All shut-off valves 2" and smaller shall be ball valves equal to Apollo 70 Series or Milwaukee BA100 Series Valve. Bronze body with chrome plated trim
- B. This Contractor shall furnish all valves as indicated on the Drawings, or as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the Facility.
- C. All domestic water valves shall have a minimum working pressure of 125 psig, steam rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacture as manufactured by Milwaukee Valve or Hammond.
- D. All gate valves within the buildings shall be wedge gauge valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be so constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.

- E. All gate valves shall be all bronze with sweat or screwed joint ends as required by the piping system in which they are installed.
- F. Globe valves shall be of all bronze with composition disc, threaded or sweat joint ends as required by piping system in which they are installed.
- G. Check valves shall be all bronze swing check type with threaded or sweat joint ends. Check valves 4 inch and larger shall be iron body bronze mountings and shall be provided with screwed or flanged joint ends as required by piping system in which they are installed.
- H. Drain valves, at risers and at low points, shall be 3/4 inch heavy cast brass with composition washers with male thread for hose connections.

### **2.3 SHOCK ABSORBERS**

- A. Shock absorbers shall be similar and equal to J.R. Smith 5000 series or Zurn Z1700 series with stainless steel pressurized shell sized in accordance with P.D.I. Bulletin WH-201.
- B. Provide shock absorbers on all fixtures and equipment having quick closing valves whether or not indicated on the Drawings.
- C. Provide access doors where shock absorbers are concealed.

### **2.4 VACUUM BREAKERS**

- A. Provide vacuum breakers on water supply piping to each fixture and equipment with submerged inlets, and on faucets and outlets, within the facility to which hose can be, or is attached forming a submerged inlet.
- B. Set vacuum breakers in exposed readily accessible locations at least four inches above floor rim level of fixture, or high point of equipment.
- C. Vacuum breakers shall be chrome-plated brass. "Watts" or other approved.
- D. Vacuum breakers under constant pressure shall be of the continuous pressure type No. 9 "Watts" or Wilkins BFP-8CH or approved equal.

### **2.5 EXPANSION JOINTS, ANCHORS AND GUIDES**

- A. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted. Refer to Drawings for locations of expansion joints and related guides and anchors. The joints, guides and anchors shall be as manufactured by Flexonics Products, Metraflex or Flex-weld.
- B. Branches shall be of sufficient length and have three elbow swings to allow for pipe expansion.
- C. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.
- D. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of this Contractor.
- E. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

## **2.6 STERILIZATION**

- A. The entire domestic water piping system shall be thoroughly sterilized with chlorine before acceptance for domestic operation.
- B. The amount of chlorine applied shall be such as to provide a dosage of not less than 50 parts per million for 24 hours or 200 p.p.m. for one hour. The chlorinating material shall be either liquid chlorine or sodium hypochlorite solution and shall be introduced into the system and drawn to all points of the system. If possible to do so, the lines shall be thoroughly flushed before introduction of the chlorinating material. After a contact period of not less than 24 hours, the system shall be flushed with clean water until the residual content is not greater than 0.2 parts per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.
- C. Sterilization and tests for purity of water in the entire piping system shall be performed by the Contractor through an approved independent testing laboratory and a certificate shall be furnished to the Architect certifying the quality of purity.
- D. Per ANSI/AWWA Standard C651-15.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. It is the intent that each part of the plumbing system shall be complete in all details and water lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Specification so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the facility.
- B. This Contractor shall examine carefully the Architectural Drawings in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.
- C. In no case shall this Contractor permit his pipes to be exposed beyond finished walls or ceilings unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.
- D. The water piping shall all be installed so as to drain to a valve provided by this Contractor and branches shall not be trapped but shall have continuous pitch. Where necessary to raise or lower mains, the same shall be provided with a drip and shall be properly valved.
- E. Piping shall be installed, whether indicated or not, so as to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired clear heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.
- F. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.
- G. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.
- H. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work has been approved by the Architect.
- I. All materials shall be new and installed in a first class manner.

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- J. In erecting pipe, friction wrenches and vises shall be used exclusively, and any pipe cut, dented or otherwise damaged shall be replaced by this Contractor.
- K. All ferrous to non-ferrous pipe connections shall be made with approved dielectric pipe or flange unions isolating joints to prevent any electrolytic action between dissimilar materials.
- L. Any piece of pipe 6 inches in length or less shall be considered a nipple. All nipples with unthreaded portion 1-1/2 inch and less shall be of weight corresponding to fitting connected. Only shoulder nipples shall be used, close nipples will not be accepted.
- M. Revised water service shall be in accordance with the local water supply department requirements. All water lines are to be protected from freezing. Install new piping for water service below frost line and provide concrete separations when crossing other utilities. Provide concrete thrust mass at changes of pipe direction conforming to authorities having jurisdiction.

**END OF SECTION**

**SECTION 22 0160**

**SANITARY DRAINAGE SYSTEMS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 DESCRIPTION OF WORK**

- A. The work under this section includes all labor, materials, equipment and appliances necessary and required to completely install all drainage systems as required by the Drawings; code and as specified herein, including but not limited to the following:
- B. Complete sanitary drainage and venting systems including connections to the existing sanitary drainage and venting systems.
- C. Piping and final connections for equipment furnished under other Divisions.
- D. Alterations and removals to existing sanitary and vent systems.
- E. Tests.

**1.2 QUALITY ASSURANCE**

- A. All Cast Iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- B. Hubless Couplings:  
Standard, Stainless-Steel Shielded, Couplings - Standard Couplings shall conform to CISPI 310 and ASTM C 1277. Shield Assemblies shall consist of a stainless steel bi-directional corrugated shield; stainless-steel bands and tightening devices; and an ASTM C 564, rubber sleeve with integral center stop. Couplings shall bear the NSF Trademark, and be manufactured in the USA.

**PART 2 - PRODUCTS**

**2.1 PIPING AND FITTING MATERIALS**

- A. All indoor underground soil, waste and vent piping shall be service weight cast iron with fittings of bell and spigot type. All exterior underground storm soil and waste piping shall be extra heavy cast iron. Each length shall have the size, weight per foot and the manufacturer's name clearly cast or stamped thereon. Fittings and traps shall be similarly marked and of corresponding weights.
- B. All aboveground soil, waste and vent piping and fittings 3" and larger shall be service weight and fittings of bell and spigot type as specified in paragraph above. Above ground waste and vent piping 2" and smaller shall be galvanized steel, fittings on waste piping shall be galvanized cast iron, recessed drainage pattern, fitting on vent piping shall be galvanized cast iron, beaded pattern, screwed joints shall be made up to be perfectly tight without the use of lead or filler of any kind, except oil or graphite. Nipples for galvanized pipe shall be shoulder type. No close nipples shall be permitted.
- C. Joints shall be made with compression gaskets conforming to ASTM C.564 and IPC 705.4.2. See 2.1, E. for aboveground joint options where permitted.

- D. All galvanized pipe and fittings shall be galvanized with prime western spelter by hot drip process.
- E. The Contractor has the option of using the following types of joints with hubless cast iron pipe only if approved by the governing agencies. These joints shall be used throughout the project. No mixing of joints shall be permitted.
  - 1. Neoprene gasketed joints similar to Ty-Seal (for above and underground application).
  - 2. Hubless cast iron pipe with neoprene gaskets and stainless steel clamps (by Clamp-All or equal) above ground only. All in accordance with Cast Iron Soil and Pipe Institute Standard 301 latest edition. Hangers and supports shall be in accordance with manufacturer's recommendations.
  - 3. Copper DWV system with 50-50 tin antimony solder, DWV with solvent welded or screwed joints meeting CS-270-65.

## 2.2 CLEANOUTS

- A. Provide easily accessible cleanouts where indicated at base of vertical stacks at ends of horizontal drainage lines and at intervals not exceeding 50 ft.; at each change of direction; on handholes of running traps, and where necessary to make entire drainage system accessible for rodding. Provide at least 18" clearance to permit access to cleanout plugs.
- B. Cleanouts for cast iron pipe shall consist of tarped extra heavy cast iron ferrule caulked into cast iron fittings and extra heavy brass tapered screw plug with solid hexagonal unit. Cleanouts for wrought iron pipe shall consist of extra heavy brass screw plug in drainage fitting.
- C. Cleanouts turning out through walls and up through floors shall be made by long sweep ells or "Y" and 1/8 bends with plugs and face or deck plates to conform to Architectural finish in the room. Where no definite finish is indicated on the Architectural and/or Mechanical Drawings, wall plates shall be chrome plated cast brass and floor plates shall be nickel bronze.
- D. Cleanouts shall be full size at the pipe up to 6" inclusive. On larger size piping 6" size plugs shall be used.
- E. Cleanout fittings in vertical stacks shall consist of tapped tees capable of receiving a rough brass raised head cleanout plug, J.R. Smith S-4730, Zurn Z1445-A-BP or approved equal.
- F. All cleanout plugs shall be brass lubricated with graphite before installation.
- G. Cleanouts occurring in cast iron soil pipe above floor at change of direction of pipe run and at ends of horizontal runs shall be J.R. Smith S-4425, Zurn Z1441-A-BP or approved equal with cast iron ferrule for caulk connection and fitted with a straight threaded tapered bronze plug with raised hex head.
- H. Cleanout deck plates for finished areas shall be similar and equal to J.R. Smith 4020 series, Zurn ZB1400-X or approved equal with cast iron ferrule, scoriated cutoff sections, brass cleanout plus collar with brass bolts for waterproofed slabs. In tile floor areas the cleanout deck plates shall be recessed to tile.

## 2.3 FLASHING

- A. Provide 6 lb. lead flashing extending at least 10" beyond edge of all floor drains and vents through roof and all floor sleeves in floors with waterproofing or vapor barriers. Flashing shall be held securely in by clamping devices.
- B. All floor drains shall be provided with flashing rings and 24" square 6 lb. sheet lead flashing, properly flashed into flashing ring of the drain.

## **2.4 SANITARY DRAINAGE**

- A. A complete system of drainage shall be provided as shown on the Drawings. The system shall include all drains, leaders, branches, house drains with all pipe fittings, hangers, anchors, etc. to make a complete sanitary drainage system. The systems shall extend through house drains and terminate as indicated on the Drawings.
- B. Piping shall be sizes as indicated on the Drawings. The sanitary drains shall have a pitch of 1/8" per ft. minimum unless otherwise noted. Branch connections to stacks and house drains shall pitch a minimum of 1/8" per ft.

## **2.5 PIPING AND FITTINGS**

- A. Provide piping of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF PIPING**

- A. The size of soil, waste and vent piping shall be as determined by the State codes, rules and regulations for plumbing and drainage, except where specifically noted to be larger by the Specifications or Drawings and all fixed rules of installation, as set forth in the codes, rules and regulations, shall be followed as part of the Specifications.
- B. This Contractor shall carefully examine the Architectural plans in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.
- C. In no case shall this Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.
- D. Piping shall be installed, whether indicated or not, so to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired cleat heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.
- E. Run piping straight and as direct as possible in general forming right angles with or parallel to walls or other piping. Risers and stacks shall be erected plumb and true. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.
- F. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work had been approved by the Architect and all other authorities having jurisdiction.
- G. Branch connections shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4 bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only. All fittings shall conform to code requirements.
- H. Cleanouts shall be provided at foot of all stacks, at changes of directions, at the ends of branch runs where shown and as required by code and shall be terminated as described under cleanouts.
- I. The house drains must be run at a minimum grade of 1/8" per ft. downward in the direction of flow. Wherever possible, a 1/4" per ft. pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per ft. where possible. Attention is again called to the necessity of maintaining the ceiling heights established.

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- J. Furnish and install complete systems of vent pipes from the various plumbing fixtures and other equipment to which drainage connections are made. Vent pipes shall be connected to the discharge of each trap and shall be carried to a point above the ultimate overflow level of the fixture before connecting with any other vent pipe; in general, this will be approximately 3'-6" above the finished floor. Branches shall be arranged to pitch back to fixtures.
- K. The individual vent pipes shall be collected together in branch vent lines and connected to existing vent connections through roof.
- L. Any existing vents through roof, damaged, or if flashing on roof comes loose while connecting new vent to them shall be repaired and reflashed to the roof as required to maintain waterproofing the satisfaction of the Architect.

**END OF SECTION**



**SECTION 22 0420**

**SUPPORTS, SLEEVES AND PLATES**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 DESCRIPTION OF WORK**

- A. This Contractor shall furnish and install all plates, hangers and supports for his piping.
- B. All piping shall be hung or supported from structural members only.

**PART 2 - PRODUCTS**

**2.1 PIPING**

- A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.
- B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.
- C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.
- D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.
- E. Piping shall be supported as follows unless otherwise indicated on the Drawings:
  - 1. Piping: 1-1/2 inch and smaller Fig. #260 adjustable clevis hanger. 2 inch and larger Fig. #174 one-rod swivel roll hanger.
  - 2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.
  - 3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.
  - 4. Spacing of pipe supports shall not exceed 6 feet for pipes up to 1-1/2 inch and 10 feet on all other piping.
  - 5. Hangers shall pass around insulation and a 16 gauge steel protective band; 12 inch long shall be inserted between hangers and insulation.

6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.
  7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in a manner to allow for proper expansion and elimination of vibration.
  8. 2 inch and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.
  9. All horizontal pipe, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4 inch.
- F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.
- G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.
- H. Hanger rods shall be steel, threaded with nuts and lock nuts, sizes in accordance with following schedule:

<u>Pipe Size</u>	<u>Rod Size</u>
3/4" to 2" inclusive	3/8"
2-1/2" and 3" inclusive	1/2"
4" and 5" inclusive	5/8"
6"	3/4"
8" to 12" inclusive	7/8"

- I. Cast iron piping shall be supported at intervals of not more than (5) feet (at each hub) on straight runs.

### **PART 3 - EXECUTION**

#### **3.1 PIPING**

- A. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.
- B. Sleeves shall not be used in any portion of building where use of same would impair strength or construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.
- C. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
- D. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors shall be heavy forged construction entirely separate from supports.

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- E. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strains on offsets and branches. Anchors, unless otherwise noted shall be heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.
- F. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor.
- G. All operating equipment including pumps, piping, etc. shall be supported so as to produce minimum amount of noise transmission.

**END OF SECTION**



## **SECTION 22 0430**

### **INSULATION**

#### **PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 DESCRIPTION OF WORK**

- A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely do all insulation work as required by the Drawings and as specified herein including but not limited to the following: Insulation, covering, bands, tie wire.

#### **PART 2 - PRODUCTS**

##### **2.1 INSULATION**

- A. The materials as specified have been selected from the catalogs of Owens-Corning Fiberglass Corp. and Johns-Manville Sales Corporation and are representative of the quality, design and finish desired. Insulation as manufactured by Gustin Bacon Co., or other approved manufacturer may be submitted for approval provided the product meets fully in all respects (such as density, moisture absorption, alkalinity, thermal-conductivity, jackets) to the materials as delineated below.
- B. All insulation shall be UL rated non-combustible type classified flame spread-25, smoke-developed-50.

##### **2.2 PIPING, FITTINGS AND VALVES**

- A. All insulation thickness shall be in accordance with the latest edition of the New York State Energy Conservation Construction Code.
- B. Minimum pipe insulation shall be:
  - 1. Hot water piping up to 1-1/4" - 1" insulation and piping 1-1/2" and larger - 1-1/2" insulation.
  - 2. Cold water piping up to 1-1/2" - 1/2" insulation and piping 1-1/2" and larger - 1" insulation.
- C. Domestic cold, hot water hot water return indirect waste, storm and piping aboveground. All piping shall be insulated with sectional glass fiber insulation, Owens-Corning 2 piece ASJ/SSL. Joints between sections shall be sealed with factory supplied 3 inch wide sealing strips. Sealing by means of Owens Corning self-sealing lap will also be acceptable. Install (anti-sweat) vapor barriers on all cold water piping.
- D. Domestic hot and cold water valves and fittings - Fittings, valves, etc. shall be insulated with flexible blanket insulation compressed to 1/2 its thickness, tied on with jute twine over which shall be applied a flood coat of Insul-Coustic IC-102 and 10-20 open weave glass cloth. Glass cloth to be finished within additional coat of IC-102. Insulation blanket shall be Owens-Corning wrap.

#### **PART 3 - EXECUTION**

##### **3.1 INSTALLATION**

- A. All insulation on pipes running through walls, floors, partitions and beams shall be continuous through sleeves and openings.

- B. Insulation shall be installed only after all tests of the piping system have been completed.
- C. All insulation shall fit snugly.
- D. All surfaces shall be clean and dry when insulation is applied.
- E. Longitudinal joints shall be on least conspicuous side off the pipe.
- F. Valves shall be insulated up to the packing unit.
- G. As specified hereinbefore, all horizontal runs of piping will be supported on adjustable clevis or group trapeze type hangers. Pipe hangers will be installed outside of the insulation. Where hangers occur, prefabricated insulation protective saddles shall be "Insul-Shield-Multi-Purpose-Saddle" as manufactured by Insul-Cooustic Corp. or approved equal.
- H. Hot and cold water branch piping extending through slab or knockout panels to serve equipment shall be insulated to a point 4 inch above the top of sleeve provided for pipe.
- I. The use of staples shall not be permitted.
- J. It is the intent of this Specification that all vapor barriers be continuous throughout. Reinstate existing piping at point of new pipe connections.

**END OF SECTION**

**SECTION 22 0470**

**TESTS AND ADJUSTMENTS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 TESTS AND ADJUSTMENTS**

- A. The Contractor shall, at his own expense, during the progress of the work or upon its completion as ordered make such tests as are specified or as required by and in the presence of the Architects, Building Inspectors, etc. At least 48 hours' notice shall be given in advance of all tests.
- B. The Contractors shall provide all apparatus, temporary work or other requirements necessary for all tests. He shall take all due precautions to prevent damage to the building, its contents or the work of the other Contractors, that may be incurred by all tests. This Contractors shall also be responsible for the work of other Contractors that may be damaged or disturbed by the tests or the repair or replacement of his work, and he shall without extra charges, restore to its original condition, any work of other Contractors to do the work of restoration.
- C. Tests on the various systems may be conducted in sections as the work progresses or when the systems are completed.
- D. No caulking of pipe joints to remedy leaks will be permitted except where joints are made with lead and oakum.
- E. Each section of the sanitary, storm and vent piping tested shall have all openings tightly closed with screw plugs, or equal device. The drainage and vent systems shall be filled with water and proven tight under a 10'-0" head for a minimum of four (4) hours. Water level must remain constant through test without adding water.
- F. Upon final completion of the sanitary systems and when all fixtures and appurtenances have been set and the systems are in complete working order, all traps in the systems shall be filled with water and a thick penetrating smoke shall be introduced into the entire system.
- G. As smoke appears at the stack openings on the roof, such openings on the roof shall be tightly closed and a pressure equivalent to 1-1/2 inch of water shall be maintained during the test. Oils of peppermint shall be added at the smoke making machines so that any leakage is readily discernible.
- H. Before any covering is applied to the domestic water piping systems, the entire domestic water piping systems shall be hydrostatically tested for eight (8) hours to a hydraulic pressure of 125 psig.
- I. At the completion of the test, Contractor shall furnish the Owner with one (1) copy of test certificates as issued by the insurance company.
- J. Adjustments: Tests and adjustments shall be repeated as often as necessary until the systems are tight and are to the entire satisfaction of the Plumbing Inspector, Engineers and any other authorities having jurisdiction.

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1. Contractor is to thoroughly instruct the building custodian in the proper care and operation of the entire system. Contractor shall prepare for use by custodian, detailed brochures of instructions in non-technical terms, describing the maintenance and operation of all fixtures, apparatus, valves, controls etc. furnished by him.
2. Should any part of the work performed under this Contract fail to function because of cracked piping, obstructions, debris in piping, leaks in piping or any other cause, this Contractor shall disconnect, clean and reconstruct the work at his own expense and pay for any damages to adjoining work.
3. Water flow is to be balanced and adjusted to all flush valves, faucets, etc.
4. All parts of the plumbing system are to be thoroughly flushed until cleared of all grease and sediment and all dirt pockets cleaned. Repeat as often as necessary, open all cleanouts and reset in graphite.
5. All new motors shall be oiled as required.
6. All new valves are to have stuffing boxes packed and adjusted.

**END OF SECTION**



**SECTION 22 0480**

**TAGS, CHARTS AND IDENTIFICATION**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 TAGS, CHARTS AND IDENTIFICATION**

- A. Every valve installed under this Contract shall be tagged or labeled as follows: Tag shall be etched brass securely fastened to valve handwheels with heavy brass "S" hooks, soldered closed. At lock shield and similar type valves, tags for same shall be securely wired to valve body.
- B. Charts shall be provided for each piping system, as approved and shall consist of schematic diagrams of piping layouts showing and identifying each valve and piece of equipment etc., and its use. Upon completion one (1) copy of diagrams and valve charts suitably framed under glass, shall be furnished and mounted where directed. One (1) copy of diagrams and valve charts shall be delivered to Owner.
- C. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.
- D. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.
- E. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.
- F. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment at changes in direction.

**END OF SECTION**



**SECTION 22 0490**

**GUARANTEE**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 GUARANTEE**

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace and/or repair and any other work which may be damaged in removing, replacing and/or repairing the work.

**END OF SECTION**



**SECTION 23 0100**

**GENERAL CONDITIONS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 GENERAL CONDITIONS**

- A. Before submitting a proposal, Bidders shall examine all related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.
- B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.
- C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, and fire underwriter's requirements applicable to work herein specified without additional expense to the Owner. (Also building code requirements).
- D. It is specifically intended that anything (whether material or labor), which is usually furnished as a part of such equipment, as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail or described in the Specifications.
- E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the greater quantity, the higher quality and/or the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.
- F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, however it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.
- G. Small scale drilling through walls and floors or cutting of piping insulation which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working of the project. This shall also apply to removal of piping, ductwork or equipment insulation.
- H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein or indicated on the accompanying Drawings.

**END OF SECTION**



**SECTION 23 0110**

**SCOPE OF WORK**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 SCOPE OF WORK**

- A. The work under this section includes all labor, materials, equipment, tools, transportation, and the performance of all work necessary and required for the furnishing and installation complete of all work as shown on the Contract Documents, including but not necessarily limited to the following:
- B. General
  - 1. Rigging of equipment.
  - 2. Furnish all combination motor starter/disconnects for equipment (with the exception of starters and electric items already mounted on equipment or equipment not requiring same). Fan motor starter/disconnects shall have contacts for ATC connection and a terminal block connection for Fire Alarm fan shutdown. Starters per manufacturer's recommendations. Underwriter's inspection and certificate required. Coordinate with Electrical Contractor.
  - 3. Air and Water System Balancing.
  - 4. Automatic temperature controls with complete wiring (regardless of voltage).
  - 5. Testing, adjusting and start-up of equipment.
  - 6. Painting and identification of all equipment and piping.
  - 7. Firestopping per NFPA requirements (UL approved systems).
  - 8. Operating and maintenance instructions.
  - 9. As-Built Drawings - Refer to Division 1.
  - 10. Cutting and Patching - Refer to Division 1.
  - 11. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".
  - 12. Removal of existing steam boiler trim.
  - 13. Removal of existing HVAC equipment as indicated on Contract Drawings.
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  - 1. Outdoor energy recovery units and related appurtenances.
  - 2. Exhaust Fans and related appurtenances.
  - 3. Boiler conversion from steam to Hot water boiler (2), and related appurtenances.

4. Variable frequency drives.
5. Outdoor packaged dedicated ventilation air units.
6. Baseboard fin tube and related accessories.
7. Sheetmetal ductwork and related accessories.
8. Duct and pipe insulation.
9. Registers, diffusers and grilles.
10. Outdoor packaged rooftop units.
11. Hot water distribution piping, valves and appurtenances.
12. Duct-mounted hot water heating and D/X coils.
13. Refrigerant piping and appurtenances.
14. Ductless split VRF systems and related appurtenances.
15. Cabinet unit heaters.
16. Dampers and related accessories.
17. Hot water circulation pumps and appurtenances.

## **1.2 WORK UNDER OTHER CONTRACTS**

- A. Power wiring of motors and equipment.

## **1.3 REMOVALS**

- A. Removals should be coordinated with other trades affected.
- B. Piping which penetrates the construction may be cut and capped provided capping is done beneath the finished surfaces so that construction over it can be achieved.
- C. All removals shall be removed from the site.

## **1.4 ALTERATION WORK**

- A. All equipment, piping, control components, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.
- B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.
- C. No dead ends shall be left on any piping upon completion of job. The existing system shall be left in perfect working order upon completion of new work.
- D. Location and sizes of existing piping, ductwork, equipment, etc. are approximate. Exact sizes and locations of all existing work shall be verified on the job.

**END OF SECTION**



**SECTION 23 0120**

**CONVERSION OF EXISTING STEAM BOILERS TO HOT WATER**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 HOT WATER HEATING BOILERS**

- A. The work includes all labor, materials, equipment, tools, transportation and the performance of all work necessary and required for the furnishing and installation complete of all work specified herein and as otherwise required by job conditions or reasonably implied, including the following:
1. The boiler-burners modifications shall be made in strict accordance with the State of New York Department of Labor, Board of Standards and Appeals, Industrial Code Rule 4, shall comply with local codes and shall be in accordance with the current standards of the National Fire Protection Association.
  2. Entire conversion system and installation shall conform to burner manufacturer's installation and applicable codes.
  3. Burners shall be adjusted to ensure high efficiency and good performance. Burners shall be adjusted in accordance with ASME short form combustion test. Readings shall be taken by means of Bacharach or equal combustion efficiency tester, having print out capability. Readings must be taken at a minimum of low, medium and high fire, and all readings (CO<sub>2</sub>, Oxygen, Smoke, Stack Temperature), must be printed out and furnished to the Engineer. The Mills series boiler and the firebox pressure must be negative. Control of the over fire draft shall be by means of the existing sequence draft control system which shall be made fully operational, and which shall have all safety interlocks associated with the burner control panel verified.
  4. The combination gas-light oil burners shall be modified to pressure atomizing operation. All items of trim associated with the air atomizing equipment, and not required for the pressure atomizing system, shall be removed and disposed of by Contractor.
  5. Boilers shall be provided with trim and instrumentation as follows:
    - a. ASME rated side outlet relief valves, set to relieve at 50 psi.
    - b. M&M 63M low water cut-off with manual reset and alarm contacts. M&M 902 probe type LWCO with test light and alarm contacts. The new low water cut-offs shall be installed using McDonnell and Miller TC-4 test and check valve to allow testing the respective (both) low water cut-offs without the requirement for completely draining the boiler. Contractor to perform all tests recommended by the burner manufacturer in the installation manual and should comply with the requirements of ASME, CSD.
    - c. 6-inch diameter combination pressure and altitude gauge, range 0" to 100 psi scale.
  6. In addition to cleaning the water side of the boilers, the fireside heating surfaces should be thoroughly cleaned of all scale and carbon deposits. Such cleaning must be inspected and approved by the burner manufacturer representative.
  7. Boilers shall be retrofitted with all necessary fittings for connecting the 63M LWCO. In addition, two brass drain valves shall be furnished for installation on the return drums. Blow-down and drain valves shall be brass lever operated ball type.

8. Boilers shall be provided with precut flexible return yoke and welded assembly of elbows and nipples including Victaulic fittings. The yoke shall permit quick, easy, strain-free assembly to the boiler headers. Nipples with running thread shall be extra heavy pipe, other nipples standard weight. Fittings shall be 125 psi cast iron.
- B. Before the boilers are turned over for operation, they shall be thoroughly cleaned internally using an approved boiler compound. The cleaning operation shall include boiling out, surface blow-off, bottom blow-down, and wash, all as described in the manufacturer's installation instructions. The boiler shall be isolated from the buildings heating system piping during these procedures.
- C. Painting: All exposed unpainted metal parts of the boiler, including foundation; headers and nipples shall be painted with one coat of asphaltic base black paint. The metal shall be thoroughly cleaned of grease, oil, pipe compound, plaster and other dirt before application of paint.
- D. All pressure parts of the boilers have been subjected to hydrostatic tests according to the ASME Code for these boilers. Field tests shall be limited to the 1-1/2 times maximum pressure for which the boiler is intended. The Contractor shall furnish all equipment, piping, water and labor necessary to perform such tests as may be required by the boiler inspector, or as directed by the project Engineer or his representative. Tests shall be of such duration as necessary to satisfy the boiler inspector and Architect, or his representative.
- E. Lead/Lag Control System
  1. Furnish and install a lead/lag programmer, PowerFlame model PML-2RD to automatically control sequence firing of the two boilers. The programmer is to automatically start the selectable lead boiler. Lag boiler is to be activated whenever lead boiler cannot meet demand or fails to start. On a call-for-heat lead boiler is activated with lag boiler always firing in sequence. A numbered light indicates lead boiler and firing status. The selector switch allows changing of lead to lag status to equalize equipment usage. Provide all required sensors.
  2. Programmer is to be interfaced through and with the burner control panel. Provisions shall be made to provide suitable working natural gas pressures to permit the firing of these burners at the required rate to meet boilers output requirements. A minimum natural gas pressure of eight (8) inches W.C. is required at the inlet to the burner gas train. Gas pressures to twelve (12) inches W.C. should be made available to meet changes in the gas train configuration.

## **1.2 BOILER-BURNER UNITS CONVERSION**

- A. Contractor shall modify where shown on Drawings the boiler-burner units as specified hereinafter, for the buildings central hot water space heating system, arranged for automatic firing with natural gas and no. 2 oil.
- B. The boilers modification shall be made in strict accordance with the State of New York Department of Labor, Industrial Code Rule 4, ASME Section IV and shall comply with local codes and shall be in accordance with the current standard of National Fire Protection Association.
- C. The modification shall also conform to the manufacturer's instruction and "Setting and Installation Requirements and Recommendations" in Section IV of ASME "Boiler and Pressure Vessel Code". Refer to excerpts hereinafter.
- D. All exposed metal part of the boilers, including the foundation, doors, headers and nipples, shall be painted with two coats of heat resistant black paint. The metal shall be thoroughly cleaned of grease, oil, pipe compound, plaster and other dirt before application of paint.

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- E. The Contractor shall thoroughly clean the system and boilers after completion, to remove all cutting oil, excess pipe joint compound and all other foreign materials. Chemical cleaners used shall not be harmful to any part of the system and the work shall be performed by men thoroughly trained in the safe and proper handling of cleaning chemicals.
- F. A qualified representative of the manufacturer shall supervise the initial startup and instruct the Owner's operating personnel as to proper operating and maintenance procedures.
- G. The boiler-burner unit shall be tested in accordance with the procedure outlined in the 1996 ASME Boiler and Pressure Vessel Code. The manufacturer shall provide copies of a suitable checklist to be used for performing the tests. The Contractor shall furnish all the necessary equipment required for performing the tests.
- H. The Contractor shall furnish the Owner with five (5) blank copies of a Maintenance, Testing and Inspection Log, in hardback binders. The log shall be similar to the 1996 ASME Boiler and Pressure Vessel Code.
- I. Instruction in operation and maintenance of the boiler and burner system and controls shall be furnished by the Contractor for a period of eight (8) hours straight time minimum.
- J. Boiler-Burner Test: When putting burners into operation, Contractor shall make all necessary oil, gas, air and draft adjustments and arrange to run a test under full load conditions, in the presence of the Engineer or his representative. Such tests for natural gas firing shall show not less than 8.5% CO<sub>2</sub>, (acceptable minimum), no CO, no smoke and a flue gas temperature of not over 550 degrees F. For firing with no. 2 fuel oil, 12.5% CO<sub>2</sub> is required. Firing rate is then to be reduced to actual load requirement. Provide all materials, equipment and parts and make any required additional adjustments. Retest again and adjust for efficient operation. Submit three certified copies of test data of both full load and actual load test. Fuel, water (Refer to Division 1). Contractor shall provide all equipment and materials to carry on the tests.
- K. Instructions and Service: Contractor shall furnish to the Engineer four (4) sets of written operating, maintenance and lubrication instructions for all installed equipment.
- L. Instructions shall include designated approved shop drawings, manufacturer's descriptive data, wiring diagrams performance test data and installation and operating instructions as specified.
- M. The above instructions, charts, etc., shall be submitted as a rough draft and after the required corrections are made, four (4) sets in loose-leaf, hardback binders shall be furnished to the Engineer.
- N. Personnel designated by the Owner shall be instructed in the operation of controls for the system, as well as the proper operation and maintenance of the equipment. Informal or unwitnessed instructions, to non-designate personnel, are not acceptable.
- O. As directed by the Owner, the Contractor shall, without additional cost to the Owner, furnish the service of competent burner service men, approved by the burner manufacturer, for one (1) eight (8) hour day and longer if necessary, to instruct the head maintenance Engineer in the care and operation of the boiler-burner units.
- P. Provide free 24-hour emergency service from the time of burner startup until the end of the guarantee period.
- Q. Contractor to make monthly inspections in presence of the building custodian without charge until end of the guarantee period regardless of emergency calls.
- R. The Contractor shall also turn over to the Owner a paid-up two (2) year service contract for servicing of the complete Boiler-Burner units and the complete gas/oil burning-piping system including all costs of labor and materials.

- S. Also include service for all associated controls and wiring. Service contract shall be made with an authorized service company approved by the burner manufacturer, the Architect and the Owner. Service contract shall terminate two (2) years after the date of official acceptance of the work by the Owner.
- T. Regulations and Certificates: All work required by the Drawings and Specifications shall be installed to comply with all applicable regulations of the National Fire Protection Association and the building laws, regulations and ordinances of the local laws and regulations as may apply, except where these requirements are exceeded by the Drawings and Specifications in quality and quantity.
- U. The Contractor shall deliver to the Architect an Underwriter's Certificate of Approval covering all electrical work, performed in connection with the Mechanical Work, in addition to all other certificates that may be issued by authorities having jurisdiction.
- V. Diagrams and Certificates: At the completion of the installation, this Contractor shall mount in the boiler room, for permanent reference the following:
  - 1. Local Permit and Inspection Certificate
  - 2. Underwriter's Inspection Certificate
  - 3. Gas/Oil Burner Wiring Diagram
  - 4. A list of simple maintenance and lubrication instructions (submit to Engineers for checking and approval)
- W. The above shall be furnished photo-etched on "Mactac" material. These diagrams and certificates shall be impervious to water and shall withstand washing without degradation.
- X. Shop Drawings: Submit for checking and approval detailed shop drawings of all equipment, thermometers, gauges, wiring, controls, etc.

## **PART 2 - PRODUCTS – NOT USED**

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**

**SECTION 23 0130**

**BOILER START-UP AND TESTING**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 BOILER START-UP AND TESTING**

- A. Before any water is added to the boiler for testing or other purposes, a sufficient amount of sodium sulphite (to provide a residual of 100 p.p.m.) shall be added to the boiler water to prevent deterioration due to dissolved oxygen in the boiler water. When ready for firing the Contractor shall clean the boiler internal surfaces in the following manner, or as required by the boiler manufacturer for hot water boilers.
- B. Fill the boiler with fresh water.
- C. Dissolve Metro Boiling Out Compound (or mixture of equal parts of trisodium phosphate, caustic soda and soda ash) at the rate of 1 pound per 20 gallons.
- D. Dosage: 50 pounds per 1000 gallons of water content of the boiler.
- E. Connect 2" full size blow off line to blow off tapping located near the boilers normal water line. The discharge of this shall be piped full size to a suitable drain.
- F. Heat the boiler for a period of 16-24 hours without generating steam.
- G. Open the blow off valve and feed the boiler with fresh water, maintaining a "normal" water line while "skimming" all oil and grease from the top blow off line.
- H. Continue this procedure until the water is clear and free of any oil or grease.
- I. Drain the boiler and flush thoroughly with a hose through the manhole opening until all signs of debris, oil, grease and mill scale are removed.
- J. Fill with fresh water, treated with Chem Aqua 999 boiler treatment (hot water systems).
- K. Raise the level of the water to remove as much dissolved oxygen as possible.
- L. Re-test the level of boiler water treatment, adding sufficient to raise protection to the proper level.
- M. Note: In the event of a boiler contaminated with large quantities of oil or grease it may be required to repeat this procedure. Procedure shall be repeated until ALL traces of oil and grease are removed from the boiler.
- N. Contractor shall operate the boiler for a minimum of eight hours, following the above procedure, during which time valves to system and terminal units shall be in the open position and all returning water shall be wasted to drain. The purpose to remove as much scale and dirt from the piping system. During this period of operation, the residual level of water treatment of sodium sulphite shall not be allowed to fall below 100 p.p.m.
- O. Upon completion of the above, the Contractor shall close manholes and handhole mating surfaces.
- P. Provide chemical feeder for boiler where shown on Drawings.

**END OF SECTION**



## **SECTION 23 0190**

### **PUMPS**

#### **PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 FLOOR MOUNTED PUMPS OR BASE MOUNTED PUMPS**

- A. The pumps shall be as manufactured by ITT Bell & Gossett or approved equal with performances noted on the Drawing schedule.
- B. The pumps shall be single stage, vertical split case design in cast iron and bronze construction. The pump's internals shall be capable of being serviced without disturbing piping connections or motor. The impeller shall be of the enclosed type, dynamically balanced and keyed to shaft and secured with a suitable locknut.
- C. Pump seal shall be standard single mechanical seal with carbon seal ring and Remite (or equal) seat. A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal of packing.
- D. The bearing frame assembly of the pump shall be fitted with re-greaseable ball bearings equivalent to electric motor bearing standards for quiet operation. The pump and motor shall be mounted on a common base plate of heavy structural steel design with securely welded cross members and open grouting area.
- E. The pumps shall be factory tested at the operating conditions, thoroughly cleaned and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.

##### **2.2 IN-LINE PUMPS**

- A. Furnish and install where indicated on Drawings, ITT Bell & Gossett pumps of model and size indicated on Drawing schedule.
- B. The pumps shall be of the horizontal oil lubricated type specifically designed and guaranteed for quiet operation and suitable for minimum 125-psig working pressure.
- C. The pumps shall have a ground and polished steel shaft with a hardened integral thrust collar. The shaft shall be supported by two (2) horizontal sleeves bearing designed to circulate oil. The pumps are to be equipped with a watertight seal to prevent leakage. Mechanical seal faces to be carbon on ceramic. The motor shall be non-overloading at any point on pump curve.
- D. The motor shall be of the drip-proof, sleeve bearing, quiet operation, and rubber mounted construction.
- E. The Contractor shall furnish and install a magnetic starter for each booster pump with at least two (2) thermal overload protectors. The starter shall be equipped with manual reset buttons.

#### **PART 3 - EXECUTION**

##### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 23 0200**

### **HYDRONIC SPECIALTIES**

#### **PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 AIR SEPARATOR**

- A. Furnish and install as shown on Drawings, an external low velocity air separator unit consisting of a steel tank with screwed piping connections and a tapping to connect the air separator directly to the compression tank with screwed piping connections and a tapping to connect the air separator directly to compression tank.
- B. The unit is to be furnished with a steel base and constructed in accordance with ASME boiler pressure vessel code and stamped 125 psi working pressure. The air separator shall be ITT Bell & Gossett "Rolairtrol" or approved equal.

##### **2.2 EXPANSION TANKS (S)**

- A. Furnish and install pre-charged bladder type expansion tank(s) of size and capacity as shown on Drawings. Tank shall have carbon steel shell and heavy-duty butyl rubber bladder.
- B. Tank to be constructed for (125 psig) working pressure and to be guaranteed leakproof by manufacturer. Tank to be stamped with "U" symbol and Form U-1 furnished denoting compliance with paragraph U-69 for Construction of Unfired Pressure Vessels Section VIII ASME.

##### **2.3 AIR VENTS**

- A. Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type.
- B. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or ITT Bell & Gossett, 125 psig rated.

##### **2.4 PRESSURE GAUGES**

- A. Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2" diameter dials, Ashton, Ashcroft or approved equal.

##### **2.5 THERMOMETERS**

- A. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

## 2.6 TRIPLE DUTY VALVES

- A. Furnish and install at each pump a non-slam check valve with a spring-loaded disc and a calibrated adjustment feature permitting regulation of pump discharge flow and shut-off. Valves shall be designed to permit repacking under full line pressure.
- B. Unit shall be installed on discharge side of pump in a horizontal or vertical position with the stem up. Allow for minimum clearance of valve stem. This unit shall be cast iron body construction suitable for maximum working pressure of 175 psig and maximum operating temperature of 300 degrees F.
- C. All units shall be ITT Bell & Gossett Triple Duty Valve model or approved equal.

## 2.7 SUCTION DIFFUSERS

- A. Furnish and install at each pump a suction diffuser. Units shall consist of angle type body with inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16 inch diameter openings for pump protection. A permanent magnet shall be located within the flow stream and shall be removable for cleaning.
- B. The orifice cylinder shall be equipped with a disposable fine mesh strainer, which shall be removed after system startup. Orifice cylinder shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2-1/2 times the pump connection diameter. Unit shall be provided with adjustable support foot to carry weight of suction piping. Each Suction Diffuser to be ITT Bell & Gossett model or approved equal.

## 2.8 COMBINATION BALANCING / SHUT-OFF VALVES (Circuit Sensors /Setters and Flow Meters)

- A. Provide Circuit Sensor/Setter balance valves as manufactured by Bell & Gossett or approved equal.
- B. Circuit Sensors: Furnish and install as shown on Drawings, a cast iron wafer-type flow meter designed for low pressure drop operation.
  - 1. The flow meter will be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice of the flow meter.
  - 2. The flow meter shall be designed to operate at a maximum working pressure of 300 psig at 250 degrees F.
  - 3. The flow meter must be furnished with a calibrated nameplate for determining an accurate system flow rate.
  - 4. Each flow meter shall be ITT Bell & Gossett Circuit Sensor Flow Meter model no. OP.
- C. Circuit Setters: Furnish and install as shown on Drawings and with manufacturer's recommendations model no. CB calibrated balance valves.
  - 1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.
  - 2. All valves 1/2 inch to 3 inch pipe size to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings.
  - 3. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be filled with internal EPT inert and check valve.
  - 4. Valve bodies to have 1/4 inch NPT tapped drain/purge port.

5. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4 inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.
- D. Readout Meters: Provide a portable Readout Meter with provision for hanging, capable of indicating pressure differential across a system component. Unit to be complete with all necessary hoses, shut-off and vent valves, and carrying case. Reading range to be .5' to .16'. Read Out Kits to be ITT Bell & Gossett model no. RO-3.

## **2.9 CHEMICAL FEEDING EQUIPMENT**

- A. Chemical Feed System Description
  1. Provide an automatic chemical feeder for the new hydronic system where shown on Drawings. The feeder shall be equal to AXIOM model no. SF100-D-P, PACKAGED HYDRONIC SYSTEM FEEDER, as manufactured by Axiom Industries Limited, 2615 Wentz Avenue, Saskatoon, SK S7K5J1. System shall include 55 gallon storage/mixing tank with cover, alternating control panel with lead/lag operation, high/low level alarm, pump suction hose with inlet strainer, two pressure pumps with thermal cutouts, integral pressure switches, integral check valve, cord and plug, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging air and agitating contents of tank, pressure regulating valve (adjustable 5-55 psig) complete with pressure gauge, built-in check valve, union connection, flexible connection hose with check valve, low level pump cut-out. Power supply 115 volt/60 Hz/1 Ph, 3.8 amps. Pump capacity, 1.0 gpm at 50 psig, self-priming. Unit shall be completely pre-assembled and certified by a recognized testing agency.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements

### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## SECTION 230215

### ROOFTOP DOAS UNITS

#### PART 2 - PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### 1.1 Dedicated Outdoor Air System – Rooftop

##### A. General

1. Alternate manufacturers must be pre-approved and shall be subject to compliance with all the requirements listed in this specification.
2. Project is based on the specified equipment. Any additional costs associated with using alternate manufacturer's equipment shall be borne by the installing contractor or equipment provider.
3. This section includes units with integral heating/cooling/heating and cooling for outdoor installation.
4. Integral Energy Recovery device shall be a rotary air-to-air total enthalpy wheel. Integral heat source shall be Indirect Gas-Fired furnace/hot water/electric heat.
5. Integral cooling source shall be split system DX with packaged DX/Air-source heat pump.
6. Integral heat source shall be indirect gas-fired furnace, electric heat, hot water heat coil, or air-source heat pump (with secondary indirect gas-fired furnace or electric heat).
7. Airflow arrangement shall be Outdoor Air only/Outdoor Air with Recirculation.
8. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in this specification.

##### B. Manufacturers

1. Available Manufactures: Subject to compliance with specifications contained within this document, manufacturer's offering products that may be incorporated into the work include but are not limited to LG.

#### PART 2 – PRODUCTS

#### 2.1 CASING/PANEL

- A. The exterior casing shall have a minimum of 22-gauge, galvanized (G90) steel meeting ASTM A653 for components without a painted finish.
- B. Unit's exterior shall be supplied using G60 galvaneal steel with proprietary pre-painted material in the following Permator™ finish color; Concrete Gray-RAL 70023.
  1. The casing shall be subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 2,500 hours.

2. High performance coating (Hi-Pro Poly) with an option for match color chip is available. The unit's exterior shall be supplied using G60 galvanized steel with a high-performance proprietary coating that has been subjected to a salt spray test per ASTM-B117 and evaluated using ASTM-D714 and ASTM-D610 showing no observable signs of rust or blistering until reaching 5,000 hours.
- C. Materials: Formed, 2-inch double wall closed cell foam insulated metal panels and 2" double wall closed cell foam insulated metal door construction, fabricated to permit access to internal components for maintenance.
- D. Cabinet Insulation shall comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
- E. Materials: Rigid urethane foam. Foam board not acceptable.
  1. Thickness: 2-inch (50.8 mm).
  2. Thermal Resistance: R13.
  3. Meets UL95HF-1 flame requirements.
  4. Location and application: Full coverage of entire exterior to include walls, roof of unit, unit base and doors.

## 2.2 CABINET ASSEMBLY

- A. All the internal assemblies shall have a minimum of 24 gauge, galvanized (G90) steel, except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.
- B. All specified components and internal accessories factory installed shall be tested and prepared for single-point high voltage connection except with electric post heat and exhaust fan only power if dual point power is selected.
- C. Unit shall be fully assembled at the factory and consists of the following:
  1. An insulated metal cabinet
  2. Downturn outdoor air intake hood with 2" aluminum mesh filter assembly
  3. Exhaust air blower
  4. Evaporator coil
  5. Condensate drain pan
  6. P trap
  7. Energy wheel
  8. Wheel frost control
  9. Energy core
  10. Hot water coils
  11. Hot gas reheat coil
  12. Indirect gas furnace
  13. Packaged DX system

14. Air-Source Heat Pump
15. Phase and burnout protection
16. Motorized dampers
17. Barometric relief damper
18. Motorized recirculating damper
19. Sensors
20. Curb assembly
21. Service receptacle
22. Filter assembly for intake air
23. Supply air blower assembly
24. Exhaust/relief blower assembly
25. Filter assembly for exhaust air
26. Electrical control center

### **2.3 SUPPLY AIR BLOWER ASSEMBLIES**

- A. Blower assembly shall consist of an electric motor and direct-drive fan(s). Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor(s) shall be capable of continuous speed modulation and controlled by a VFD.

### **2.4 EXHAUST AIR BLOWER ASSEMBLIES**

- A. Blower assembly shall consist of an electric motor, with an ODP enclosure and a direct-drive fan. Assembly shall be mounted on heavy gauge galvanized steel rails and further mounted on 1.125 inch thick neoprene vibration isolators. Blower motor shall be capable of continuous speed modulation and controlled by a VFD.

### **2.5 ACCESS PANELS / DOORS**

- A. Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components.
- B. Doors and access panels shall be fabricated of minimum 22 gauge galvanized G90 steel or painted galvanized steel with 2 inch closed cell foam insulation.

### **2.6 EVAPORATOR COIL**

- A. Evaporator coil shall be AHRI Certified and shall be (silver) soldered or brazed into the compressed refrigerant system. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame.

- B. Units with two compressors shall have the evaporator coil of “interlaced” configuration, permitting independent operation of either compressor without conflict with the other compressor.
- C. Optional: The evaporator and condenser coils are coated with ElectroFin® coil coating, E-Coat coated coils are tested and passed ASTM B-117 Salt Spray tests exceeding 10,000 hours.

## **2.7 CONTROL PANEL / CONNECTIONS**

- A. Rooftop Ventilator units shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.
- B. RTU shall be equipped with a Unit Disconnect Switch. Electric heater shall have a separate electrical control center and separate high voltage power circuit as shown on the plans.
- C. Optional: Electric heater shall have single point power.

## **2.8 CONDENSATE DRAIN PAN**

- A. Drain Pan shall be an integral part of the unit whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a drain connection at the front (access side) for connection to a P trap.
- B. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall.

## **2.9 P TRAP**

- A. If the unit is equipped with a condensate drain pan, contractor shall provide, or fabricate, and install an appropriate P trap, in accordance with all local and area codes and Best Practices.

## **2.10 ENERGY WHEEL**

- A. Unit energy wheel shall handle the full volume of outdoor and exhaust air without an energy wheel bypass damper(s).
- B. Bypass dampers are only acceptable during economizer operation and cannot be used during normal operation.
- C. Energy wheel shall be of total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette.
- D. The cassette shall consist of a galvanized steel framework (designed to produce laminar air flow through the wheel), an energy wheel as specified and a motor and drive assembly.
  - 1. The cassette shall incorporate a pre-tensioned urethane drive belt or a link style belt with a five year warranty.
  - 2. The wheel media shall be a polymer film matrix in a stainless-steel framework.
  - 3. Wheel shall be comprised of individual segments that are removable for servicing Silica gel desiccant shall be permanently bonded to the polymer film.
- E. The energy wheel is to have a five year warranty.



- F. Performance criteria are to be as specified in AHRI Standard 1060, complying with the Combined Efficiency data in the submittal.

## **2.11 WHEEL FROST CONTROL**

- A. Timed Frost control will start/stop the wheel based on differential pressure readings.
- B. Energy wheel VFD Frost control will modulate the wheel speed based on exhaust air leaving air temperature.
- C. Reheat Coil with factory installed modulating hot gas reheat valve.
  - 1. Coil(s) shall be coated with ElectroFin® coil coating.

## **2.12 PACKAGED DX HEAT PUMP SYSTEM**

- A. Unit shall have an integral compressor(s) and evaporator coil located within the weather-tight unit housing.
  - 1. The evaporator and condenser coils shall be coated with ElectroFin® coil coating.
- B. Condenser coils and appurtenant condenser fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit.
  - 1. Unit condenser fans shall feature swept owlet blade design resulting in reduced sound levels.
  - 2. Condenser fan motors shall be three phase, external rotor, type 56 frame, open air over and shaft up.
  - 3. Each condenser fan motor shall have a vented frame, rated for continuous duty and be equipped with an automatic reset thermal protector.
  - 4. Lead condenser fan will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.
- C. Motors shall be UL Recognized and CSA Certified. The refrigerant compressor(s) shall be inverter driven.
- D. Optional: inverter hermetic scroll-type and shall be equipped with:
  - 1. Liquid line filter drier
  - 2. Thermostatic (optional: electronic) expansion valves (TXV) (EXV)(s)
  - 3. Manual reset high pressure and low pressure cutouts.
  - 4. Sensors
  - 5. Service ports and safety devices.
  - 6. Compressed refrigerant system shall be fully charged with R-410A refrigerant.
  - 7. Each compressor shall be factory-equipped with electric crankcase heater to boil off liquid refrigerant from the oil.

### **2.13 AIR SOURCE HEAT PUMP**

- A. Unit shall have an integral compressor(s) and indoor coil located within the weather-tight unit housing.
- B. The condensing/evaporator and condensing coils are coated with Electrofin® coil coating.
- C. Outdoor coils and appurtenant outdoor fan assemblies shall be factory installed as integral subassemblies of the unit and mounted on the exterior of the unit.
- D. Lead/All condenser fan(s) will have an electronically commutated (EC) motor that will modulate to maintain a head pressure set point.
- E. Motors shall be UL recognized and CSA certified. The lead refrigerant compressor shall be inverter hermetic scroll type.
- F. Compressors shall be equipped with liquid line filter drier, expansion valve, accumulator, sight glass, manual reset high pressure and low-pressure cutouts and all appurtenant sensors, service ports and safety devices. Compressed refrigerant system shall be fully charged with R-410A refrigerant. Each compressor shall be factory-equipped with an electric crankcase heater to boil off liquid refrigerant from the oil.

### **2.14 PACKAGED DX CONTROL AND DIAGNOSTICS**

- A. The Packaged DX system shall be controlled by an onboard digital controller (DDC) that indicates both owner-supplied settings and fault conditions that may occur.
- B. The DDC shall be programmed to indicate the following faults:
  - 1. Global alarm condition (active when there is at least one alarm)
  - 2. Supply Air Proving alarm
  - 3. Dirty Filter alarm
  - 4. Compressor Trip alarm
  - 5. Compressor Locked Out alarm
- C. Supply Air Temperature Low Limit alarm
  - 1. Sensor #1 Out of Range (outside air temperature)
  - 2. Sensor #2 Out of Range (supply air temperature)
  - 3. Sensor #3 Out of Range (cold coil leaving air temperature)

### **2.15 PHASE AND BURNOUT PROTECTION**

- A. RTU shall have a factory-installed phase monitor to detect electric supply phase loss and voltage brown-out conditions.
- B. Upon detection of a fault, the monitor shall disconnect supply voltage to all motors.

### **2.16 MOTORIZED DAMPERS / OUTDOOR AIR / RETURN AIR**

- A. Damper shall be of (optional: insulated) low leakage AMCA Class 1A certified construction.
- B. Leakage rate shall not exceed 3 CFM/ft<sup>2</sup> @ 1 in. wg. and shall be factory installed.
- C. AMCA Class 1A motorized recirculating air damper designed to permit 100% maximum recirculation of return air shall be factory installed.

**2.17 SENSORS**

- A. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified by the A/E.

**2.18 CURB ASSEMBLY**

- A. A curb assembly made of 14-gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division.
- B. The curb assembly shall provide perimeter support of the entire unit and shall have duct adapter(s) for supply air and return air.
- C. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit.
- D. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration.
- E. Contractor shall provide and install appropriate insulation for the curb assembly. The curb shall be the height of (14", 18", 24", 36").

**2.19 SERVICE RECEPTACLE**

- A. 120 VAC GFCI service outlet shall be factory-provided and installed by this contractor in a location designated by the A/E. Unit contains a 120 VAC transformer to provide power to service outlet.

**2.20 HAIL GUARDS**

- A. Protects the condensing unit from damage due to extreme weather conditions such as hail and flying debris.

**2.21 BLOWER/MOTOR ASSEMBLY**

- A. Blower section construction Supply Air
  1. Direct drive motor(s) and blower(s) shall be assembled on a 14 gauge galvanized steel platform and shall be equipped with 1.125 inch thick neoprene vibration isolation devices.
  2. Blower assemblies shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
  3. Fan: Direct drive, airfoil plenum fan with painted steel or aluminum wheels statically and dynamically balanced and AMCA certified for air and sound performance.
  4. Blower section motor source quality control
  5. Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency.
  6. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating."
- B. Motors
  1. General
    - a. Blower motors greater than ¾ horsepower shall be "NEMA Premium™" unless otherwise indicated.
    - b. Compliance with EPA's minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable.

- c. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure.
- d. Motors shall be 60 cycle, 3 phase 208/230/460 volts.
- e. The designation "NEMA Premium™" applies to electric motors with efficiencies that are "better than EAct." The terms "high efficiency" have no industry definitions.

## **2.22 FILTER ASSEMBLY**

- A. Units shall have supply final air filter shall be of:
  - 1. Optional: hood filter shall be of 1 inch aluminum type.
  - 2. MERV 13 with a 2 inch MERV 8 pre-filter.
  - 3. Energy recovery section shall have outdoor air and exhaust air filters of 2 inch MERV 8.
- B. Additional Materials
  - 1. Furnish Extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    - a. Filters: Sets of MERV 8 and MERV 13 disposable filters for each unit. When MERV 13 filters are specified, they are used in tandem with MERV 8 pre-filters for Supply Air only.

## **2.23 UNIT CONTROLS**

- A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors, and it can be operated as a heating and cooling system controlled by a Building Management System (BMS).
- B. This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
  - 1. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status.
  - 2. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software.
  - 3. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable.
  - 4. Alarm readouts consisting of flashing light codes are not acceptable.
- C. RTU supply fan shall be configured for Constant Volume (ON / OFF)
- D. Exhaust fan shall be configured for Constant Volume (ON /OFF)
  - 1. Network control, building pressure by factory, damper tracking, 0-10 VCD by others to DDC, Supply Tracking.
- E. Outside Air / Return Air damper control shall be field adjustable two-position,
  - 1. Network control, CO2 sensor by factory.
  - 2. Economizer control shall be temperature, temperature / dew point, comparative temperature, comparative enthalpy.

3. Dirty filter sensor shall be factory-installed.
- F. Operating protocol
1. The DDC shall be factory-programmed for Bacnet IP and Modbus RTU standard.
  2. Optional: BACnet MSTP, Modbus, Modbus IP
  3. Must be compatible with LG AC Smart Controller.
  4. Graphical Web UI required.
- G. Variable Frequency Drive (VFD) unit shall have factory installed variable frequency drive for modulation of the supply air blower assembly and exhaust air blower assembly. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
1. Airflow monitoring required in the Outdoor / Exhaust / Supply / All airstreams.
  2. Room thermostat shall be provided as a shipped loose item. Room thermostat and room humidity sensor shall be provided as a shipped loose item.
- H. Controller shall auto trend 7 days of operating points for trouble shooting purposes.
- I. Embedded web page with complete web user interface to allow full remote control and monitoring of unit.
- J. Alarm Recording: Controller shall store all alarm events for download.
- K. Alarm Operating Snapshot: Controller shall store operating inputs and outputs at time of alarm.

## **2.24 SUBMITTALS**

- A. Product Data: For each type or model include the following:
1. Complete fan performance curves for Supply Air and Exhaust Air with system operating conditions indicated as tested on an AMCA Certified Chamber.
  2. Sound performance data for Supply Air and Exhaust Air as tested on an AMCA Certified chamber.
  3. Motor ratings, electrical characteristics, motor and fan accessories.
  4. Performance ratings for all chilled water or DX coils.
  5. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
  6. Estimated gross weight of each installed unit.
  7. Installation, Operation and Maintenance manual (IOM) for each model.
  8. Microprocessor Controller (DDC) specifications to include available options and operating protocols. Include complete data on all factory-supplied input devices. Modbus RTU and BACnet IP are standard protocols. They must be compatible with LG AC Smart Controller.

9. AHRI Certified coil performance ratings with system operating conditions indicated. Ratings shall be in accordance with Standard 410.
10. Cabinet finish Concrete Gray-RAL 7023 is standard.
11. Energy wheel performance data for both summer and winter operation.
12. Electrical consumption data and construction specification for electric heater, to include heat output, warranty and safety certifications.

## **2.25 CONNECTIONS**

- A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
  1. Piping installation requirements are specified in other sections. Drawings indicate general arrangement of piping, fittings and specialties.
  2. Duct installation and connection requirements are specified in other sections.
  3. Electrical installation requirements are specified in other sections.

**2.26 EXAMINATION**

- A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
- B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
- C. Proceed with installation only after all unsatisfactory conditions have been corrected.

**2.27 INSTALLATION**

- A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

**2.28 COORDINATION**

- A. Coordinate size and location of all building penetrations required for installation of each unit and associated plumbing and electrical systems.
- B. Coordinate location of water system fittings to ensure correct positioning for connection to the water coil and condensate drain pipe.
- C. Coordinate sequencing of construction of associated plumbing, HVAC, electrical supply and sheet metal contractor.

**2.29 QUALITY ASSURANCE**

- A. Source Limitations: Obtain unit with all appurtenant components or accessories from a single manufacturer.
- B. For the actual fabrication, installations, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
- C. Product Options: Drawings must indicate size, profiles, and dimensional requirements of Energy Recovery Unit and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".
- D. Certifications
  - 1. Blowers shall be AMCA Certified for airflow.
  - 2. Entire unit shall be ETL Certified per U.L. 1995 and bear an ETL sticker.
  - 3. Energy Wheel shall be AHRI Certified per Standard 1060.
  - 4. Coils shall be recognized components for ANSI/UL 1995, CAN/CSA c22.2 No 236.05. DX and water coils shall be AHRI Certified per standard 410-2001.
  - 5. Indirect gas-fired furnace shall be ETL certified as a component of the unit.

## **2.30 FIELD QUALITY CONTROL**

### **A. Manufacturer's Field Service**

1. Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections.

### **B. Reports results to A/E in writing**

1. Inspection must include a complete startup checklist to include (as a minimum) the following:  
Completed Start-Up Checklists as found in manufacturer's IOM.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories, and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

### **3.3 CLEANING**

- B. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



**SECTION 23 0235**

**ROOFTOP ENERGY RECOVERY UNITS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 THIS SECTION INCLUDES**

A. Mechanical Specification for energy recovery rooftop units.

B. References

- |    |              |   |
|----|--------------|---|
| 1. | ASTM E90     | Standard Test method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements                 |
| 2. | ASTM E1332   | Standard Classification for Determination of Outdoor-Indoor Transmission Class  |
| 3. | SMACNA       | HVAC Duct Construction Standards—Metal and Flexible   |
| 4. | AMCA 210     | Laboratory Methods of Testing Fans for Rating Purposes  |
| 5. | AFBMA 9      | Load Ratings and Fatigue Life for Ball Bearings   |
| 6. | ARI 410      | Forced-Circulation Air-Cooling and Air-Heating Coil   |
| 7. | UL 1995      | Heating and Cooling Equipment   |
| 8. | ASHRAE 52-76 | Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI/ASHRAE Approved) (for Filters) |
| 9. | ASHRAE 62.1  | Ventilation for Acceptable Indoor Air Quality   |

**1.2 SCOPE**

A. Provide air handling designed and manufactured to the specific requirements of this project.

**1.3 QUALITY**

- A. Service for the unit shall be available locally either directly from the manufacturer or from the manufacturer's certified local representative.
- B. Components not manufactured at the factory shall be provided by manufacturers regularly engaged in the production of such equipment and shall conform to recognized industry standards.
- C. The unit shall meet or exceed the specified performance parameters which serve as a basis for unit selection including airflow rates, external static pressures, capacities, water flow rates, brake horsepower, motor horsepower, face velocities, & acoustical performance.
- D. Units shall be built and shipped in sections to fit into mechanical equipment room (MER).
- E. The performance off all heating and cooling coils shall be ARI certified.
- F. All fans and blowers shall conform to AMCA standard 210 and bear the AMCA certified ratings seal for performance
- G. Unit construction shall otherwise comply with ASHRAE Standard 62.1.

#### **1.4 INSTALLATION, OPERATION AND MAINTENANCE MANUAL**

- A. A single electronic manual containing detailed information regarding the Installation, Operation, and Maintenance of the unit shall be included with the units.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be shipped with integral lifting lugs welded to the unit frame. Before leaving the factory, units shall be wrapped, packaged, and sufficiently protected for transportation by truck and outdoor storage.
- B. During storage the blower wheels should be manually rotated each month to redistribute the grease and prevent flat spots from developing on the bearings.

#### **1.6 APPROVED MANUFACTURERS**

- A. Design Basis: Energy Wall, American Aldes.

#### **1.7 SUBMITTALS**

- A. Submit shop drawings which are clear and legible and labeled so that different sections can be easily identified.
- B. All technical data relevant to the provided unit shall be submitted including all data shown in the schedules. Product performance data shall include unit dimensions, weights, capacities, component performance data, electrical data, construction details, required clearances and service access dimensions, field connection requirements and data, static pressure drops, methods of vibration isolation, included gages, performance data for each blower, and unit surface material and finish.
- C. Performance data for each blower shall include performance curves showing the operating point as described on the schedule.
- D. Performance data for coils shall include selection sheets showing entering air conditions, altitude, air density, glycol concentration, and leaving air conditions.
- E. The submittal shall contain detailed information about drain connections, locations, and trap heights.
- F. The submittal shall provide information on filters including pressure drop, efficiency, media description, and frame details.
- G. Submittal shall include sound performance data by octave for each blower.
- H. Submittal shall include electrical data for the unit including full load amps for each unit component, maximum circuit ampacity, breaker and disconnect size, transformer size, and wiring diagrams for control panel wiring and unit component wiring that indicates factory and field installed wiring.

### **PART 2 - PRODUCTS (CABINET CONSTRUCTION)**

#### **2.1 WELDED FORMED STEEL BASE FRAME AND FLOOR**

- A. Unit shall have formed C channel base. The frame shall include formed supports under blowers and other components.
- B. The base frame shall incorporate a minimum of four (4) integral lifting lugs for every separate unit section.

- C. A 16 gauge galvanized steel interior floor shall be installed on the base frame. The floor shall be insulated and a 22 gauge galvanized steel sub-floor shall be installed under the insulation.
- D. Floor insulation shall be 2" thick and consist of a load-bearing, rigid, closed-cell polyiso foam core laminated to a black glass reinforced mat facer. Insulation blowing agents shall be HCFC-free and qualify under the Federal Procurement Regulation for Recycled Material. Additionally, insulation shall meet the following criteria:
  - 1. Insulation shall have an LTTR R-Value of 12.1 (where the LTTR is based on a 15 year time-weighted average in accordance with CAN/ULC-S770).
  - 2. Insulation shall have a compressive strength of 20 psi under ASTM D 1621, a density of 2 pcf under ASTM D 1622, a dimensional stability of less than 2% under ASTM D 2126, a moisture vapor transmission of less than 1 Perm under ASTM E 96, and a water absorption of less than 1% by volume under ASTM C 209. Insulation shall have a service temperature of -100 °F to 250 °F.
  - 3. Insulation shall be compliant with the following specifications: ASTM C1289, Type II, Class 1; UL Classified; FM Class 1 Approved; and CAN/ULC-S704. Additionally, the manufacturer's facility shall be ISO 9002 Registered.

## 2.2 DOUBLE WALL CONSTRUCTION

- A. Cabinet frame exterior shall be of formed 18 gauge (minimum) galvanized steel. Panels (fixed and access) to be of 18 gauge galvanized steel.
- B. Frame and panels to be double-walled construction with two inch thick mineral wool insulation. Insulation shall be 4# density, non-combustible, semi-rigid mineral wool insulation boards that are water repellent, designed for high temperature applications where flexibility is required, and meet the following criteria:
  - 1. Insulation shall have a thermal resistance R factor of 8.4.
  - 2. Insulation shall comply with ASTM C 612, Type IVA and have a melting point of no less than 2150 °F. Under ASTM E 136 and CAN4 S114 it shall be Non-Combustible. Under ASTM E 84 and CAN/ULC S102 it shall have a maximum Flame Spread of zero (0).
  - 3. Insulation shall have linear shrinkage of less than 1% at 1200 °F under ASTM C 356.
  - 4. Insulation shall have a moisture sorption of no more than 0.03% under ASTM C 1104.
  - 5. Insulation shall be free of CFC and HCFC materials and be made from natural and recycled materials.
  - 6. Insulation shall be UL Classified.
  - 7. Urethane foam insulation is not acceptable.
- C. Frame and panels to have an internal liner of 22 gauge galvanized steel and be sealed with silicone sealant to provide a complete vapor barrier and non-contaminating surface to all air streams.
- D. Framing and panels of dissimilar metals that could create a galvanic effect are not allowed.

### **2.3 ROOFTOP / OUTDOOR CONSTRUCTION**

- A. Weatherized outdoor construction shall include sloped roof panels with rain gutters that overhang the sidewalls to shed water away from access panels, capped roof seams, outside air shut-off damper, exhaust air backdraft damper, and intake and exhaust weather hoods with bird-screens. Secondary roof panels that could trap moisture are not allowed.
- B. Roof curb shall be 16 gauge galvanized steel with additional supports and cross members as needed. Curb to have wood nailer and 1.5" thick fiberglass insulation of the same type used to insulate the unit floor.

### **2.4 2" MERV 13 FILTERS**

- A. Outside and return air filters shall be medium-efficiency ASHRAE pleated panels consisting of cotton and synthetic media, media support grid and enclosing frame with integral channel for side-access application.
- B. The filter shall have a Minimum Efficiency Reporting Value of MERV 13 when evaluated under the guidelines of ASHRAE Standard 52.2-2007. It shall also have a MERV-A of 13 when tested per Appendix J of the same standard.
- C. Initial resistance to airflow shall not exceed 0.31" w.g. at an airflow of 500 fpm.
- D. A welded wire grid, spot-welded on one-inch centers and treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.
- E. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media to prevent air bypass and include integral diagonal support members on the air entering and air exiting side to maintain uniform pleat spacing in varying airflows. The top and bottom of the enclosing frame shall include integral reinforced channels for housing installation.
- F. The filter shall be classified by Underwriters Laboratories as UL Class 2.
- G. Filters shall be mounted within unit in galvanized holding frames upstream of exchanger and accessible through access panels or doors.

### **2.5 FANS AND MOTORS**

- A. Supply and exhaust air blowers shall be EMC fans.

### **2.6 ENTHALPY HEAT EXCHANGER WHEEL**

- A. Air-to-air heat exchanger wheel shall transfer both sensible and latent energy between the incoming outdoor air stream and exhaust air stream.
  - 1. Energy Recovery
    - a. The factory-installed enthalpy wheel shall be certified to meet the requirements of AHRI Standard 1060 and shall be AHRI listed.
    - b. The enthalpy wheel shall be constructed of corrugated synthetic fibrous media with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media.
    - c. The desiccant material shall be molecular sieve, 4 angstrom or smaller.
    - d. The rotor shall be constructed of alternating layer of flat and corrugated media.
    - e. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass.

- f. The wheel frames shall be evenly spaced steel spokes with a galvanized steel outer band and rigid center hub.
- g. The wheel seals shall be full contact nylon brush type.
- h. The wheel shall slide out of the cabinet side for service.
- i. Wheel cassettes shall be constructed of galvanized steel. Cassettes shall have integral purge section.
- j. The wheel bearings shall be inboard mounted, permanently sealed roller bearings or externally flanged bearings.
- k. The wheel shall be driven by a fractional horsepower AC motor via multilink drive belts.
- l. Energy wheel defrost control and air bypass shall be available.
- m. The wheel air carry-over from supply to exhaust shall be less than one percent at the wheel face with three to five inches of pressure differential between the airstreams.

## **2.7 CONTROLS**

- A. Controls shall be by others.
- B. The unit manufacturer shall incorporate Frost Control and core bypass.

## **2.8 ELECTRICAL**

- A. Electrical controls shall include for direct drive units: motors with internal thermal protection and relays; fused branch circuit breakers, control transformer for low voltage controls, service switch, and terminal points/blocks all contained in a NEMA 3R, unit-mounted control panel.
- B. A single main disconnect switch for single point power connection shall be provided. The disconnect switch shall be mounted through the access panel so that power will have to be shut-off before the access door can be opened.
- C. The motor power and branch circuits shall be protected by circuit breakers so replaceable fuses will not be necessary.
- D. All provided wiring and controls shall be factory tested before shipment.
- E. The unit wiring diagram shall be provided in the panel.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. The unit manufacturer shall provide a factory trained supervisor to instruct and supervise the contractor in rigging, erecting, pre-operation checkout and starting of each unit as necessary.
- B. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- C. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**3.4 WARRANTY**

- A. The warranty shall be a 1 year parts warranty for the entire unit from date of startup or 6 months from shipment whichever occurs first.

**END OF SECTION**

**SECTION 23 0240**

**COMMERCIAL AIR-COOLED CONDENSING UNITS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 SYSTEM DESCRIPTION**

- A. Outdoor-mounted, air-cooled split system outdoor section suitable for on rooftop installation. Unit shall consist of a scroll compressor, an air-cooled coil, propeller-type blow-thru outdoor fans, accumulator, full refrigerant charge, and control box. Unit shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling and system.
- B. Units shall be used in a refrigeration circuit matched to a ducted cooling coil.

**1.2 QUALITY ASSURANCE**

- A. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.
- B. Units shall be constructed in accordance with UL standards.
- C. Units shall be listed in the CEC directory.
- D. Unit cabinet shall be capable of withstanding Federal Test Standard No. 141 (method 6061) 500-hour salt spray test.
- E. Air-cooled condenser coils shall be leak tested at 350 psig air pressure with the coil submerged in water.

**1.3 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT**

- A. General:  
Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, full charge of 410A refrigerant and special features required prior to field start-up.
- B. Unit Cabinet
  - 1. Unit cabinet shall be constructed of galvanized-steel, bonderized and coated with a baked-enamel finish.
  - 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
  - 3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans

1. Outdoor fans shall be direct-drive propeller type and shall discharge air horizontally. Fans shall blow air through the outdoor coil.
2. Outdoor fan motors shall be totally-enclosed, single-phase motors with class B insulation and permanently-lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
3. Shaft shall have inherent corrosion resistance.
4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
5. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.

D. Compressor

1. Compressor shall be scroll type.
2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from overtemperature and overcurrent. Scroll compressors shall also have high discharge gas temperature protection if required.
3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
4. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.

E. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes which are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator, pressure relief, and a full charge of refrigerant.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls

- a. Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
- b. Automatic restart on power failure.
- c. Safety lockout if any outdoor unit safety is open.
- d. A time delay control sequence provided through the fan coil board, thermostat, or controller.
- e. High-pressure and liquid line low-pressure switches.
- f. Automatic outdoor-fan motor protection.



2. Safeties
  - a. System diagnostics.
  - b. Compressor motor current and temperature overload protection.
  - c. High pressure relief.
  - d. Outdoor fan failure protection.
  
- H. Electrical Requirements
  1. Unit electrical power shall be a single point connection, as scheduled.
  2. Unit control voltage to the indoor-fan coil shall be 24V.
  3. All power and control wiring must be installed per NEC and all building codes.
  4. High and low voltage terminal block connections.

**END OF SECTION**



## **SECTION 23 0245**

### **PACKAGED ROOFTOP UNITS**

#### **PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 SYSTEM DESCRIPTION**

- A. Unit is an outdoor rooftop mounted, electrically controlled heating and cooling unit utilizing fully hermetic scroll compressors with on demand crankcase heaters for cooling duty. Supply air shall be discharged as shown on contract drawings. Units shall be of ultra-high cooling efficiency and utilize environmentally friendly Puron (R-410A) refrigerant.

##### **1.2 QUALITY ASSURANCE**

- A. Unit shall well exceed ASHRAE 90.1-2001 Energy Efficiency Standards. All units shall be ENERGY STAR qualified.
- B. Unit shall be rated in accordance with ARI Standards 360. All units shall be designed in accordance with UL Standard 1995. Unit shall be rated in accordance with ARI sound standard 370.
- C. Unit shall be designed to conform to ASHRAE 15.
- D. Unit shall be UL and UL, Canada, tested and certified in accordance with ANSI Z21.47 Standards as a total package.
- E. Roof curb shall be designed to conform to NRCA Standards.
- F. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- G. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).
- H. Unit shall be manufactured in a facility registered to ISO 9001:2000.
- I. Each unit shall be subjected to a completely automated run testing on the assembly line.

##### **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Unit shall be stored and handled per manufacturer's recommendations.

#### **PART 2 - PRODUCTS**

##### **2.1 EQUIPMENT (STANDARD)**

- A. General:  
The unit shall be a fully factory assembled, pre-tested, single-piece cooling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, Puron refrigerant charge (R-410A), and special features required prior to field start-up. Outdoor sound ratings shall be as low as 82 dB.

B. Unit Cabinet

1. Constructed of galvanized steel, bonderized and coated with a pre-painted baked enamel finish on all externally exposed surfaces. Internal surfaces shall be of a primer coated finish.
2. All airstream interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb. density foil-faced cleanable insulation. Insulation shall be bonded with a thermosetting resin (8 to 12% by weight nominal, phenol formaldehyde typical), and coated with an acrylic or other material that meets the NFPA 90 flame retardance requirements and has an "R" value of 3.70. Insulation shall also be encapsulated with panel design or tape edges ensuring secure fit.
3. Cabinet panels shall be hinged with integrated non-corrosive hinges. Large area hinged access panels for the filter, compressors, evaporator fan, and control box and heat section areas. Each panel shall use multiple quarter-turn latches and handles. Each major external hinged access panel shall be double-wall construction and permanently attached to the rooftop unit. Panels shall also include tiebacks.
4. Return air filters shall be accessible through a dedicated hinged access panel and be on a slide-out track using standard size filters. Filter shall be standard off the shelf sizes and be the size per cabinet. Capability for 2 or 4 inch filters shall be on all sizes.
5. Holes shall be provided in the base rails (minimum 16 gauge) for rigging shackles and level travel and movement during overhead rigging operations.
6. Fork lift slots shall be available from two sides of the unit (end and side).
7. Unit shall have a factory-installed internally sloped condensate drain pan, providing a minimum 3/4-in.-14 NPT connection to prevent standing water from accumulating. Pan shall be fabricated of epoxy powder coated steel. All drain pans conform to ASHRAE 62 self-draining provisions.
8. Unit shall have standard thru-the-bottom power and control wiring connection capability.

C. Fans

1. Indoor blower (evaporator fan)
  - a. Centrifugal supply air blower shall have pillow-block ball bearings and adjustable belt drive.
  - b. Fan wheel shall be made from steel with a corrosion resistant finish. It shall be a dynamically balanced, double-inlet type with forward-curved blades.
  - c. The indoor fan system (blower wheels, motors, belts, and both bearings) shall slide out for easy access.
  - d. Evaporator-fan motors shall be continuous operation, open drip-proof. Bearings shall be sealed, permanently lubricated ball-bearing type for longer life and lower maintenance.
  - e. A fan belt catch system shall be used.
2. Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades riveted to corrosion-resistant steel supports. They shall be dynamically balanced and discharge air upwards. Condenser-fan motors shall be totally enclosed, thermally protected, and be of a shaft down design to protect from direct contact from harsh environments.

D. Compressor(s)

1. Fully hermetic, scroll type with on demand crankcase heaters, internal high-pressure and temperature protection.
2. Factory mounted on rubber grommets and internally spring mounted for vibration isolation.
3. Be mounted on dedicated mounting plate to ensure secure design and reduced sound levels.

E. Coils

1. Standard evaporator coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
2. Shall have face-split type evaporator coil.
3. Evaporator coils shall be single slab, single pass design to facilitate easy coil cleaning.
4. Condenser coils shall use Micro-Channel coil technology. Coil shall have a series of flat tubes containing a series of multiple, parallel flow micro-channels layered between the refrigerant manifolds. Micro-channel coils shall consist of a two-pass arrangement.
  - a. Coil construction shall consist of aluminum alloys for the fins, tubes and manifolds in combination with a corrosion resistant coating on the tubes.
  - b. 0.3 fins/inch
  - c. 18 louvers per fin
  - d. 32 ports per tube
  - e. Double wall thickness on exposed tube edges
  - f. Epoxy-lined shrink wrap protection of Al to Cu tube joint
5. Coils shall be leak tested at 170 psig and pressure tested at 1875 psig.

F. Refrigerant Components - Each refrigerant circuit shall include:

1. Balanced port thermostatic expansion valve (TXV) with removable power element.
2. Solid core refrigerant filter driers with pressure ports.
3. Refrigerant pressure gage ports and connections on suction, discharge, and liquid lines.

G. Filter Section

1. Standard filter section shall consist of factory-installed 4-in. thick disposable fiberglass filters and shall be on a dedicated slide out track to easily facilitate access and replacement.
2. Filter section shall use standard size filters and be of common sizes within cabinet sizes.
3. Optional MERV-8 pleated filters of commercially available sizes shall be available as a factory installed option.
4. 4-inch filter capability shall be available as factory-installed option.

H. Controls and Safeties

1. Unit Controls:

- a. Scrolling Marquee display.
- b. CCN (Carrier Comfort Network®) capable.
- c. Unit control with standard suction pressure transducers and condensing temperature thermistors.
- d. Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
- e. Shall provide and display a current alarm list and an alarm history list.
- f. Automatic compressor redundancy on units without Humidi-MiZer™ system.
- g. Service run test capability.
- h. Shall accept input from a CO2 sensor (both indoor and outdoor).
- i. Configurable alarm light shall be provided which activates when certain types of alarms occur.
- j. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
- k. Service diagnostic mode.
- l. Economizer control (optional).
- m. Multiple capacity stages.
- n. Unit shall be complete with self-contained low-voltage control circuit.
- o. Unit shall have 0° F low ambient cooling operation.

2. Safeties

- a. Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat should any of the following safety devices trip and shut off compressor:
  - Compressor lockout protection provided for either internal or external overload.
  - Low-pressure protection.
  - Freeze protection (evaporator coil).
  - High-pressure protection (high pressure switch or internal).
  - Compressor reverse rotation protection (*ComfortLink™* units only).
  - Loss of charge protection.
  - Start assist on single-phase units.
- b. Supply-air sensor shall be located in the unit and detect both heating and cooling operation.

3. Direct Digital Control

- a. Provide BACnet Interface card.

I. Operating Characteristics

1. Unit shall be capable of starting and running at 125 F ambient outdoor temperature per maximum load criteria of ARI Standard 360.
2. Unit controls will operate in cooling down to an outdoor ambient temperature of 0° F. Electro-mechanical shall operate down to 40 F.
3. Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

J. Electrical Requirements: All unit power wiring shall enter unit cabinet at a single location; side or bottom.

K. Motors

1. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers. Evaporator motors are designed specifically for Carrier and do *not* have conventional horsepower (hp) ratings listed on the motor nameplate. Motors are designed and qualified in the “air-over” location downstream of the cooling coil and carry a maximum continuous bhp rating that is the maximum application bhp rating for the motor; no “safety factors” above that rating may be applied.
3. All evaporator fan motors 5 hp and larger shall meet the minimum efficiency requirements as established by the Energy Policy Act of 1992 (EPACT), effective October 24, 1997.
4. Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.

L. Special Features

1. Full Perimeter Roof Curbs
  - a. Formed of 14-gauge galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight. Shall be interlocking design.
  - b. Permits installing and securing ductwork to curb prior to mounting unit on the curb. Field assembly required.
  - c. Shall be available 24-in. height.
2. Integrated Economizer
  - a. Economizer shall be furnished and installed complete with outside air dampers and controls.
  - b. Economizer shall be a gear-driven parallel blade design with low-leakage, opposing damper blades, gear-driven dampers and UL approved gears.
  - c. Capable of introducing up to 100% outdoor air for minimum ventilation as well as free cooling.
  - d. Economizer shall be available for both field or factory installation.
  - e. Damper blades shall be low-leakage design, not to exceed 2% leakage at 1 in. wg pressure differential.
  - f. Shall include a 40F compressor lockout sensor (opens at 35 F, closes at 50 F).
  - g. Shall include either a single outdoor air temperature sensor or single outdoor air enthalpy sensor. Additional sensors for alternative control methods shall be available for field installation.
  - h. Damper actuator
    - Shall be controlled by an electronic 4-20 mA/2 signal.
    - shall be a fully modulating actuator
    - shall contain an internal spring to allow dampers to close during loss-of-power situations
    - Actuator shall be direct coupled to economizer gear, eliminating linkage arms and rods.

3. Energy Recovery Module with Power Exhaust (as scheduled)
  - a. Package shall be one piece electrically controlled ventilation air pre-conditioner utilizing an ARI 1060 certified energy recovery cassette. Unit shall be factory installed. Blowers shall be direct drive with variable speed motors. Motor shall be high efficiency. The energy recovery wheel shall be coated with silica gel desiccant, permanently bonded without the use of binders or adhesives.
4. Differential Enthalpy Sensor
  - a. For use with economizer only.
  - b. Capable of comparing heat content (temperature and humidity) of outdoor air and indoor air and controlling economizer cut-in point at the most economical level.
5. Convenience Outlet:

Optional factory-installed powered convenience outlet shall be internally mounted with an externally accessible 115-v, 2-plug female receptacle with hinged cover. Shall include 15 amp GFI with independent fuse protection and service receptacle disconnect. The convenience outlet is powered from the line side of the disconnect or circuit breaker with a factory-installed step down transformer, therefore it will not be affected by the position of the disconnect or circuit breaker.
6. Non-Fused Disconnect Switch:

Shall be factory-installed, internally mounted, NEC and UL approved. Non-fused switch shall provide unit power shutoff. Shall be accessible from outside the unit and shall provide power off lockout capability.
7. Return Air/Supply Air Smoke Detector:

The smoke detector shall send input to the controller to shut down the unit in case smoke is detected. The smoke detector shall be factory installed in the return air section or shall be available as a field-installed accessory.
8. Filter Status:

The filter status switch shall be a pressure switch and will indicate a dirty filter. The switch shall be available as field or factory-installed.
9. Fan Status:

The fan status switch shall be a pressure switch and will indicate indoor fan operation. The switch shall be available as field or factory-installed.
10. MERV-8 Pleated Return Air Filters:

The filters shall be MERV-8 efficient. The filters shall be 2-in., pleated filters.
11. 4-in. Return Air Filter Capability:

The unit with factory-installed option of 4-in. filter capability shall be capable of accepting field-supplied 4-in. filters by removal of the factory-supplied 2-in. filters and filter retainer.
12. Mid-High Fan Performance Motor/Drive:

This motor/drive option shall provide medium to high motor and drive capability to enhance evaporator fan performance.
13. Phase Loss Protection (3-phase units only) :

Shall provide unit shutdown when an electrical phase loss is detected – automatic reset type.



14. Adaptive Dehumidification System

- a. The dehumidification system shall be factory-installed in the rooftop units, and shall provide greater dehumidification of the occupied space by two modes of dehumidification operations beside its normal design cooling mode:
  - Subcooling mode further subcools the hot liquid refrigerant leaving the condenser coil when both temperature and humidity in the space are not satisfied.
  - Hot gas reheat mode shall mix a portion of the hot gas from the discharge of the compressor with the hot liquid refrigerant leaving the condenser coil to create a two-phase heat transfer in the system, resulting in a neutral leaving-air temperature when only humidity in the space is not satisfied.
- b. The system shall consist of a subcooling/reheat dehumidification coil located downstream of the standard evaporator coil. This dehumidification coil shall be a two row coil.
- c. The system shall include a low outdoor air temperature switch to lock out both subcooling and hot gas reheat modes when the outdoor-air temperature is below 40 F.
- d. The system shall include a low-pressure switch on the suction line to ensure low pressure start-up of hot gas reheat mode at lower outdoor temperature condition.
- e. The system operation may be controlled by a field-installed, wall-mounted space humidity sensor or humidistat. The dehumidification circuit will then operate only when needed. Field connections for the humidistat are made in the low-voltage compartment of the unit control box. The sensor can be set for any level between 55% and 80% relative humidity.
- f. For units with multiple circuits, depending on the conditions required to maintain the space set points, one circuit (and compressor) can operate in subcooling mode while the other(s) operate in hot gas reheat mode, or one or all the circuits (compressors) can operate in hot gas reheat mode.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 23 0255**

### **VRF INDOOR UNITS**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 SYSTEM DESCRIPTION**

- A. Indoor, in-ceiling mounted and ducted direct-expansion fan coils are matched with a heat recovery VRF outdoor unit. Design Basis: LG

##### **1.2 AGENCY LISTINGS**

- A. Unit shall be ETL listed and certified to UL 1995 4th edition standard.

##### **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be stored and handled per unit manufacturer's recommendations.

#### **PART 2 - PRODUCTS**

##### **2.1 EQUIPMENT – Ceiling Cassettes**

- A. General: Indoor, direct-expansion, low profile (10.6 in.), in-ceiling fan coil (compact when capacity is available in compact unit). Unit shall be complete with a coil, fan, DC inverter driven fan motor, PMV valve, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, condensate pump with a lift capability of 24.7", and hanging brackets.
- B. Unit Cabinet: Cabinet shall be constructed of zinc-coated steel. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact non-metallic material. The inlet grille shall have hinges and can be opened to obtain access to the cleanable filters, indoor fan motor and control box.
- C. Fans
  - 1. Fan shall be centrifugal direct-drive blower type with air intake in the center of the unit and discharge at the perimeter. Automatic, motor-driven vertical air sweep shall be provided standard. Automatic motor-driven louvers shall be provided standard and shall be adjustable for 2, 3 or 4-way discharge.
  - 2. Air sweep operation shall provide three user selectable modes.
- D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a factory installed condensate pump and drain connection for hose attachment to remove condensate. A replaceable element in the condensate disposal system provides antibacterial protection.
- E. Motors: Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.

F. Controls

1. The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control and shall have an accuracy of 0.9 OF (+ 0.5 OC). The following user interface accessories shall be compatible with the unit.
  - a. Building Management System:  
The system shall be able to be controlled by BACnet, or Lon Works either directly or through an external gateway. BACnet and Lon Works shall be able to control: ON / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation. BACnet and Lon Works shall be able to monitor: ON / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation, Room temperature, Error status, Error code.
2. The unit shall have the following functions as a minimum:
  - a. Selectable automatic restart, after power failure the system will restart at the same operating conditions as before the failure.
  - b. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control.
  - c. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
  - d. Automatic air sweep control to provide multiple operating modes of the air sweep louvers.
  - e. Dehumidification mode shall provide increased latent removal through total system modulation.
  - f. Fan-only operation to provide room air circulation when no cooling is required.
  - g. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined (Auto) based on the differential between the room temperature and the set point during all modes of operations.
  - h. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
  - i. Cold blow prevention in heating.
  - j. Adjustable compensation for air stratification in heating.

G. Filters

1. Unit shall have factory-supplied resin net (cleanable) type filters. The return air filter material shall have the following characteristics:
  - a. Odorless
  - b. Temperature resistant to 185°F (85°C)
  - c. Humidity resistant up to 95% RH

H. Electrical Requirements: Indoor units are 208/230-1-60.

I. Special Features (Accessories)

1. User Interface can be accomplished with:
  - a. Wireless remote control.
  - b. Wired remote control (programmable or non-programmable) shall be capable of controlling from 1 to 8 daisy-chained units.
2. Ceiling panel (grille).

## 2.2 EQUIPMENT – High Static ducted fan coil units

### A. General

1. Unit shall be manufactured by LG.
2. Unit shall be designed to be installed for indoor applications.
3. Ducted high Static- Unit shall be a low profile design with a maximum height of twelve inches.
4. Unit shall be designed to mount fully concealed above the finished ceiling.
5. Unit shall have opening to supply air from front horizontal and a dedicated rear horizontal return.
6. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.

### B. Casing/Panel

1. Unit case shall be manufactured using galvanized steel plate.
2. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
3. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
4. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

### C. Cabinet Assembly

1. Unit shall have horizontal supply air discharge outlets and a return air inlet
2. Unit shall be equipped with factory installed temperature thermistors for:
  - a) Return air
  - b) Refrigerant entering coil
  - c) Refrigerant leaving coil
3. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
4. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
5. Unit shall have the following functions as standard:
  - a) Self-diagnostic function
  - b) Auto addressing
  - c) Auto restart function
  - d) Auto changeover function (Heat Recovery system only)
  - e) Auto operation function
  - f) Child lock function
  - g) Forced operation
  - h) Dual thermistor control
  - i) Sleep mode
  - j) External static pressure (ESP) control
  - k) Dual set point control
  - l) Multiple aux heater applications
  - m) Filter life timer
  - n) External on/off input
  - o) Wi-Fi compatible
  - p) Auto fan operation
  - q) Leak detection logic

D. Fan Assembly

1. The unit shall have two direct drive Sirocco fans made of high strength ABS GP-2200 polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.
3. The fans shall be mounted on a common shaft.
4. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
5. The fan motor shall include thermal, overcurrent and low RPM protection.
6. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
7. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of three pre-programed fan speeds, each setting is also adjustable by field setting to compensate for a limited amount of additional resistance to airflow by adjusting the RPM of the fan motor.
8. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
9. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
10. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
11. Unit shall be designed for high speed air volume against an external static pressure of up to 0.98", model dependent.

E. Filter Assembly

1. The return air inlet shall have a factory supplied accessory MERV 13 filter rack.
2. The filter access shall be from the side of the unit.

F. Coil Assembly

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have a minimum two to three row coil, 18-21 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
5. Unit shall include an installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit. The unit drain pan is supplied with a secondary drain port/plug allowing the pan to be gravity drained and serviced.>
6. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan, model dependent.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.

G. Microprocessor Control

1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system with or without the use of a wall mounted controller. The unit shall have a factory mounted return air thermistor for use as a space temperature control device. All operating parameters except scheduling shall be stored in non-volatile memory resident on the microprocessor. The microprocessor shall provide the following functions, self-diagnostics, auto-restart after a power failure and a test run mode.

2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted, and shielded communication cable (RS-485).
3. The unit controls shall operate the indoor unit using one of the five operating modes:
  - a) Auto changeover (Heat Recovery System only)
  - b) Heating
  - c) Cooling
  - d) Dry
  - e) Fan only
4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
6. The unit shall be able to operate with a continuous fan setting.
7. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
8. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable thermostat controller.

H. Electrical

1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**





## **SECTION 23 0260**

### **DUCTLESS SPLIT SYSTEMS**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 SYSTEM DESCRIPTION**

- A. Outdoor-mounted, air-cooled split system outdoor section suitable for rooftop installation. Unit shall consist of a hermetic reciprocating, scroll, or rotary compressor, an air-cooled coil, propeller-type blow-thru outdoor fans, reversing valve, accumulator, holding refrigerant charge heating mode metering device, and control box. Unit shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling and heating system.
- B. Indoor, in-the-ceiling-mounted or wall mounted direct-expansion fan coil to be matched with the commercial heat pump unit.

##### **1.2 QUALITY ASSURANCE**

- A. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.
- B. Unit shall be rated (when matched with appropriate outdoor unit) per ARI Standard 210/240. Units shall be certified by UL and CSA.
- C. Units shall be constructed in accordance with UL standards.
- D. Units shall be listed in the CEC directory.
- E. Unit cabinet shall be capable of withstanding Federal Test Standard No. 141 (method 6061) 500-hour salt spray test.
- F. Air-cooled condenser coils shall be leak tested at 350 psig air pressure with the coil submerged in water.

##### **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.

#### **PART 2 - PRODUCTS**

##### **2.1 OUTDOOR HEAT PUMP CONDENSING UNIT**

- A. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, charge of R-410A refrigerant and special features required prior to field start-up.
- B. Unit Cabinet
  - 1. Unit cabinet shall be constructed of galvanized-steel, bonderized and coated with a baked-enamel finish.
  - 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
  - 3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans

1. Outdoor fans shall be direct-drive propeller type and shall discharge air horizontally. Fans shall blow air through the outdoor coil.
2. Outdoor fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
3. Shaft shall have inherent corrosion resistance.
4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
5. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.

D. Compressor

1. Compressor shall be fully hermetic reciprocating or scroll type.
2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and over current. Scroll compressors shall also have high discharge gas temperature protection if required.
3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.
5. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.
6. Compressors shall be single phase or 3-phase as specified on the Contract Drawings.

E. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes that are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator, bi-flow filter drier, pressure relief, reversing valve, and heating mode metering device.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls

- a. Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
- b. Automatic restart on power failure.
- c. Safety lockout if any outdoor unit safety is open.
- d. A time delay control sequence is also provided standard through the fan coil board, thermostat, or controller.
- e. High-pressure and liquid line low-pressure switches.
- f. Automatic outdoor-fan motor protection.
- g. Start capacitor and relay (single-phase units without scroll compressors).

2. Safeties
  - a. System diagnostics.
  - b. Compressor motor current and temperature overload protection.
  - c. High pressure relief.
  - d. Outdoor fan failure protection.

H. Electrical Requirements

1. Unit shall operate on a 208-v or 230-v, 60 Hz power supply as specified on the equipment schedule.
2. Unit shall operate on single-phase, 60 Hz power at 115 v or 208/230 v, or three-phase, 60 Hz power at 208/230 v or 460 v, as specified.
3. Unit electrical power shall be a single point connection.
4. Unit control voltage to the indoor-fan coil shall be 24 v, except 38BK009 and 012 units, which shall supply line voltage.
5. All power and control wiring must be installed per NEC and all building codes.
6. Unit shall have high- and low-voltage terminal block connections.

I. Special Features (Field Installed)

1. Low-Ambient Kit: Control shall regulate fan-motor cycles in response to saturated condensing pressure of the unit. The control shall be capable of maintaining a condensing temperature of 100 F  $\pm$  10 F with outdoor temperatures to -20 F. Installation of kit shall not require changing the outdoor-fan motor.
2. Liquid Solenoid Valve: This electronically operated shutoff valve shall close and open in response to compressor operation. The valve should be used with all long-lines applications (over 100 ft).
3. Crankcase Heater (units with scroll compressors only): Unit shall be shipped with a clamp-on compressor oil sump heater.

**2.2 4 WAY CEILING CASSETTE INDOOR UNIT**

- A. Indoor, direct-expansion, low-profile (11-3/4 in. high) in-ceiling fan coil. Unit shall come complete with cooling/heating coil, electric heater, fan, fan motor, piping connectors, electrical controls, condensate pump, and hanging brackets.
- B. Unit cabinet shall be constructed of zinc-coated steel. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall have filter tracks and cleanable filters which shall be accessible from below with a 1/4 -turn fastener. Adjacent room cooling to be provided by a simple knock-out in the cabinet side panel, and cabinet shall have provisions to accommodate a limited amount of ductwork, if desired.
- C. Fan shall be a centrifugal, direct-drive blower type with air intake in center of the unit and discharge on the perimeter. Air louvers shall be adjustable for 2, 3, or 4-way discharge.
- D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins will be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a factory-installed condensate pump and drain connection for hose attachment to remove condensate.

- E. Motors: Motor shall be totally enclosed and permanently lubricated with inherent protection. Fan motor shall be 3-speed.
- F. Controls: Controls shall be 24-v and shall be easily operated by the user from a wall-mounted control unit. Float control shall be in the condensate sump to shut unit down in case of pump malfunction. A wall-mounted electromechanical thermostat with 3 fan-speed selections and an auto/manual switch shall be supplied for field installation. Automatic changeover from cooling to heating modes and selectable 2 or 4 minute start-up delay shall be included. The R-22 refrigerant shall be controlled with a piston-type refrigerant metering device, and evaporator coil freeze protection shall be provided.
- G. Filters: Unit shall have filter track with factory-supplied cleanable filters.
- H. Electrical Requirements: Unit shall operate on a 208-v or 230-v, 60 Hz power supply as specified on the equipment schedule.
- I. Operating Characteristics: (See Drawing Schedule)
- J. Special Features (Field Installed)
  - 1. Power Ventilation Kit:  
Kit shall allow ventilation of the conditioned space with outdoor air. The kit shall include filter, booster fan, and controls.
  - 2. Electronic Programmable Thermostat:  
Thermostat shall be commercial grade and shall provide 7-day, 4-event scheduling. Integral sub base shall be included. Thermostat shall also provide 3-speed fan switchover capability, air sweep auto changeover, and shall not require a battery to retain memory.
  - 3. Fresh Air Intake Kit:  
Kit shall include filter and duct connections to provide for outdoor ventilation air.

**2.3 AIR CONDITIONING CONDENSATE PUMP  
(PROVIDE IN ALL CASES WHERE CONDENSATE CANNOT DRAIN BY GRAVITY)**

- A. Pump shall be equal to “Little Giant” model no. VCMA-15ULS-554401. Automatic, 15 ft. shut-off, 1/2 gallon tank, safety switch check valve, 6 ft. power cord power cord with plug.
- B. Provide 3/8” copper tubing discharge piping installed per manufacturer’s recommendations.
- C. For roof discharge applications provide pitch pocket, rigid 3/8” copper discharge piping and gooseneck turned down 12 inches above roof. Provide splash block and remove pump check valve before installation.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 23 0265**

### **VRF HEAT RECOVERY OUTDOOR UNITS**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 SYSTEM DESCRIPTION**

- A. The Heat Recovery Variable Refrigerant Flow system is a three pipe system consisting of a single or multiple outdoor units, multiple indoor units of various types and capacities, and multiple Flow Selector boxes, individual or central indoor unit controls with on/off temperature settings, all connected by fully insulated refrigerant lines utilizing factory supplied, fully insulated, branching kits. Indoor units are connected to condensate piping that shall be terminated to the nearest drain point.
- B. The system shall be fully capable of simultaneous heating and cooling operation as requested by the individual indoor zones that can consist of single or multiple indoor units.
- C. The maximum number of connected indoor units shall not exceed 40.
- D. The total connected indoor unit capacity shall range between 80 and 125% of the outdoor unit capacity.

##### **1.2 AGENCY LISTINGS**

- A. Units shall be listed by ETL and be evaluated in accordance with UL standard 1995, 4<sup>th</sup> edition.
- B. Units shall be listed in the AHRI directory.
- C. All units shall meet the minimum Federal minimum efficiency standards and be tested per AHRI 1230 Standard.

##### **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer's recommendations.
- B. Units shall be supplied with a base rail that provides openings for moving the unit by truck or rigging the unit by crane.

#### **PART 2 - PRODUCTS**

##### **2.1 EQUIPMENT**

- A. General:  
Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter driven twin rotary compressors.
  - 1. The maximum sound pressure rating for single module shall not exceed 63.5 dBA sound pressure in cooling and 65.5 dBA in heating. For twinned systems the sound pressure number should not exceed 66.5 dBA and 68.5 dBA.
  - 2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV valve (metering device) to shut off completely when a zone is satisfied.

3. The outdoor unit shall be protected by a High-pressure switch, High-pressure sensor, Low-pressure sensor, Fusible plug, PC board fuse, and an inverter overload protector.
  4. The outdoor unit shall be capable of operating in cooling mode down to 14°F ambient air temperature and down to -14°F ambient air temperature in heating. For simultaneous heating and cooling the unit shall be capable of operating between 14°F and 60°F ambient air temperature.
  5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows to move oil and refrigerant between twinned units if required even if one of the units is not running.
- B. Unit Cabinet
1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
  2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan and control components.
  3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
  4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
  5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (Method 6061).
- C. Fans
1. Outdoor fan shall discharge air vertically and be driven by a DC inverter variable speed motor with 64 steps that is capable of running down to 60 RPM.
  2. Outdoor fan motor shall be totally enclosed with permanently lubricated bearings.
  3. Motor shall be protected by internal thermal overload protection.
  4. Fan blade shall be non-metallic and shall be statically and dynamically balanced.
  5. Outdoor fan shall be protected by a raised non-metallic protective grille.
- D. Compressors
1. Each outdoor unit module shall be equipped with two or three inverter driven twin rotary compressors with full range control to a level of 0.1 Hz.
  2. Compressor shall be totally enclosed in the machine compartment.
  3. Compressors shall be equipped with factory mounted crankcase heaters.
  4. Internal overloads shall protect the compressor from over-temperature operation.
  5. Motor shall be suitable for operation in a R-410A refrigerant atmosphere.
  6. Compressor assembly shall be installed on rubber vibration isolators.
  7. To maximize compressor reliability, multiple compressors, within a module, shall be started and operated in variable patterns to ensure equal run time on all compressors.
  8. To ensure maximum efficiency throughout the system operations range, no compressor is required to run at maximum speed under any condition.



E. Outdoor Coil

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated and sealed.
2. The coil configuration shall be 4 sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fans shall have a factory applied corrosion resistant blue-fin finish.

F. Controls and Safeties

1. All unit controls shall be capable of being interfaced with the existing Johnson Control System. The unit shall be able to be controlled by BACnet or LonWorks either directly or through an external gateway. Refer to Automatic Temperature Control Section for Sequence of Operation and Control Points.
2. Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
3. Controls
  - a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
  - b. Outdoor fan motor speed for higher efficiency and lower sound.
  - c. Oil control from improved system reliability and comfort.
  - d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starting any units.
  - e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
  - f. Module control of compressor operation, compressor speed, and outdoor heat exchange surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
  - g. Control of the outdoor heat exchanger surface (main vs. sub heat exchangers) for maximum efficiency and comfort.
4. Safeties - The following safety devices shall be part of the condensing unit:
  - a. High pressure switch
  - b. Fuses
  - c. Crankcase heater
  - d. Fusible plug
  - e. Over current relay for the compressor
  - f. Thermal protectors for compressor and fan motor
  - g. Compressor time delay
  - h. Oil Recovery system
  - i. Oil level sensor
  - j. Over-current sensor
  - k. Compressor suction and discharge temperature sensor
  - l. Compressor suction and discharge pressure sensor

G. Electrical Requirements

1. All sizes shall utilize 208/230-3-60 or 460-3-60 field power supply, as scheduled.
2. Twinned systems shall have separate field power supply to each module.
3. Two core shielded low voltage cable shall be required for communication between outdoor and indoor unit.
4. All power and control wiring must be installed per NEC and all Building codes.

H. Refrigerant Piping and Line Lengths

1. Piping connections shall be from the front or the bottom of the unit.
2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 985 ft.
3. The outdoor unit should have the ability to operate with a maximum height of 165 ft. between the outdoor and lowest indoor unit.
4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 575 ft. No line size changes or oil traps shall be required.
5. The system should be capable of operating when the height difference between the upper and lower fan coil is 130 ft.

I. Auxiliary Refrigerant Components

1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of another header.
3. When twinning two modules, and in order to maximize efficiency and comfort, a 3/8" oil balance line shall be used to allow the flow oil and refrigerant between the two units even when one of the units is not running.
4. A flow selector box will be required to regulate the flow of high pressure hot gas or high pressure liquid to the fan coil requiring heating or cooling.
5. Up to 8 fan coils, all requiring same duty cycle, maybe connected to a single flow selector box.
6. A fan coil that runs in cooling only will not be required to connect to a flow selector box.
7. The flow selector box can be installed up to 49 feet away from the indoor unit.
8. The flow selector box shall be wired from the indoor unit using a factory supplied power and control wire harness.
9. The flow selector box shall not require a drain connection.
10. The flow selector box shall include a galvanized steel enclosure, full interior insulation and shall be tested prior to shipment.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## SECTION 23 0280

### VARIABLE FREQUENCY DRIVES

#### PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### 1.2 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.
- B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFD's installed on this project shall be from the same manufacturer.

#### 1.3 QUALITY ASSURANCE

##### A. Referenced Standards

- 1. Institute of Electrical and Electronic Engineers (IEEE)
  - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
- 2. Underwriters laboratories
  - a. UL508C
- 3. National Electrical Manufacturer's Association (NEMA)
  - a. ICS 7.0, AC Adjustable Speed Drives
- 4. IEC 16800 Parts 1 and 2
- 5. National Electric Code (NEC)
  - a. NEC 430.120, Adjustable-Speed Drive Systems
- 6. International Building Code (IBC)
  - a. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

##### B. Qualifications

- 1. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFD's with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
- 2. CE Mark – The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

3. The entire VFD enclosure, including the bypass shall be seismically certified and labeled as such in accordance with the 2006 International Building Code (IBC):
  - a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
  - b. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.
  - c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.
4. Acceptable Manufactures
  - a. ABB ACH Series.
  - b. Alternate manufacturer's requests must be submitted in writing to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.
5. The VFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user's site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID number. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

#### 1.4 SUBMITTALS

- A. Submittals shall include the following information:
  1. Outline dimensions, conduit entry locations and weight.
  2. Customer connection and power wiring diagrams.
  3. Complete technical product description include a complete list of options provided. **Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.**
  4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
    - a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, **no exceptions.**

## PART 2 - PRODUCTS

### 2.1 VARIABLE FREQUENCY DRIVES

- A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

1. Environmental operating conditions: VFD's shall be capable of continuous operation at 0 to 50° C (32 to 122° F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40° C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
  2. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable. NEMA only type 1 enclosures are not acceptable (must be UL Type 1).
  3. Provide NEMA 3R enclosures where exposed to outside weather or wet conditions.
- B. All VFD's shall have the following standard features:
1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.
  2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
  3. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back-up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
  4. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
  5. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.
  6. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
  7. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
  8. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

9. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.
  10. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.
  11. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
  12. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
  13. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload
  14. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
  15. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
  16. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
  17. Provide drive with circuit breaker option and remote panel mounting kit.
- C. All VFD's to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
  2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.



3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
4. Two (2) programmable analog inputs shall accept current or voltage signals.
5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.
7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.
8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.
9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
10. Seven (7) programmable preset speeds.
11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
14. The VFD shall include password protection against parameter changes.

- D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
1. Start-up assistant
  2. Parameter assistants
    - a. PID assistant
    - b. Reference assistant
    - c. I/O assistant
    - d. Serial communications assistant
    - e. Option module assistant
    - f. Panel display assistant
    - g. Low noise set-up assistant
  3. Maintenance assistant
  4. Troubleshooting assistant
  5. Drive optimizer assistants
- E. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
  2. Motor Speed (RPM, %, or Engineering units)
  3. Motor Current
  4. Motor Torque
  5. Motor Power (kW)
  6. DC Bus Voltage
  7. Output Voltage
- F. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.
- G. Serial Communications
1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available. Protocol provided shall match ATC system in Building. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
  2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
    - a. Data Sharing – Read Property – B.
    - b. Data Sharing – Write Property – B.
    - c. Device Management – Dynamic Device Binding (Who-Is; I-Am).

- d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
  - e. Device Management – Communication Control – B.
3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFD's sharing one gateway shall not be acceptable.
  4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
  5. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
  6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.
  7. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.
- H. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.
- I. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.
- J. OPTIONAL FEATURES – Optional features shall be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
1. Door interlocked, pad-lockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Disconnect option shall be available with or without systems requiring bypass.

2. Field-bus adapters - Protocols such as BACnet IP shall be a plug in modules.

K. Bypass

1. A complete factory wired and tested bypass system consisting of a door interlocked, pad-lockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.
2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the “Off” position before either enclosure may be accessed.
3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.
4. The drive and bypass package shall be seismic certified and labeled to the IBC:
  - a. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake table test data as defined by ICC AC-156.
5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor “isolation contactors” are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.
6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
7. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.
9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.
  - a. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad “Hand” or “Auto” selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial

- communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.
- b. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.
10. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.
11. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.
12. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.
13. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.
14. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
15. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:
- a. Over current
- b. Over voltage
- c. Under voltage
- d. Loss of analog input
16. The following operators shall be provided:
- a. Bypass Hand-Off-Auto
- b. Drive mode selector
- c. Bypass mode selector
- d. Bypass fault reset

17. The bypass shall include a two line, 20 character LCD displays. The display shall allow the user to access and view:
  - a. Energy savings – in US dollars
  - b. Bypass motor amps
  - c. Bypass input voltage– average and individual phase voltage
  - d. Bypass power (kW)
  - e. Bypass faults and fault logs
  - f. Bypass warnings
  - g. Bypass operating time (resettable)
  - h. Bypass energy (kilowatt hours – resettable)
  - i. I/O status
  - j. Parameter settings / programming
  - k. Printed circuit board temperature
  
18. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.
  - a. Power-on (Ready)
  - b. Run enable
  - c. Drive mode selected
  - d. Bypass mode selected
  - e. Drive running
  - f. Bypass running
  - g. Drive fault
  - h. Bypass fault
  - i. Bypass H-O-A mode
  - j. Automatic transfer to bypass selected
  - k. Safety open
  - l. Damper opening
  - m. Damper end-switch made
  
19. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.
  
20. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.
  - a. System started
  - b. System running
  - c. Bypass override enabled
  - d. Drive fault
  - e. Bypass fault
  - f. Bypass H-O-A position
  - g. Motor proof-of-flow (broken belt)
  - h. Overload
  - i. Bypass selected
  - j. Bypass run
  - k. System started (damper opening)
  - l. Bypass alarm
  - m. Over temperature

21. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
22. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps even with the VFD out of service.
23. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.
24. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.
25. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.
26. Class 10, 20 or 30 (programmable) electronic motor overload protections shall be included.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
- B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

#### **3.2 START-UP**

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

**3.3 PRODUCT SUPPORT**

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.
- B. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

**3.4 WARRANTY**

- A. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

**END OF SECTION**



**SECTION 23 0290**

**DUCT MOUNTED COILS**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**PART 2 - PRODUCTS**

**2.1 DUCT MOUNTED COILS**

- A. Coils as manufactured by Carrier shall be with aluminum plate fins, have collars drawn, belled, and firmly bonded to copper tubes by mechanical expansion of tubes. No soldering or tinning used in the bonding process.
- B. Coils have galvanized steel casing and are mounted pitched in the unit casing. Coils are to be removable in duct flanges.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 23 0300**

### **FANS**

#### **PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 FANS**

- A. Furnish and install fans of the type, models, size and capacity indicated on the Drawings. Models indicated are as manufactured by Carnes Company. ACME or Greenheck, with equivalent characteristics will be considered.
- B. Refer to Drawing schedule for required accessories and related appurtenances.

##### **2.2 ROOF EXHAUST FANS**

- A. All roof exhaust fans shall be centrifugal roof exhausters of aluminum rustproof construction.
- B. Units shall be direct connected with full ball-bearing motor. Power unit shall be isolated against vibration by means of oil resistant rubber or spring steel mounting.
- C. Provide square insulated curb cap of aluminum with aluminum liner as an integral part of the unit. Each unit shall be equipped with a back draft or automatic damper, disconnect switch for the motor and birdscreens.

##### **2.3 KITCHEN HOOD EXHAUST FANS**

- A. Upblast exhaust ventilators shall be of the centrifugal belt driven type. The motor compartments shall be construed of aluminum mounted on an independent support structure. The outer shroud shall have a rolled bead for added strength. The wheel and spun inlet venturi shall be a centrifugal design of non-sparking construction. For maximum performance and quiet, efficient operation, the wheel shall overlap the inlet venturi and have backward inclined blades. The wheel shall be dynamically balanced to assure smooth and vibration-free rotation under maximum loading. The complete drive assembly, including the motor and the wheel, shall be mounted on vibration isolators. Motors and drives shall be factory mounted. All fans shall be test run prior to shipment.
- B. Motor and drives shall be isolated from the exhaust airstream. Air for cooling the motor shall be supplied to the internal motor compartments through a vent tube from a location free from discharge contaminants. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Motors shall be readily accessible for maintenance. The wheel shaft shall be ground, polished, coated with a rust inhibitive finish and mounted in heavy duty, permanently sealed pillow block ball bearings which are capable of 200,000 hours of life, average operation.
- C. The drives shall be sized at a minimum of 165% of driven horsepower. Drive belts shall be oil-resistant, non-static and be capable of 25,000 hours of life, average operation. Sheaves shall be fully machined cast iron or pressed steel, keyed and securely attached to the shafts. Variable pitch motor sheaves shall be standard.

- D. The motor shall be factory wired to the disconnect switch which shall be mounted in a junction box located on the fan plate inside the motor compartment. Wiring connected to the switch will travel through rigid conduit to a weatherproof junction box mounted on the exterior of the unit. Wiring shall not pass through the motor compartment vent tube. Horsepower and noise levels shall not exceed the published values and oversized motors will not be acceptable. Performance ratings shall be AMCA licensed for air and sound. Centrifugal power upblast ventilators for commercial kitchen applications shall be belt driven, as manufactured by Greenheck, or approved equal.

## **2.4 HEAT AND FUME HOOD EXHAUST FANS**

- A. Upblast exhaust ventilators shall be of the centrifugal direct driven type. The motor compartments shall be construed of aluminum mounted on an independent support structure. The outer shroud shall have a rolled bead for added strength. The wheel and spun inlet venturi shall be a centrifugal design of non-sparking construction. For maximum performance and quiet, efficient operation, the wheel shall overlap the inlet venturi and have backward inclined blades. The wheel shall be dynamically balanced to assure smooth and vibration-free rotation under maximum loading. The complete drive assembly, including the motor and the wheel, shall be mounted on vibration isolators. Motors and drives shall be factory mounted. All fans shall be test run prior to shipment.
- B. Motor and drives shall be isolated from the exhaust airstream. Air for cooling the motor shall be supplied to the internal motor compartments through a vent tube from a location free from discharge contaminants. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Motors shall be readily accessible for maintenance. The wheel shaft shall be ground, polished, coated with a rust inhibitive finish and mounted in heavy duty, permanently sealed pillow block ball bearings which are capable of 200,000 hours of life, average operation. The drives shall be sized at a minimum of 165% of driven horsepower. Drive belts shall be oil-resistant, non-static and be capable of 25,000 hours of life, average operation. Sheaves shall be fully machined cast iron or pressed steel, keyed and securely attached to the shafts. Variable pitch motor sheaves shall be standard.
- C. The motor shall be factory wired to the disconnect switch which shall be mounted in a junction box located on the fan plate inside the motor compartment. Wiring connected to the switch will travel through rigid conduit to a weatherproof junction box mounted on the exterior of the unit. Wiring shall not pass through the motor compartment vent tube. Horsepower and noise levels shall not exceed the published values and oversized motors will not be acceptable. Performance ratings shall be AMCA licensed for air and sound. Centrifugal power upblast ventilators for commercial applications shall be as manufactured by Greenheck, or approved equal.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 23 0310**

### **HOT WATER CABINET HEATERS**

#### **PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 HOT WATER CABINET HEATERS**

- A. Furnish and install where indicated on the Drawings hot water cabinet heaters as manufactured by Sterling Co. of model, capacity and performance noted on the Drawing schedule.
- B. The cabinet shall be 16 gauge steel, four side overlap front panels, with M-shaped stiffener running entire panel length as standard. Integral, stamped, inlet and outlet insulated over entire coil section.
- C. Front panel removed with two tamperproof screws and shall be of finish as selected by Architect. Unit to be equipped with factory mounted fan cycling thermostat. Fans are forwardly curved double-inlet centrifugal of aluminum construction and are modular in design.
- D. The water coil is constructed of copper tubing mechanically expanded into aluminum fins. All joints are brazed with high temperature silver alloy. Water coils have a plugged drain tube and vent tube extended into the unit end compartment. Automatic air vent fittings shall be provided. Coils are field reversible.
- E. Filters are removable by removing front panel. 1" woven glass filters standard to be used.
- F. Provide factory finished trim flange for all semi-recessed applications.

#### **PART 3 - EXECUTION**

##### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

##### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

##### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**





## **SECTION 23 0320**

### **HOT WATER UNIT HEATERS**

#### **PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 HOT WATER UNIT HEATERS**

- A. Furnish and install where shown on the Drawings model as manufactured by Sterling Co. or approved equal and shall be of sizes noted on the Drawing.
- B. Casing shall be 20-gauge die-formed steel. Casing substrates shall be prepared for finishing with a hot wash, iron phosphatizing clear rinse, chromic acid rinse and oven drying. Paint finish shall be of lead-free, chromate-free, alkyd melamine resin base and applied with an electrostatic two-pass system.
- C. Coil elements and headers shall be of heavy wall drawn seamless copper tubing. Element tubes shall be brazed into extruded header junctions. Pipe connection saddles shall be of cast bronze. Aluminum fins shall have drawn collars to assure permanent bond with expanded element tubes and exact spacing.
- D. Motors shall be totally enclosed, resilient mounted with class B windings. All motors shall be designed for horizontal mounting.
- E. Fans shall be of the aluminum blade, steel hub type designed and balanced to assure maximum air delivery, low motor horsepower requirements and quiet operation. Blades are spark proof. Fan guards shall be welded steel, zinc plated or painted.
- F. Units shall be equipped with horizontal, individually adjustable louvers. Vertical louvers for 4-way air control shall be available as an optional extra.

#### **PART 3 - EXECUTION**

##### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

##### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

##### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## **SECTION 26 0330**

### **CONVECTORS**

#### **PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### **PART 2 - PRODUCTS**

##### **2.1 CONVECTORS**

- A. Furnish and install Convectors as manufactured by Sterling Co., Airtherm Co. and American Air Filer Co. considered equal as indicated on the Drawings. Type and size as noted on Drawing. Unit shall be installed in a neat and workmanlike manner in accordance with the Specifications and manufacturer's recommendations.
- B. Convector element shall be constructed of copper tubes expanded and rolled into cast iron headers with contact further strengthened by brass bushings, aluminum fins, ribbed steel side plates and fin tube supports.
- C. Cabinet shall have a one piece 14 gauge steel front panel. Front panel shall be held in place by camlock fasteners.
- D. Dampers shall be factory mounted on the element to reduce heating capacity up to 70% when closed. Key operated damper-tamperproof. Baked enamel finish shall be provided in standard manufacturer's colors as selected by the Architect. Unit shall have (camlock) access doors to provide access to valves.

#### **PART 3 - EXECUTION**

##### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

##### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

##### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



**SECTION 23 0340**

**FIN-TUBE RADIATION**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**PART 2 - PRODUCTS**

**2.1 FIN TUBE RADIATION**

- A. Furnish and install fin-tube heating elements and enclosures, indicated on Drawings, together with required mounting components and accessories.
- B. Materials shall be as manufactured by Sterling Radiator Co., Vulcan Radiator Co. or Standard Fin-Pipe Radiator Corp.
- C. Heating Elements
  - 1. Various lengths and assemblies are indicated on the plan together with their pipe sizes, fin sizes, and spacing. Elements shall be completely independent of and shall not touch enclosures to assure low surface temperature.
  - 2. Heating elements shall consist of full-hard aluminum plate fins not less than .20" thick, permanently bonded to copper seamless drawn tube and guaranteed for working pressure at 300 degrees F not less than 200 psi for 1-1/4" tube. Fins shall be actually embedded in the copper tube.
- D. Enclosure and Accessories
  - 1. Enclosures and accessories shall be of style and dimensions indicated on our Drawings and shall be fabricated from zinc-coated steel. Enclosures shall be 16 gauge. On wall-to-wall applications, enclosures shall be furnished in one piece up to a maximum of 10' - 10" enclosure length for rooms or spaces measuring a maximum of 10' - 10" wall length, using a 6" end trim each end. Enclosures shall be furnished in two or more lengths for wall lengths exceeding 10' - 10".
  - 2. Left end of all enclosures shall have spot-welded back-up angles. The mating right end shall be fastened securely with screws. End enclosures shall have same method of joining.
  - 3. End trims, furnished with roll-flanged edges, shall be used between ends of enclosures and walls on wall-to-wall applications. End trims to be 6" maximum length and shall be attached without visible fasteners. End enclosures shall be furnished where indicated, shall be same gauge as enclosures, and be factory-welded to enclosures.
  - 4. Enclosures shall be supported at top and bottom by means of heavy gauge mounting channel and allow installation and removal of enclosures without scraping walls or disturbing paint lines. Enclosures are securely fastened to the bottom support.
  - 5. Access doors shall be provided where noted on Drawings. Doors shall be 8" x 8" and shall be located directly in the enclosures. Doors shall be hinged. Where radiation is located behind casework coordinate access door locations with casework vendor.

6. Provide vertical and horizontal enclosure for pipe risers and runouts which are exposed above/below/adjacent to radiation enclosure. Riser enclosure shall be of same gauge and finish as radiation enclosure. Provide wall plate which enclosure shall snap onto without exposed fasteners. Sterling model PCH (V).
  7. Enclosure finish shall be as selected by Architect (and shall match unit ventilator finish when unit ventilators are also specified for the project).
- E. Enclosure Brackets and Element Hangers
1. Enclosure bracket and element hangers shall be installed not farther than 4' apart. Brackets shall be die-formed from 3/16" thick stock, 1-1/2" wide, and shall be lanced to support and position lower flange of enclosure. Enclosures shall be firmly attached to brackets by set screws, operated from under the enclosure. Devices, which do not provide positive fastening of enclosures, are not acceptable. Brackets shall be inserted in pre-punched slots in mounted channel to ensure correct alignment and shall be fastened securely to wall at bottom.
  2. Sliding saddles shall support heating elements and provide positive positioning of element in enclosure to ensure maximum heating efficiency while preventing any possibility of fin impingement on brackets or enclosure joints during expansion or contraction. Element supports shall be a double saddle design fabrication from 16 gauge zinc-coated steel.
  3. Saddle shall slide freely on saddle support arm bolted to support bracket. Support arm shall allow 1-1/2" height adjustment for pinch. The element support saddle shall allow 1-5/8" lateral movement for expansion and contraction of heating element. Rod or wire hangers not acceptable.
  4. Submit shop drawings of all heating elements and enclosures. Enclosure measurements and accessories are not to be fabricated until after verified measurements have been taken at the site.
- F. Piping Enclosures: Where concealed piping in ceilings and wall of finished spaces is not possible, provide vertical or horizontal metal piping enclosures equal to "Sterling" model PCH (horizontal) or PCHV (vertical). Provide all required hangers, supports, corners, brackets, etc. color per Architect.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

#### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**

**SECTION 23 0400**

**SHEETMETAL WORK AND RELATED ACCESSORIES**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

**PART 2 - PRODUCTS**

**2.1 SHEETMETAL DUCTWORK**

- A. Contractor shall furnish and install all sheet-metal ducts as shown on the Drawings. While the Drawings shall be adhered to as closely as possible, the Engineer reserves the right to vary the run and size to meet the field conditions. Any duct size not shown shall be sized in proportion to the air carried at the same resistance in similar ductwork, or of size as directed.
- B. All ductwork shall be constructed of galvanized steel gauges in accordance with the latest edition of the ASHRAE/SMACNA Guide. Bracing angles for ductwork shall be hot dipped galvanized for steel ductwork and appropriate gauge for aluminum ductwork. All ducts 18" and over in width shall be cross broken to prevent flutter.
- C. Ducts shall be braced as follows:
  - 1. All ducts not exceeding 24" on one side shall be assembled with airtight slip joints.
  - 2. 25" to 40" larger dimension 1" x 1" x 1/8" angles.
  - 3. 41" to 60" larger dimension 1-1/2" x 1-1/2" x 1/8" angles.
  - 4. All bracing angles shall be a minimum of 4' apart along the length of the duct.
  - 5. Furnish and install all angles and frames for all registers, diffusers, grilles and louvers.
  - 6. Support horizontal ducts with hangers spaced not more than 8' apart. Place hangers at all changes in direction. Use strap hangers for cuts up to 30" wide.
- D. Comply with all State and Local regulations regarding fire stopping and fireproofing. Provide fusible link fire dampers as required by State, local and Underwriter authorities and where indicated on the Drawings. Each fire damper shall be installed in such a manner as to permit ready access for inspection and maintenance purposes.
- E. Provide splitter and butterfly dampers, deflecting vanes for control of air volume and direction and for balancing systems, where indicated, specified, directed and as required for the proper operation of the systems. Dampers shall be of the same material as the duct, at least one gauge heavier than the duct, reinforced where indicating quadrant and locking device for adjusting damper and locking in position.
- F. Where ducts fewer than 100 square inches penetrate a rated wall, steel ductwork system of a minimum 0.0127 inch thickness shall be used.
- G. All elbows shall have a minimum center line radius of 150% of duct width. If the radius is smaller, turning vanes shall be used: Turning vanes shall be double thickness, fitted into slide strips and screwed or riveted to duct below.

- H. Contractor shall furnish and install all access doors in ducts as required. Access doors shall be of the pan type 1" thick and shall be provided with two galvanized hinges and suitable latched. Access doors insulated with same thickness material as duct and shall be double casing construction.

## **2.2 REGISTERS AND DIFFUSERS**

- A. Registers and diffusers shall be installed where shown on the Drawings and shall be of the sizes specified and the type indicated on the drawing schedule.
- B. All registers and diffusers shall be installed in accordance with manufacturer's recommendations.
- C. Registers and diffusers shall be as manufactured by Anemostat Co., Carnes or Hart and Cooley.

## **2.3 KITCHEN EXHAUST DUCTWORK**

- A. Duct work or plenums for kitchen exhaust ventilators shall be constructed of not less than 16 gauge black steel or 18 gauge stainless steel with all joints and seams made with a continuous great tight weld on the external surface.
- B. Duct system shall be so constructed that grease cannot become pocketed and shall slope not less than 1/4" per lineal foot toward the ventilator hood. Duct systems shall be equipped with cleanout openings that have tight fitting doors. Doors shall be constructed of same material and gauge as duct and shall be equipped with a latching mechanism to hold the door tightly closed.
- C. Kitchen exhaust system shall conform in all respects with NFPA 96
- D. Insulate existing and new duct per NFPA requirements (minimum 2" calcium silicate insulation with all service jacket) and all other agencies having jurisdiction.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## SECTION 23 0405

### DUCT SILENCERS

#### PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

#### PART 2 - PRODUCTS

##### 2.1 DUCT SILENCERS

###### A. General

1. Furnish and install Price Silencers, or approved equal, of the sizes, configuration, and performance as described on plans and schedules. Silencer inlet and outlet connections shall be equal to the duct sizes shown on the drawings. Duct transitions shall be provided by the contractor and are not permitted unless shown on the drawings and approved by the engineer. If discrepancies between the suggested specifications and the silencer schedule occur, the latter takes precedence.
2. Performance: Silencer performance characteristics including insertion loss, pressure drop, and generated noise shall have been attained through testing in accordance with the latest ASTM E477 test standard for acoustical duct silencers. Performance data shall be obtained from the manufacturer's NVLAP accredited laboratory. Laboratory performance verification may be requested in the manufacturer's test facility and a comparative test report made available to the engineer.

###### B. Construction

1. Absorptive Silencers shall consist of solid steel casings, perforated sheet metal liners, absorptive acoustic fiberglass media, and additional liners as required.
2. (Standard) Construction Class 1: 22 gauge galvanized casing / 22 gauge galvanized perforated liner.
3. Acceptable methods of fastening shall be button lock, Pittsburgh lock, and welds. In situations where these methods are not feasible, rivets can be used. Screws or other types of mechanical fasteners will not be acceptable.
4. The silencer perforated liners shall be rigidly fastened to the casing of the silencer on both ends and attached to the outer casing with a minimum of two stiffeners.

C. Acoustic Media: Acoustic media shall be shot free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin. Glass fiber shall be packed with a minimum 10% compression to eliminate voids and settling; density shall be consistent with that used to generate catalogued test data.

D. Film Lined Silencer Models: Film lined silencer models shall be provided with a layer of Tedlar or Mylar film securely wrapped around the internal acoustic media to prevent contamination from moisture and airborne particulate that may be present in the duct system. Acoustic standoff shall run the entire length of the internal baffles and be located between the perforated metal liner and the film liner to ensure the highest level of acoustic performance. If Tedlar or Mylar Film Bagged is required, the acoustic media will be fully encapsulated. Film lined silencers shall have attenuation performance for film lined silencers tested in accordance with latest ASTM E477 standard.

- E. Combustion Ratings: Combustion ratings for acoustic media shall be equal to or less than the combustion ratings noted below when tested in accordance with ASTM E84, UL723 and NFPA255.  
Flame Spread Classification: 25  
Smoke Development Rating: 50

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

#### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**

**SECTION 23 0410**

**PIPING, FITTINGS, VALVES AND NOTES (HOT WATER)**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

**1.1 PIPING NOTES**

- A. The Contractor shall erect all pipe, fittings, valves, hangers, anchors, and all accessories specified, indicated on the Drawings or required to assure proper operation of all piping systems installed under this Contract.
- B. All piping shall be maintained at a proper level to assure satisfactory operation, venting and drainage. Piping and valves in any locality where possible shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.
- C. All piping shall be new and of the material and weight specified under various services. Steel and wrought iron pipe 2" and larger shall be seamless or lap welded. All piping shall have the maker's name and brand rolled on each length of pipe.
- D. All piping, fittings, valves and strainers shall be cleaned of grease, dirt and scale before installation. All temporary pipe openings shall be kept closed during the performance of the work. The ends of all piping shall be reamed smooth and all burrs removed before installation.
- E. Piping connections shall have unions where necessary for replacement and repair of equipment. Gate valves and controls valves shall be installed where shown and where necessary for proper operation and service.
- F. Vertical piping shall be plumb and horizontal piping shall be parallel to walls and partitions. Piping shall be supported as required to prevent the transmission of noise and vibration.
- G. Work shall include all pipe, fittings, offsets and requirements for the installation of piping of other work including ducts and conduit. Reducing fittings shall be used where pipe changes size. All piping shall be installed with ample clearance to center accurately in sleeves through floors, and walls and partitions.
- H. Piping shall be downgraded to drain connections at low points and upgraded to vent connections at high points unless otherwise noted. Drain connections shall be valved and piped to a floor drain.
- I. Vent connections on mains shall be equipped with air vent valves fitted with a copper tube drip line extended to a drain outlet. Vent connections on branches and equipment shall be fitted with key type manual vent cocks.

**PART 2 - PRODUCTS**

**2.1 PIPING (ABOVEGROUND)**

- A. Pipe/Grooved (Standard): Carbon Steel, A-53B/A-106B - Roll or cut grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends to be grooved in accordance with current listed standards conforming to ANSI/AWWA C-606.

B. Victaulic Mechanical Couplings for Joining Carbon Steel Pipe

1. Standard Mechanical Couplings, 2 inch (DN50) through 24 inch (DN600): Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard.
  - a. Rigid Type: Coupling housings with torque-absorber and self-limiting offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13, and to prevent miss-assembly due to overshift. Housing cast with alignment indicator notch for visual proper alignment to adjoining fittings. Basis of Design: Victaulic Installation-Ready tm Style 107V.
    - 2” (DN50) through 12” (DN300): Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C). Center-leg gasket with pipe stop to insure proper groove engagement, alignment, and pipe insertion depth.
  - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source. Basis of Design: Victaulic Style 177 and Style 77.
    - 2” (DN50) through 8” (DN0200): Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C). Center-leg gasket with pipe stop to insure proper groove engagement, alignment, and pipe insertion depth.
  - c. AGS two-segment couplings for pipe sizes 14” (DN350) and larger, with wide-width FlushSeal® gasket and lead-in chamfer on housing key. Basis of Design: Victaulic Style W07 (rigid) and Style W77 (flexible).
2. Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125 / 150 flanges. Basis of Design: Victaulic Style 741 and AGS W741.
3. Grooved couplings shall meet the requirements of ASTM F- 1476.
4. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.
  - a. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.

C. Grooved End Fittings

1. Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9, 53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.

- a. 2" through 12" (DN50 through DN300); ASTM A536 Grade 65-45-12 ductile iron with Victaulic Original Grooved System (OGS) grooved ends, stiffening ribs, and alignment indicators, orange coated or hot dipped galvanized as per ASTM A123, working pressure 400-psi (2758-kPa). Basis of Design: Victaulic QuickVic™ V10 (90-deg), V11 (45-deg), and V20 (tee).
  2. AGS Fittings shall be supplied with factory AGS grooved ends, for use with Victaulic W07 or W77 couplings and W741 flange adapter. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards
  3. Hole-Cut Branch Outlets
    - a. Bolted Branch Outlet: Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183. Basis of Design: Victaulic Style 920 / 920N.
    - b. Strapless Outlet: 1/2"(DN15) or 3/4"(DN20) NPT outlet on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa). Basis of Design: Victaulic Style 923.
    - c. Strapless Thermometer Outlet: To accommodate industrial glass bulb thermometers with standard 1-1/4"-18 NEF 2B extra fine thread and 6" (152mm) nominal bulb length on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa). Basis of Design: Victaulic Style 924.
- D. Grooved End Valves
1. Butterfly Valves
    - a. 2"(DN50) through 12"(DN300) Sizes: 300 psi CWP (2065 kPa) suitable for bidirectional and dead-end service at full rated pressure. Body shall be grooved end black enamel coated ductile iron conforming to ASTM A536. Disc shall be electroless nickel plated ductile iron with blowout proof 416 stainless steel stem. Disc shall be offset from the stem centerline to allow full 360 degree seating. Seat shall be pressure responsive [EPDM] [Lubricated Nitrile]. Valve bearings shall be TFE lined fiberglass, and stem seals shall be of the same grade elastomer as the valve seat. Valve shall be complete with ISO flange for actuation mounting. Valve operators shall be lever handle or gear operator, available with memory stop feature, locking device, chainwheel. (Valve with EPDM seat is UL classified in accordance with ANSI/NSF-61.)
    - b. 14"(DN350) through 24"(DN600) Sizes: 300 psi CWP (2065 kPa) suitable for bidirectional and dead-end service at full rated pressure. Body shall be AGS grooved end Polyphenylene-sulfide coated ductile iron conforming to ASTM A536. Disc shall be Polyphenylene-sulfide coated ductile iron with blowout proof stainless steel stem. Disc shall be offset from the stem centerline to allow full 360 degree seating. Disc mounted [EPDM][Nitrile] seal. Basis of Design: Victaulic AGS Vic300.
  2. Check Valves
    - a. 2"(DN50) through 3"(DN80) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, stainless steel non-slam tilting disc, stainless steel

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- spring and brass shaft, nickel-plated seat surface, 365 psi (2517 kPa). Victaulic Series 716H.
- b. 4”(DN100) through 12”(DN300) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 716.
  - c. 2”(DN50) through 4”(DN100) Sizes Horizontal Swing: Horizontal installation, ductile iron body, ASTM A-536, Grade 65-45-12, and Type 316 stainless steel clapper. Synthetic rubber bumper & bonnet seals suitable for intended service, stainless steel wetted parts, 300 psi (2065 kPa). Victaulic Series 712.
  - d. 4”(DN100) through 12”(DN300) Sizes Venturi Check: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12 with venturi-like taps, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 779.
  - e. 14”(DN350) through 24”(DN600) Sizes: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, stainless steel disc(s), spring, and shaft, AGS grooved ends, suitable for working pressure to 230-psi (1575 kPa). Basis of Design: Victaulic Series W715.
3. Tri-Service Valve Assembly: Combination shut-off, throttling and non-slam check valve.
- a. 2-1/2”(DN65) through 12”(DN300) Sizes: Vic®-300 MasterSeal™ butterfly valve with memory stop feature assembled with Series 716 (2-1/2” & 3”) (DN65 & DN75) or Style 779 Venturi Check (4” – 12”) (DN100-DN300). Series 779 check valve with venturi like taps for flow measurement. Working pressures to 300 psi (2065 kPa).
4. Ball Valves: 1-1/2”(DN40) through 6”(DN150) sizes, ASTM A-536, Grade 65-45-12, ductile iron body, chrome plated carbon steel ball and stem, TFE seats, with Fluoroelastomer seals. 800 psi (5515 kPa).
5. Plug Valves: 3”(DN75) through 12”(DN300) sizes, with memory stop for throttling, metering or balancing service. Unidirectional bubble-tight shut-off, bi-directional sealing optional. Ductile iron body, bonnet and plug, ASTM A-536, Grade 65-45-12. Plug encapsulated with synthetic rubber suitable for intended service. Welded-in nickel seat, stainless steel self-lubricating bearings. 175 PSI (1200 kPa). AWWA rigid groove dimensions may be adapted to IPS sized system through the use of Victaulic Style 307 transition couplings.
6. Circuit Balancing Valves
- a. 2”(DN50) and Smaller Sizes: 300 psi (2065 kPa), y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 786 or 787 STAD.
    - Install Series 78U union port fitting and Series 78Y strainer/ball valve combination to complete terminal hookup at coil outlet.
    - Install Series 793 differential pressure controller to stabilize differential pressure and ensure stable and accurate modulating control. Ametal® brass copper alloy body, bonnet, cone and spindles, threaded ends only.

- b. 2-1/2"(DN65) and Larger Sizes: 300 psi (2065 kPa), y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8, 12 or 16-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 788 or 789 STAG.
- c. Differential Pressure Controller: For use in conjunction with TA Balancing valves to stabilize differential pressure and ensure stable and accurate modulating control. Ductile iron or Ametal body, Ametal® brass copper alloy bonnet, cone and spindles, flanged ends only.

E. Grooved End Specialties

- 1. Expansion Joints
  - a. 2"(DN50) through 6"(DN150) Sizes: Packless, gasketed, type with grooved end telescoping body, suitable for axial end movement to 3". 350 psi (2410 kPa). Victaulic Style 150 Mover®.
  - b. 3/4"(DN20) and Larger Sizes: Expansion joint consisting of a series of grooved end nipples joined with flexible-type couplings. Joint movement and expansion capabilities determined by number of couplings / nipples used in the joint. Victaulic Style 155.
- 2. Dielectric Waterways: 1"(DN25) through 4"(DN100) sizes, grooved, or threaded end copper-silicon casting conforming to UNS C87850. Victaulic Style 647.
- 3. Strainers - Grooved-End
  - a. Y-Type Strainer. 2"(DN50) through 18"(DN450) sizes, 300 PSI (2065 kPa) Y-Type Strainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16" (1,6mm) diameter perforations 2"-3" (DN50-DN75) strainer sizes, 1/8" (3,2mm) diameter perforations 4"-12" (DN100-DN300) strainer sizes, and 0.156" (4mm) diameter perforations 14" -18" (DN350-DN450) strainer sizes. Victaulic Style 732 and W732.
- 4. Manufactured Vibration Isolation Pump Drops for Sizes 3" (DN75) through 12" (DN300): Installation-Ready with grooved joints, orange enamel coating, with flexible couplings to accommodate vibration attenuation and stress relief, and pipe spool with thermometer and pressure ports. Assembly rated for working pressure to 300-psig (2068-kPa).
  - a. Discharge Pump Drop: Class 150 flange for pump connection, [base elbow for horizontal pump connection] [straight line with concentric reducer for vertical pump connections], tri-service valve assembly consisting of a spring-actuated check [Venturi-Check] valve and butterfly valve with offset stem for 360-degree circumferential seating. Victaulic Series 380.
  - b. Suction Pump Drop: Suction diffuser with stainless steel basket and diffuser and Class 150 flange for pump connection, butterfly valve with offset stem for 360-degree circumferential seating. Victaulic Series 381.
  - c. Suction Pump Drop: Class 150 flange for pump connection, Wye pattern strainer with stainless steel perforated metal basket, butterfly valve with offset stem for 360-degree circumferential seating. Victaulic Series 382.

- d. Discharge CBV Pump Drop: Class 150 flange for pump connection, [base elbow for horizontal pump connection] [straight line with concentric reducer for vertical pump connections], spring-actuated check [Venturi-Check] valve and Series 789 circuit balancing valve. Victaulic Series 383.

F. Tooling:  
Tools shall be manufactured and supplied by coupling manufacturer. Use roll sets or cut groovers compatible with the pipe material and wall thickness per manufacturer's installation instructions.

## 2.2 VALVES

- A. All valves, unless specified or noted otherwise, shall be designed for a working pressure of not less than 200 psi water or 125 psi steam with name and pressure rating of valve cast in body. All valves shall be of the same manufacturer, unless specified otherwise. Valves for cut-off shall be gate valves, unless otherwise specified.
- B. All valves of same manufacturer: similar to Jenkins Bros., Walworth, Kennedy or approved equal.
- C. Four inch and larger, flanged; smaller sizes, screwed.
- D. All Gate and Globe valves shall be installed with handle in an upright position.
- E. The Contractor shall furnish and install all valves shown on Drawings and all valves that are necessary for proper operation and maintenance of systems and equipment. All piping connections to each piece of equipment and all branch connections to mains shall have cut-off valves.
- F. The following schedule of valves for hot water, etc. is based on Jenkins Brothers, Inc. catalog numbers (except as noted); equivalent Lukenheimer, Walworth, O-I-C, Crane Fairbanks Company valves will be acceptable.
- G. Ball Valves
  - 1. 1/4" to 2-1/2" rated for 600 p.s.i wog, with brass body, chrome plated brass ball, virgin PTFE seats and full port with threaded or solder connections.
  - 2. 2-1/2" and larger rated for 200 p.s.i with carbon steel body, stainless steel full port ball, RTFE seats, lever operated to 4" gear operated 6" and above, with flanged end connections.
- H. Gate Valves
  - 1. Up to 2" : Bronze gate solid wedge, inside screw traveling stem union bonnet, - Fig. 47U
  - 2. 2-1/2" and 3" : Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, -Fig. 650-A
  - 3. 4" and larger: Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, - Fig. 651-A



I. Globe Valves

1. Up to 2" : Bronze body, regrinding seat ring and plug, union bonnet, -Fig. 546P
2. 2-1/2" and 3" : Iron body, bronze-mounted globe and angle, regrinding disc and seat ring, OS&Y -Fig. 613
3. All gate valves 6" and larger: Fitted 3/4" by-pass globe valve.

J. Plug Valves

1. Up to 2" : Lubricated, semi-steel short pattern wrench operated, -Fig. 142
2. 2-1/2" and larger: Lubricated, semi-steel short pattern wrench operated, -Fig. 143
3. Similar to Rockwell Mgd. Co., Jenkins, Kennedy or approved equal.

K. Butterfly Valves used for hot water shall be the following:

1. 2-1/2" to 12" rated for 175 p.s.i bubble tight close off, 14" and larger for 150 p.s.i close-off.
2. Full lug cast iron body, aluminum bronze disc, stainless steel stem EPDM peroxide cured seat.
3. 2-14" to 6" valves to be equipped with 10 position notch plate and lever lock handle.
4. On installation, valves to be in full open position when flange bolts are tightened and stem in a horizontal position except when equipped with a chain-wheel gear operator.
5. Provide chain wheel gear operator on all valves installed 7 feet or higher.
6. Valves to be designed with replaceable seat and parts kits.
7. Valve to be Bray series 31, Dezurik 637 or Demco.

L. Check Valves

1. 150 psi WSP class.
2. Up to 2" : Bronze, regrinding bronze disc, screw-in cap, -Fig. 762A.
3. 2-1/2" and 3" : Iron body, bronze mounted regrinding bronze seat ring and disc, - Fig. 623.
4. 4" and larger: Iron body, bronze mounted regrinding bronze seat ring and disc, - Fig. 624.

M. Drain Valves: All low points shall have drain valves, with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipples and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

## 2.3 FITTINGS

### A. Nipples

1. All nipples shall have clean cut threads and shall be made from new pipe, standard weight for all lengths, except that close and shoulder nipples shall be extra heavy.
2. Fittings - 2-1/2" and Smaller: All fittings shall be standard weight steam pattern gray cast iron, Grinnell, Stockholm or equal approved.
3. Fittings - 3" and Larger: The Contractor has the option to use screwed, flanged or welded fittings so long as all ASME requirements are met.

### B. Joints and Unions

1. Threaded joints shall be full and clean cut. The ends of pipe shall be reamed to the full inside diameter, all burrs shall be removed and no more than three threads shall be exposed beyond fittings when made up. Joints shall be made up tight with graphite base pipe joint compound. Exposed threads of ferrous pipe shall be painted with acid-resisting paint after caulking, lampwick or other material will be allowed for correction of defective joints.
2. Flange joints shall be made up perfectly square and tight. Screwed flanges and loose flanges shall be cast iron and welding flanges shall be steel. Flanges shall be faced true and bolted up tight with 1/16" Carlock ring type gasket.
3. Bolts shall be high quality steel with hexagon nuts and heads. The Contractor shall apply grease to threads of bolt.
4. Welded joints in piping shall be by the electric or oxyacetylene process using welding rods if the characteristics similar to pipe material and as recommended by the pipe manufacturer and shall be done in accordance with the ASME Code for pressure piping. Welding shall be done by qualified welders under the requirements of the ASME Boiler and Pressure Vessel Code.
5. The pipe lengths shall be aligned with welding rings and the abutting pipe ends shall be concentric. Prior to welding, the groove and adjacent surfaces shall be thoroughly cleaned of all grease, scale or rust. During welding, all slag, or flux remaining on the bead shall be removed before laying down the next bead. The welding metal shall be thoroughly fused with the base metal at all sections of the weld. Short lengths of pipe may be beveled on the job with oxyacetylene torch, provided all scale and oxides are removed.
6. Joints shall be butt-welded, single V-type. All fittings shall be steel welding fittings. Elbows and fittings formed with coupling or welded cut pipe sections shall not be acceptable.
7. Bonney Weldolets or welding saddles may be used for branch connections, which are less than one-half the size of the main to which they connect.

8. Ground Joint Unions, Flange Connections, Reaming & Filling Ground joint unions shall be 200 lb. s.w.p. for brass. Flanges shall be 150 lb. s.w.p. for brass, 125 lb. s.w.p. for cast iron.
  9. Ground joint unions of flanges shall be used only on exposed accessible piping. Where concealed, right and left nipples and couplings must be used. Where flanged connections are used, full size gaskets must be inserted.
- C. Threads: Shall be standard, clean cut and tapered. All piping shall be reamed free from burrs. All piping shall be kept free of scale and dirt. Caulking of threads will not be permitted. All piping shall be threaded and made up in accordance with the current edition of the ASA Standard Specifications for pipe threads.
- D. Unions
1. Unions for use on ferrous pipe 2" and smaller shall be malleable iron with brass to iron ground joint spherical seat and threaded connections. Unions 2 1/2" and over shall be flanged type with gasket.
  2. Unions for copper tubing shall be cast bronze conforming to ASA B16. The Contractor shall furnish adapters where required for copper pipe.
  3. Where copper pipe connects to ferrous pipe or metals, the Contractor shall furnish EPCO isolating type dielectric unions. Plastic type isolating bushings are not acceptable.
  4. Unions shall be installed wherever necessary for repair or replacement of equipment, valves, strainers, etc. Final connections to equipment shall be made in a manner that will permit removal without cutting of pipelines.
  5. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- E. Solder
1. All sweat joints shall be made up with lead and antimony free solder.
  2. Solder shall be Oatey or approved equal. Flux shall be non-toxic and non-corrosive.
  3. All copper tubing ends shall be reamed, filed and cleared of burrs and rough edges. All pipes shall be reamed after cutting and threading.
- F. Expansion
1. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted.
  2. Branches shall be of sufficient length and have 3 elbow swings to allow for pipe expansion.
  3. Provide expansion joints, guides and anchors equal to "Flexonics" Type HCF where indicated on Drawings or where necessary for proper expansion compensation. Submit shop drawing.

4. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.
5. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of the Contractor.
6. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

#### 2.4 PIPING SLEEVES

- A. Furnish sleeves built into place for all piping passing through walls, floors or building construction. Sleeves, not less than 1/2" larger in diameter than piping and its covering, if any, and extending full depth of construction pierced. Pack sleeves through walls/floors in accordance with Underwriters' Requirements.
- B. Sleeves piercing exterior walls, integral waterproofed walls shall be standard weight steel piping. Furnish welded center flange buried in construction for sleeves through exterior walls below grade. At exterior walls, make pipes watertight in sleeves with oakum packing and caulked lead joints on both sides of wall. All other sleeves: Galvanized sheet steel with lockseam joints, #22 USSG for 3" or under. Sleeves for piping 4" and larger, #18 USSG.
- C. Pipes passing through interior membrane waterproofed floors, cast iron flashing sleeve, with integral flashing flange and clamping ring, similar to Josam Series #1880. Adjust sleeves to floor construction with steel or wrought iron pipe nipples top and bottom, extending 3" above finished floor. Burn & J.R. Smith are equal.
- D. Pipes passing through membrane waterproofed walls, cast iron flashing sleeve with internal flashing flange and clamping ring similar to Josam Series #1870. Make pipes watertight in sleeves with oakum packing and caulked lead joints. Burn & J.R. Smith are equal.
- E. For flashing sleeves specified in Pars. C and D, lead flashing extended at least 10" around flashing sleeves, securely held in place by clamping device.

#### 2.5 PIPING ENCLOSURES

- A. Where concealed piping in ceilings and wall of finished spaces is not possible vertical or horizontal metal piping enclosures equal to "Sterling" model PCH (horizontal) or PCHV (vertical). Provide all required hangers, supports, corners, brackets, etc. Color per Architect.

### PART 3 - EXECUTION

#### 3.1 PIPING NOTES

- A. Installation
  1. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing.
  2. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.

3. Install the piping system in accordance with the latest manufacturer's installation instructions.
  4. Use grooving tools with AGS roll sets to groove the pipe. Follow manufacturer's guidelines for tool selection and operation.
  5. Couplings installation shall be complete when visual metal-to-metal contact is reached.
  6. See the latest copy of the manufacturer's Field Assembly and Installation Instructions.
  7. Piping shall be installed as indicated on Drawings.
  8. Except for drainage piping, which shall pitch down with flow, mains shall pitch upward or be installed dead level. Horizontal runs shall be parallel to walls.
  9. In general, all branch connections shall be top of bottom 45 degree or 90 degree, pitching up or down from mains.
  10. All piping shall be adequately supported with approved type hangers so as to prevent absolutely any sagging of lines, or any undue strain on pipes or fittings. All pipe lines shall be capped during construction to prevent entry of dirt or other foreign material. All piping lines after erection shall be blown or flushed out to render the piping system as clean as possible before system water is added for operation.
  11. Clean interior and exterior surfaces installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances promptly after installation
- B. Training:  
A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.
- C. Application
1. A representative shall periodically visit the job site and review installation. Contractor shall remove and replace any improperly installed products.
  2. All grooved components shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-31.9, ASME, UL/ULC, FM, IAPMO or BOCA.
  3. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**END OF SECTION**



**SECTION 23 0420**

**SUPPORTS, SLEEVES AND PLATES**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 DESCRIPTION OF WORK**

- A. This Contractor shall furnish and install all plates, hangers and supports for his equipment including piping, headers, fans expansion tank, ductwork, etc.
- B. All ductwork, piping and equipment shall be hung or supported from structural members only.

**PART 2 - PRODUCTS**

**2.1 PIPING, DUCTWORK AND EQUIPMENT**

- A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.
- B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.
- C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.
- D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.
- E. Piping shall be supported as follows unless otherwise indicated on the Drawings:
  - 1. Heating piping shall be 1-1/2 " and smaller Fig. #260 adjustable clevis hanger. 2" and larger Fig. #174 one-rod swivel roll hanger.
  - 2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.
  - 3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.
  - 4. Spacing of pipe supports shall not exceed 8 feet for pipes up to 1-1/2" and 10 feet on all other piping.
  - 5. Hangers shall pass around insulation and a 16 gauge steel protective cradle; 12" long shall be inserted between hangers and insulation. Insulation under cradle shall be high density calcium silicate or approved equal to prevent crushing.

6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.
  7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in manner to allow for proper expansion and elimination of vibration.
  8. 2" and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.
  9. All horizontal pipes, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4".
- F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.
- G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.
- H. Hanger rods shall be steel, threaded with nuts and lock nuts sizes in accordance with the following schedule:

<u>Pipe Size</u>	<u>Rod Size</u>
3/4" to 2" inclusive	3/8"
2-1/2" and 3' inclusive	1/2"
4" and 5" inclusive	5/8"

- I. Hangers for copper tubing shall be tacked up with formed lead sheet on which tubing or pipe shall be placed.
- J. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.
- K. Sleeves shall not be used in any portion of building where use of same would impair strength of construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.
- L. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
- M. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors: Heavy forged construction entirely separate from supports.
- N. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strain on offsets and branches. Anchors, unless otherwise noted: Heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.
- O. Ducts shall be hung with 1" x 1/8" metal straps. When width of duct is less than 48", hangers shall be fastened to side of ducts. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor. All operating equipment including fans, piping, etc. shall be supported so as to produce minimum amount of noise transmission.
- P. Refer to "General Conditions" as well.



**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

**3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



**SECTION 23 0430**

**INSULATION AND COVERINGS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 DESCRIPTION OF WORK**

- A. Furnish insulation for all piping, equipment and sheet-metal work as noted.
- B. Insulate no piping, ducts or equipment until tested and approved for tightness. All piping and ducts shall be dry when covered. Where existing insulation has been damaged, altered or removed during the course of the work, it shall be replaced with new insulation in a neat manner to match the adjacent insulation.
- C. All insulation must be done by an approved Sub-Contractor or by mechanics skilled in this line of work.
- D. Fire hazard classification shall be 2550 per ASTM E-84, NFPA 255 and UL 723. Insulation shall be rated non-combustible type classified flame spread - 25, smoke developed - 50.

**PART 2 - PRODUCTS**

**2.1 DUCTWORK (INDOOR)**

- A. Supply, outside air intake and exhaust (on discharge side of fan) and return ductwork shall be covered with fiberglass insulation (unless otherwise indicated) with aluminum foil vapor barrier. All joints shall be lapped so maximum coverage is achieved.
- B. All insulated ductwork shall be insulated with fiberglass board insulation with canvas finish in areas where ductwork is exposed.
- C. Insulation thickness shall be in accordance with the latest edition of the State Energy Code.
- D. Thermal acoustic lining of ductwork where indicated shall be 1" thickness closed cell non-fiberglass unless otherwise noted. The lining shall have a mat facing and shall meet the Life Safety Standards as established by NFPA 90A and 9B and conform to the requirements of ASTM C 1071. All ductwork within 20 feet of Air Handlers shall be lined. All exhaust ductwork within 10 feet of roof outlets shall be lined.

**2.2 DUCTWORK (INDOOR EXPOSED IN MECHANICAL ROOMS)**

- A. All exposed ductwork shall be insulated with 2" thick rigid insulation and vapor barrier.

**2.3 DUCTWORK (EXPOSED OUTDOOR)**

- 4. All exposed outdoor ductwork shall be insulated with 2" thick rigid insulation and weatherproof vapor barrier wrap.

**2.4 PIPING/EQUIPMENT (INDOOR)**

- A. All new heating water system supply and return piping shall be covered with Manville Micro-Lok or equal approved fiberglass insulation with all service (factory applied) vapor retardant jacket. Seal with type H mastic.

- B. Fittings shall be insulated with same material and thickness as adjoining pipe insulation and shall be pre-molded fittings or miter cut segmental insulation wired on. Over the insulation, apply a wrapper of OCF glass cloth sealed with type H mastic. Apply aluminum bands on pipe covering in addition to self-sealing feature.
- C. Insulation Material: Molded fibrous glass insulation, density not less than 4 lbs. per cubic foot.
- D. Insulation Thickness: Shall be in accordance with the latest edition of the State Energy Code.
- E. Jacket and Finish: White flame retardant type, meeting all requirements of "Fire Hazard Classification" of NFPA, similar to "Fiberglass" Type FRJ, Insul-Coustic, Johns-Manville or approved equal.
- F. Insulation and Finishes for Fittings, Valves and Flanges
1. Valves, fittings and flanges other than vapor seal insulation: Insulated in same manner and same thickness as piping in which installed.
  2. Use pre-molded sectional covering where available; otherwise use mitered segments of pipe covering.
  3. Obtain written approval prior to using other than molded sectional covering.
- G. Vapor seal Insulation for Valves, Fittings and Flanges: Same as above, except joints sealed with vapor barrier adhesive and wrapped with glass mesh tape. Each fitting shall be finished with two coats of vapor seal mastic adhesive.
- H. Jacket and Finishes: Exposed fittings - 6 oz. canvas jacket adhered with lagging adhesive.
- I. Concealed fittings: Standard weight canvas jacket adhered with lagging adhesive and with bands of 18 gauge copper coated steel - 2 bands at elbows, 3 at tee.
- J. Insulation at Pipe Hangers
1. Where shields are specified at hangers on piping with fibrous glass covering, provide load bearing calcium silicate between shields and piping as follows:
    - a. For pipe covering without vapor barrier jacket, furnish at each shield 12" - long calcium silicate section with canvas section with canvas jacket continuous between shield and insulation.
    - b. For pipe covering with vapor barrier jacket, furnish at each shield 12" - long vapor barrier jacket section with section of fibrous glass replaced with section of calcium silicate. Vapor barrier jacket, continuous between shield and insulation for continuous vapor barrier.
- K. Condensate drain piping shall be insulated with 1/2" Imcosheild un-split polyolefin insulation.
- L. Refrigerant piping shall be insulated with Armacell or approved equal closed cell insulation. Thickness shall be in accordance with the latest edition of the State Energy Conservation Code, and the VFR manufacturer's recommendations. Minimum thickness shall be 1" for interior liquid and suction piping, and 1 1/2" for hot gas piping. Exterior piping shall be 2" thick insulation, with PVC cover and UV paint coating.
- M. Equipment
1. Secure fibrous glass block or board insulation in place with wire or galvanized steel bands.
    - i. Small Areas: Secure insulation with 16 gauge wire on maximum 6" centers.
    - ii. Large Areas: Secure insulation with 14 gauge wire or .015" thick by 1/2" wide galvanized steel bands on maximum 10" centers. Stagger insulation joints.

- iii. Irregular Surfaces: Where application of block or board insulation is not practical insulate with insulating cement built-up to same thickness as adjoining insulation.
  
- 2. Fill joints, voids and irregular surfaces with insulating cement to a uniform thickness.
  - b. Stretch wire mesh over entire insulated surface and secure to anchors with wire edges laced together.
  
  - c. Apply finishing cement, total of 1/2" thick, in 1/4" thick coats. Trowel second coat to a smooth hard finish. Neatly bevel insulation around hand-holes, cleanouts, ASME stamp, manufacturer's nametag and catalog number.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
  
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

#### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



## SECTION 23 0440

### DAMPERS AND MISCELLANEOUS

#### PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

#### PART 2 - PRODUCTS

##### 2.1 DAMPERS AND MISCELLANEOUS

- A. Furnish and install where shown on Drawings ARROW PIN-LOCK Dampers No. OBDPL-507 (Opposed) as manufactured by the Arrow Louver & Damper Corp. of Maspeth, NY 11378, or approved equal. Frames and blades to 1/8" extruded aluminum.
- B. Blades to be single unit PIN-LOCK design 6" wide, with the PIN-LOCK an integral section within the blade center axis. Frames to be a combination of 4" extruded aluminum channel and angle, with reinforcing bosses and groove inserts for vinyl seals.
- C. Pivot rods to be 1/2" diameter extruded aluminum, PIN-LOCK design interlocking into blade section. Bearings to be "Double-Sealed" type with Celcon inner bearing on rod riding in Merlon Polycarbonate outer bearing inserted in frame so that outer bearing cannot rotate.
- D. Blade linkage hardware is to be installed in angle or channel frame section out of air stream. All hardware to be of non-corrosive reinforced material or to be cadmium plated.
- E. Rod bearing to be designed for minimum air leakage by means of overlapping design and by extruded vinyl seals to fit into integral ribbed groove inserts in both frames and blades. All dampers in excess of 10 sq. ft. free area to have reinforced corners by means of gusset plates.
- F. Dampers shall be sized by the Control Manufacturer to properly control the flow of air and ensure minimum air stratification in mixing applications. Sizing shall be submitted for approval with information similar to that submitted on valve when sizing valve.

##### 2.2 FIRE DAMPERS

- A. Dampers shall be multi blade construction UL labeled and be installed in accordance with UL 555, with breakaway connections. The units shall have stainless steel actuator springs with locking devices for horizontally mounted type.

##### 2.3 COMBINATION FIRE / SMOKE DAMPERS

- A. Furnish and install at locations shown on Drawings, or as described in schedules, combination fire smoke dampers.
- B. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped single-piece hollow construction with 14 gauge equivalent thicknesses. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame for long life. Galvanized bearing shall not be acceptable.
- C. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge (adhesive or clip fastened seals shall be acceptable) and shall withstand a minimum of 450 degrees F. (232 degrees C.) Jamb seals shall be non-corrosive stainless steel flexible metal compression type to further ensure smoke management.

- D. Each combination fire/smoke damper shall be classified for use for fire resistance ratings of less than 3 hours in accordance with UL Standard 555 and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers, required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 c.f.m./sq. ft. at 1" w.g. and 8 c.f.m./ft. at 4" w.g.).
- E. As part of UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and 4000 f.p.m. air velocity in the open position.
- F. In addition to the leakage rating already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. (177 degrees C.). Appropriate electric actuators (equal to Ruskin model MA) shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity, which meets all applicable UL555S qualifications for both dampers and actuators. Damper and actuator assembly shall be factory cycled 10 times to assure operation.
- G. Manufacturer shall provide factory assembled sleeve of 17" minimum length (Contractor to verify requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge above 84" wide.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

#### **3.3 CLEANING**

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

**END OF SECTION**



**SECTION 23 0460**

**AUTOMATIC TEMPERATURE CONTROLS**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 QUALIFICATIONS OF BIDDER**

- A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 10 years.
- B. All bidders must have an office in the within 50 miles of jobsite.
- C. All bidders must be authorized distributors or branch offices of the manufacturers specified.
- D. All bidders must have a trained staff of application Engineers, who have been certified by the manufacturer in the configuration, programming and service of the automation system.

**1.2 SCOPE OF WORK**

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration, and installation for complete building automation system (also identified as BMS, Direct Digital Control System For HVAC) including all necessary hardware and all operating and applications software as required for the complete performance of the Work, as shown on the Drawings, as specified herein. The District has standardized on Andover. The ATC Sub-Contractor shall be Automated Control Logic (ACL), Thornwood, New York, (914) 769-8880, subject to District's approval.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - 2. Applicable general requirements for electrical Work specified within Divisions 23, 25 Specification Sections apply to this Section.
- C. Network level components of the system - workstations, servers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2004. No gateways shall be used for communication to controllers furnished under this section.
- D. At a minimum, provide controls for the following:
  - 1. Air Handling Units, Indoor and Outdoor
  - 2. VRF Systems
  - 3. Cabinet unit heater controls
  - 4. Electric resistance heaters
  - 5. Constant Air Volume Terminal Units
  - 6. Exhaust and Supply Fans
- E. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, Room Controllers, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and

operable system. Except as otherwise specified, provide operators for equipment such as dampers if the equipment manufacturer does not provide these. Coordinate requirements with the various Contractors.

- F. The BAS system supplier shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
- G. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS system supplier and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS system supplier shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
- H. Provide services and manpower necessary for commissioning of the system in coordination with the HVAC Contractor, Balancing Contractor, and Owner’s representative.
- I. All work performed under this section of the specifications will comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.
- J. Related Sections:
  - 1. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units. Depending on the scope of the project, the complete specification may have numerous sections that interface to this section.

### 1.3 REFERENCES

- A. Owner shall be furnished with a complete, hard-bound copy of all installed software code. Final payment shall be contingent upon this requirement being met.
- B. General, Code Compliance: The code listed below form a part of this Specification to the extent referenced. The codes are referred to in the text by the basic designation only. The edition/revision of the referenced code shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
  - 1. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.
  - 2. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.
  - 3. All wiring shall conform to the National Electrical Code.
  - 4. All smoke dampers shall be rated in accordance with UL 555S.
  - 5. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.
  - 6. Comply with FCC, Part 68 rules for telephone modems and data sets.

## 1.4 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

### 1. Standard

- a. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
- b. AHU: Air Handling Unit
- c. BACnet: Building Automation Controls Network
- d. BMS: Building Management System
- e. DDC: Direct Digital Control
- f. EIA: Electronic Industries Alliance
- g. GUI: Graphical User Interface
- h. HVAC: Heating, Ventilation, and Air Conditioning
- i. IEEE: Institute Electrical Electronic Engineers
- j. MER: Mechanical Equipment Room
- k. PID: Proportional, Integral, Derivative
- l. VAV: Variable Air Volume Box

### 2. Communications and protocols

- a. ARP: Address Resolution Protocol
- b. BACnet: Building Automation and Control Networks
- c. CORBA: Common Object Request Broker Architecture
- d. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
- e. DDE: Dynamic Data Exchange
- f. FTP: File Transfer Protocol
- g. FTT: Free Topology Transceivers
- h. HTTP: Hyper Text Transfer Protocol
- i. IIOP: Internet Inter-ORB Protocol
- j. IP: Internet Protocol
- k. LAN: Local Area Network
- l. LON: Echelon Communication – Local Operating Network
- m. MS/TP: Master Slave Token Passing
- n. OBIX: Open Building Information Exchange
- o. ODBC: Open Database Connectivity
- p. ORB: Object Request Broker
- q. SNVT: Standard Network Variables Types
- r. SQL: Structured Query Language
- s. UDP: User Datagram Protocol
- t. XML: Extensible Markup Language

### 3. Controllers

- a. ASD: Application Specific Device
- b. AAC: Advanced Application Controller
- c. ASC: Application Specific Controller
- d. CAC: Custom Application Controller
- e. DCU: Distributed Control Unit
- f. HRC: Hotel Room Controller
- g. LCM: Local Control Module
- h. MC: MicroControllers

- i. MPC: Multi-purpose Controller
  - j. NSC: Network Server Controller
  - k. PEM: Package Equipment Module
  - l. PPC: Programmable Process Controller
  - m. RC: Room controller
  - n. RPC: Room Purpose Controller
  - o. SDCU: Standalone Digital Control Units
  - p. SLC: Supervisory Logic Controller
  - q. UEC: Unitary Equipment Controller
  - r. VAVDDC: Variable Air Volume Direct Digital Controller
4. Tools and Software
- a. AFDD: Automated Fault Detection and Diagnostic
  - b. APEO: Automated Predictive Energy Optimization
  - c. DR: Demand Response
  - d. CCDT: Configuration, Commissioning and Diagnostic Tool
  - e. BPES: BACnet Portable Engineering Station
  - f. LPES: LON Portable Engineering Station
  - g. POT: Portable Operator's Terminal
  - h. PEMS: Power and Energy Management Software
  - i. MTBF: Mean Time Between Failure

## 1.5 SYMSTEM DESCRIPTION

- A. In accordance with the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability and allowing future expansion of both input/output points and processing/control functions.
- B. For this project, the system shall consist of the following components:
- 1. Administration and Programming Workstation(s): The BAS system supplier shall include Operation software and architecture as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile.
  - 2. Web-Based Operator Workstations: The BAS system supplier shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
  - 3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS system supplier shall furnish needed quantity of Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to

communicate with the workstations will not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Controllers (B-BC).

4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. Each BACnet protocol SDCU shall conform to the BACnet device profile B-AAC. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Advanced Application Controllers (B-AAC).
- C. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Modbus, XML and HTTP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.
- D. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
- E. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol are required to assure that the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.
- F. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 Kbaud protocol, as a common communication protocol between controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2004, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- G. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.
  1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.
  2. The products used in constructing the BMS shall be LonMark™ compliant.
  3. In those instances, in which Lon-Mark™ devices are not available, the BMS system supplier shall provide device resource files and external interface definitions for LonMark devices.
- H. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2004, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. BACnet clients shall comply with the BACnet Operator Workstation (B-OVS) device profile; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.
- I. The system shall provide support for Modbus TCP and RTU protocols natively, and not require the use of gateways.

- J. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
1. The supplied system must incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs. The system shall not require JAVA to be enabled in the browser.
  2. Data shall reside on a supplier-installed server for all database access.
  3. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network.
- K. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the approved manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 3 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, calibration and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in place support facility within 100 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.
- L. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC), monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.

## 1.6 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Division 1, in addition to those specified herein.
1. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.
  2. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.
  3. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.
  4. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three-ring binder with an index and tabs. Diagrams shall be on 11" by 17" foldouts. If color has been used to differentiate information, the printed copies shall be in color.
  5. Submit five (5) copies of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.

6. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.
7. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".
  - a. System architecture drawing.
  - b. Layout drawing for each control panel
  - c. Wiring diagram for individual components
  - d. System flow diagram for each controlled system
  - e. Instrumentation list for each controlled system
  - f. Sequence of control
  - g. Binding map
  - h. A matrix sheet detailing all system addresses and communication settings for the following:
    - i. All IP network addresses & settings.
    - ii. All BMS device addresses & communication settings
  - i. Operation and Maintenance Manuals
8. Information common to the entire system shall be provided. This shall include but not be limited to the following.
  - a. Product manuals for the key software tasks.
  - b. Operating the system.
  - c. Administrating the system.
  - d. Engineering the operator workstation.
  - e. Application programming.
  - f. Engineering the network.
  - g. Setting up the web server.
  - h. Report creation.
  - i. Graphics creation.
  - j. All other engineering tasks.
  - k. System Architecture Diagram.
  - l. List of recommended maintenance tasks associated with the system servers, operator workstations, data servers, web servers and web clients.
  - m. Define the task.
  - n. Recommend a frequency for the task.
  - o. Reference the product manual that includes instructions on executing the task.
  - p. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
  - q. Licenses, guarantees, and warranty documents for equipment and systems.
  - r. Submit one copy for each building, plus two extra copies.
9. Information common to the systems in a single building shall be provided.
  - a. System architecture diagram for components within the building annotated with specific location information.
  - b. As-built drawing for each control panel.
  - c. As-built wiring design diagram for all components.
  - d. Installation design details for each I/O device.
  - e. As-built system flow diagram for each system.
  - f. Sequence of control for each system.
  - g. Binding map for the building.
  - h. Product data sheet for each component.

- i. Installation data sheet for each component.
- j. Submit two copies for each building and two extra copies.

10. Software shall be provided:

- a. Submit a copy of all software installed on the servers and workstations.
- b. Submit all licensing information for all software installed on the servers and workstations.
- c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
- d. Submit all licensing information for all of the software used to execute the project.
- e. All software revisions shall be as installed at the time of the system acceptance.
- f. Firmware Files
- g. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
- h. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
- i. Submit a copy of all application files that were created during the execution of the project.
- j. Submit a copy of all graphic page files created during the execution of the project.

## 1.7 QUALITY ASSURANCE

- A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 5 years.
  - 1. The Building Management System contractor shall have a full service facility within 100 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The contractor's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.
  - 2. Any installing contractor, not listed as prequalified in the Approved Manufacturer's section, shall submit credentials as detailed in the Pre-bid Submittal section for the engineer's review 2 weeks prior to bid date. Failure to follow the attached formats shall disqualify potential alternate bidders. Credentials must attest that the contractor meets all requirements of the specification and the Engineers judgment regarding approval to bid as an acceptable installer after reviewing the data will be final.
- B. All bidders must be authorized distributors or branch offices of the manufacturers specified.
- C. The following bidders have been pre-qualified:
  - 1. Schneider Electric by Automated Control Logic – Tie into Existing Campus BMS Network.
  - 2. Or as approved by owners.
- D. Any installing contractors or manufacturers interested in participating as acceptable bidders for this project that are not pre-qualified shall furnish a detailed technical pre-bid submittal to the consulting engineer. All information must be submitted 2 weeks prior to the published bid date to allow the engineer adequate time to review the bidder's credentials.
- E. The Pre-Bid submittal shall contain the following information as a minimum:
  - 1. A profile of the manufacturer and the local installation and service/organization.
  - 2. Description of how the system meets and achieves all the specified criteria in terms of configuration, operation, and control.



3. System Architecture with single line riser diagram showing all major components (digital controllers, routers, hubs, etc.) that will be required for this project.
  4. Procedure for commissioning and time required to startup and commission each of the systems for this project.
  5. Contractors approach for the project planning and management.
  6. Product Data Sheets for all components, DDC panels, and all accessories listed per the appropriate specification sections herein.
  7. Examples of actual graphic screens for other similar projects.
  8. Number and types of DDC panels required for this installation.
  9. Number and types of spare points provided with the proposed system.
  10. Recommended spare parts list for components with list price schedule.
  11. List of 2 similar systems in size, point capacity, total installed value, installed and commissioned by the local office with a list of the installers/manufacturers design team members for each project and the owner's contact information.
  12. Samples of service offerings and a list of current similar service contracts with contact information.
  13. Resumes for the management team and all employees who will be involved with the project design, commissioning, project management, and after installation service. Resumes should include copies of manufacturer's certifications for the proposed product line.
  14. Copy of this Control Specification in its entirety with a check mark beside each paragraph to signify that the manufacturer's equipment and software shall fully conform to the specified requirement. If the requirement cannot be met, indicate the reasons/limitations and the alternative proposed.
  15. An interview may be conducted and the bidder will be requested to make a formal presentation concerning the proposed system and possibly provide an installed project tour prior to a final decision.
- F. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
- G. The BAS system supplier shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.
- H. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded.
- I. Required elements of the startup testing include:
1. Measurement of voltage sources, primary and secondary
  2. Verification of proper controller power wiring.
  3. Verification of component inventory when compared to the submittals.
  4. Verification of labeling on components and wiring.
  5. Verification of connection integrity and quality (loose strands and tight connections).
  6. Verification of bus topology, grounding of shields and installation of termination devices.
  7. Verification of point checkout.
  8. Each I/O device is landed per the submittals and functions per the sequence of control.

9. Analog sensors are properly scaled and a value is reported.
  10. Binary sensors have the correct normal position and the state is correctly reported.
  11. Analog outputs have the correct normal position and move full stroke when so commanded.
  12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
  13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
  14. Documentation of Loop tuning (sample rate, gain and integral time constant).
- J. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following.
1. Graphics navigation.
  2. Trend data collection and presentation.
  3. Alarm handling, acknowledgement, and routing.
  4. Time schedule editing.
  5. Application parameter adjustment.
  6. Manual control.
  7. Report execution.
  8. Automatic backups.
  9. Web Client access.
- K. A Startup Testing Report and a Performance Verification Testing Report shall be provided upon test completion.

## **1.8 COORDINATION**

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- E. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

## **1.9 OWNERSHIP**

- A. The Owner shall retain licenses to software for this project.
- B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.

- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing, or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
  - 1. Server and workstation software
  - 2. Application programming tools
  - 3. Configuration tools
  - 4. Network diagnostic tools
  - 5. Addressing tools
  - 6. Application files
  - 7. Configuration files
  - 8. Graphic files
  - 9. Report files
  - 10. Graphic symbol libraries
  - 11. All documentation

#### **1.10 WORK BY OTHERS**

- A. The BAS system supplier shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.
- B. The BAS system supplier shall furnish all Airflow Stations, Control Dampers, Control Valves, Flow Meters, Flow Switches for installation by the Mechanical Contractor and/or others.
- C. The BAS system supplier shall provide field supervision to the designated contractor for the installation of the following:
  - 1. Automatic control dampers
  - 2. Blank-off plates for dampers that are smaller than duct size.
  - 3. Sheet metal baffles plates to eliminate stratification.
  - 4. The Electrical Contractor shall provide:
    - a. All 120VAC power wiring to motors, heat trace, junction boxes for power to BAS panels.
    - b. Furnish smoke detectors and wire to the building fire alarm system. HVAC Contractor to mount devices. BAS system supplier to hardwire to fan shut down.
    - c. Auxiliary contact (pulse initiator) on the electric meter for central monitoring of kWh and KW. Electrical Contractor shall provide the pulse rate for remote readout to the BAS. BAS system supplier to coordinate this with the electrical contractor.
- D. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- E. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

- F. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

## **1.11 WARRANTY**

- A. All components, system software, and parts furnished and installed by the BMS system supplier shall be guaranteed against defects in materials and workmanship for 2 years of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS system supplier at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS system supplier shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design Product: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
  - 1. Electric Components
    - a. Schneider-Electric Field Devices
  - 2. Electronic Components
    - a. Schneider-Electric Field Devices
  - 3. Direct Digital Control Systems Field Controller Devices:
    - a. Schneider Electric EcoStruxure Building MPX BACnet series, b3 BACnet series, MNB BACnet installed by approved manufacturer's local field office or authorized distributor.
    - b. Or approved equal.

### **2.2 SYSTEM ARCHITECTURE**

- A. General
  - 1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
  - 2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
  - 3. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
  - 4. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
  - 5. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, Lon Works IP, and/or Modbus TCP protocol.

- B. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.
- C. A sub-network of SDCUs using the BACnet IP, BACnet MS/TP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- D. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.
- E. The fieldbus layer shall support all of the following types of SDCUs:
  - 1. BACnet IP SDCU requirements: The system shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs.
  - 2. BACnet MS/TP SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2004. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
- F. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- G. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches, and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- H. System Expansion
  - 1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
  - 2. Web-based operation shall be supported directly by the NSCs and require no additional software.
  - 3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
- I. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232).

### **2.3 OPERATOR WORKSTATION REQUIREMENTS**

- A. General
  - 1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project

provide a minimum of 5 concurrent operator users and/or 1 concurrent engineering user within the enterprise server.

2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
3. Web-based workstations (web stations) shall have a minimum of 10 concurrent operator users.
4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
5. A minimum of 0 physical Workstations shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC. Systems with a central database will not be acceptable.

B. Administration/Programming Workstation, Enterprise Server, and Enterprise Central Requirements

1. The Enterprise Central shall consist of the following:
  - a. Processor
    - 1) Minimum: Intel Core i5 @ 3.0 GHz or equivalent
    - 2) Recommended: Intel Core i5 @ 4.0 GHz or better
  - b. Memory
    - 1) Minimum: 6GB
    - 2) Recommended: 12GB or higher
  - c. Operating systems:
    - 1) Microsoft Windows 8.1 64-bit
    - 2) Microsoft Windows 10 64-bit
    - 3) Microsoft Windows Server 2008 R2 64-bit
    - 4) Microsoft Windows Server 2012 64-bit
    - 5) Microsoft Windows Server 2012 R2 64-bit
    - 6) Microsoft Windows Server 2016 R2 64-bit
  - d. 10/100MBPS Ethernet NIC
  - e. Storage
    - 1) Minimum: 1TB
    - 2) Recommended: 4TB
    - 3) Solid State Drive recommended
  - f. Required additional software:
    - 1) Microsoft .Net 4.7
  - g. License agreement for all applicable software
2. The workstation shall consist of the following:
  - a. Processor
    - 1) Minimum: 2.0 GHz
    - 2) Recommended: 3.0 GHz or higher
  - b. Memory
    - 1) Minimum: 4GB
    - 2) Recommended: 8GB or higher
  - c. Operating systems:
    - 1) Microsoft Windows 7 64-bit
    - 2) Microsoft Windows 8.1 64-bit
    - 3) Microsoft Windows 10 64-bit
    - 4) Microsoft Windows Server 2008 R2 64-bit
    - 5) Microsoft Windows Server 2012 64-bit

- 6) Microsoft Windows Server 2012 R2 64-bit
- 7) Microsoft Windows Server 2016
- d. Serial port, parallel port, USB port
- e. 10/100MBPS Ethernet NIC
- f. 20 GB hard disk
- g. DVD drive
- h. High resolution (minimum 1280 x 1024), 17" flat panel display
- i. Optical mouse and full function keyboard
- j. Audio sound card and speakers
  
- k. Required additional software:
  - 1) Microsoft .Net 4.7
- l. License agreement for all applicable software.

C. Web-Based Operator PC Requirements

- 1. Any user on the network can access the system, using the following software:
  - a. Minimum:
    - 1) Google Chrome 61 or higher
    - 2) Mozilla Firefox 60 or higher
    - 3) Microsoft Edge (EdgeHTML) 16 or higher
    - 4) Safari 11.1 or higher
  - b. Recommended:
    - 1) Google Chrome 71 or higher
    - 2) Mozilla Firefox 64 or higher
    - 3) Microsoft Edge (EdgeHTML) 17 or higher
    - 4) Safari 11.4 or higher

D. General Administration and Programming Workstation Software

- 1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
- 2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
- 3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

E. User Interface:

- 1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other

applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Italian, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
5. Personalized layouts and panels within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
6. Webstations shall give the user the same capabilities within the graphics pages as are given within the workstation but shall be mobile responsive for use on smaller devices.
7. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
8. Workstation shall indicate at all times the communication status between it and the server.

#### F. User Security

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon Microsoft Windows Security Domains that enable the customer IT department to assist in user access.
2. Additional requirements include mandatory change of passwords:
  - a. At first logon with default credentials
  - b. Of admin passwords before deploying
3. No general accounts, one account per user
4. Capability to integrate and use Windows Active Directory for user log on credentials
5. Include a timed auto log off feature
6. Use TLS 1.2 encryption or higher
7. Capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
8. All devices and software that support HTTP shall allow disabling the HTTP access and require access via HTTPS.
9. All devices that have web portals for the configuration of IP addresses and other configuration attributes shall have the ability, through commands issued, to disable this service upon completion. A direct connection method with ASCII commands shall enable this service again if changes need to be applied. Loss of power or cycling the device shall not reverse this command. Disabling this web portal eliminates the security risk and the need for updating security patches.
10. All devices shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks.



11. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
12. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.

G. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a “network map” of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created from the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all “child” objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
  - a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
  - b. The system shall support HTML5 enabled graphics.
  - c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
  - d. The editor shall use Scalable Vector Graphics (SVG) technology.
  - e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, and graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
  - f. Support for high DPI icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
  - g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
  - h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
  - i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
  - j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
  - k. Graphics should rescale based on whatever monitor or viewing device is being used.
  - l. Be able to create graphics on varying layers that can be moved and repeated.

- m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
- n. The ability to create re-usable cascading menus.
- o. The ability to have multiple instances of a graphic and edit one instance to change all.
- 3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:
  - a. Create and save pages.
  - b. Group and ungroup symbols.
  - c. Modify an existing symbol.
  - d. Modify an existing graphic page.
  - e. Rotate and mirror a symbol.
  - f. Place a symbol on a page.
  - g. Place analog dynamic data in decimal format on a page.
  - h. Place binary dynamic data using state descriptors on a page.
  - i. Create motion through the use of animated .gif files or JavaScript.
  - j. Place test mode indication on a page.
  - k. Place manual mode indication on a page.
  - l. Place links using a fixed symbol or flyover on a page.
  - m. Links to other graphics.
  - n. Links to web sites.
  - o. Links to notes.
  - p. Links to time schedules.
  - q. Links to any .exe file on the operator workstation.
  - r. Links to .doc files.
  - s. Assign a background color.
  - t. Assign a foreground color.
  - u. Place alarm indicators on a page.
  - v. Change symbol/text/value color as a function of an analog variable.
  - w. Change a symbol/text/value color as a function of a binary state.
  - x. Change symbol/text/value as a function of a binary state.
  - y. All symbols used by Schneider Electric EcoBuilding Business in the creation of graphic pages shall be saved to a library file for use by the owner.
- I. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user configurable.
- J. Alarm Management
  - 1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
  - 2. Alarm management features shall include:
    - a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be

10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.

- b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
- c. Playing an audible sound on alarm initiation or return to normal.
- d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS) No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
- e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.
- f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
- g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
- h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
- i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
- j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
- k. The alarm viewer can be configured to auto hide alarms when triggered.
- l. An operator shall have the capability to assign an alarm to another user of the system.
- m. Time schedules shall be able to be used to set control notifications to users.
- n. An operator shall have the capability to save and apply alarm favorites.
- o. Alarm notifications must support multiple distribution methods within one notification.

K. Report Generation

- 1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
- 2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
- 3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used.
- 4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
- 5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
- 6. All reports shall be able to be set up to automatically run or be generated on demand.
- 7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
- 8. Reports can be of any length and contain any point attributes from any controller on the network.

9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
  - a. Activities Per Server Report
  - b. Activities Per User Report
  - c. Alarm Amount by Category Report
  - d. Alarm Amount by Type Report
  - e. Alarms Per Sever Report
  - f. Current Alarm Report
  - g. Most Active Alarm Report
  - h. System Errors Per Server Report
  - i. Top Activities Report
  - j. Top Alarms Report
  - k. Top System Errors Report
  - l. Trend Log Comparison Report
  - m. User Logins Report
  - n. Users and Groups Reports
13. Minimum Energy Reports shall include:
  - a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
  - b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
  - c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.
14. Reports Server Hardware Requirements
  - a. Processor
    - 1) Minimum: 2.0 GHz
    - 2) Recommended: 2.0 GHz or higher
  - b. Memory
    - 1) Minimum: 6 GB
    - 2) Recommended: 8GB or higher
  - c. Hard Disk: 500 GB
15. Reports Server Software Requirements
  - a. Operating System:
    - 1) Microsoft Windows 7 32-bit (Professional)
    - 2) Microsoft Windows 7 64-bit (Professional)
    - 3) Microsoft Windows 8.1 32-bit (Pro or Enterprise)
    - 4) Microsoft Windows 8.1 64-bit (Pro or Enterprise)
    - 5) Microsoft Windows 10 64-bit (Pro or Enterprise)
    - 6) Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
    - 7) Microsoft Windows Server 2012 64-bit (Standard)
    - 8) Microsoft Windows Server 2012 R2 64-bit (Standard, Datacenter)

- b. SQL Versions:
  - 1) Microsoft SQL Server 2008 R2 64-bit SP2 (Standard and Express with Advanced Services)
  - 2) Microsoft SQL Server 2012 64-bit (Standard and Express with Advanced Services)
- c. Additional required software”
  - 1) Microsoft .Net 4.5

L. Scheduling

- 1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
- 2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
- 3. Schedules shall be programmable for a minimum of one year in advance.
- 4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
- 5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
- 6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
- 7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
- 8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
- 9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
- 10. It should accommodate a minimum of 16 priority levels.
- 11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment

- 1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
- 2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
- 3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
- 4. NSC devices will support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development and write global control programs. Both languages will have debugging capabilities in their editors.
- 5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
- 6. The system shall be capable of creating “ custom types.” These types can be created within the programming environment, graphics, or as full controller ‘templates’ that can be pushed to any other variable pertaining to it to allow for singular reference to multiple objects. This allows easing of updating/changes allowing the use to make a singular change and push to all connected instances.
- 7. It shall be possible to view graphical programming live and real-time from the Workstation.
- 8. The system shall be capable of creating ‘binding templates’ allowing the user to bind multiple points to multiple objects all at once.

9. Key terms should appear when typing (IntelliType).
  10. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.
  11. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
- N. Saving/Reloading
1. The workstation software shall have an application to save and restore NSC and field controller memory files.
  2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.
- O. Audit Trail
1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
  2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
  3. The Enterprise server shall be able to store up to 5 million events.
  4. The event view shall support viewing of up to 100,000 events.
  5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
  6. It shall be capable to search and view all forced values within the system.
- P. Fault Tolerant Enterprise Server Operation (Top level NSC)
1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.
- Q. Web-based Operator Software
1. General:
    - a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
    - b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
  2. Graphic Displays
    - a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
    - b. Through the browser-based interface, operators must be able to navigate through the entire system and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.
    - c. System shall have out-of-the-box dashboards that enable customizable views of live data which can be public to all users or capable to make them specific to a user based on log in credentials.

- d. The user shall have the ability to create custom dashboards.
  - e. The dashboards shall have a kiosk mode which allows for occupant level data display on monitors or tablets throughout the building.
  - 3. Alarm Management
    - a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
    - b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.
  - R. Groups and Schedules
    - 1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
    - 2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.
  - S. User Accounts and Audit Trail
    - 1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
    - 2. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.
  - T. Web Services
    - 1. The installed system shall be able to use web services to “consume” information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable.
      - a. Shall be able to “consume” data into the system via SOAP and REST web services.
- 2.4 NETWORK SERVER CONTROLLERS (NSC)**
- A. Network Server Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
  - B. The BACnet NSC shall be classified as a “native” BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).
  - C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices and provide global supervisory control functions over the control devices connected to the NRS.
  - D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.
  - E. Whitelisting of file extensions for documents shall be capable.
  - F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2.

- G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.
- H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.
- I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.
- J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.
- K. It shall be capable of executing application control programs to provide:
  - 1. Calendar functions
  - 2. Scheduling
  - 3. Trending
  - 4. Alarm monitoring and routing
  - 5. Time synchronization by means of an Internet site including automatic synchronization
  - 6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
  - 7. Network Management functions for all LonWorks based devices
- L. Hardware Specifications
  - 1. Memory:
    - a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
  - 2. Each NRC shall provide the following on-board hardware for communication:
    - a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
      - 1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
      - 2) Support IPv4 addressing
      - 3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
      - 4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices
      - 5) It shall be possible to disable Ethernet port 2
      - 6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
      - 7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
      - 8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
      - 9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)
      - 10) Where a switch is needed, use a Cisco 9000 Catalyst or IE switch, EtherWAN EX63402-01B, or other equal and approved equivalent.
    - b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)



- c. One TP/FT port for communication to LonWorks devices.
  - d. One device USB port
  - e. One host USB port
3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).
- M. Modular Expandability:
1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
  2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
  3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.
- N. Hardware Override Switches:
1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition, each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.
- O. Universal Input Temperatures
1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
    - a. 10 kohm Type I (Continuum)
    - b. 10 kohm Type II (I/NET)
    - c. 10 kohm Type III (Satchwell)
    - d. 10 kohm Type IV (FD)
    - e. Linearized 10 kohm Type V (FD w/11k shunt)
    - f. Linearized 10 kohm (Satchwell)
    - g. 1.8 kohm (Xenta)
    - h. 1 kohm (Balco)
    - i. 20 kohm (Honeywell)
    - j. 2.2 kohm (Johnson)
  2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
    - a. PT100 (Siemens)
    - b. PT1000 (Sauter)
    - c. Ni1000 (Danfoss)
- P. Local Status Indicator Lamps:
1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

Q. Real Time Clock (RTC):

1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
3. No batteries may be used to for the backup of the RTC.

R. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

S. Automatic Restart After Power Failure:

1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

T. Data Retention:

1. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

U. Software Specifications

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

V. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a “canned” program method will not be accepted.

W. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:
  - a. Proportional, Integral plus Derivative Control (PID)
  - b. Two Position Control
  - c. Digital Filter

- d. Ratio Calculator
- e. Equipment Cycling Protection

X. Mathematical Functions:

1. Each controller shall be capable of performing basic mathematical functions (+, -, \*, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

Y. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot/Cold Deck Reset
14. Hot Water Reset
15. Chilled Water Reset
16. Condenser Water Reset
17. Chiller Sequencing

Z. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales, and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.

7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

AA. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

BB. Embedded Web Server

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

## 2.5 BACNET IP FIELDBUS CONTROLLERS

A. Controllers – BACnet/IP Protocol

1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
  - a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
  - b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACNET/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:

1. Supporting IPv4 addressing

2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
  3. It shall be possible to disable Ethernet port 2
- C. Topologies
1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
  2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
    - a. In case of any disruption there shall be no communication interruption
    - b. In case of any disruption there shall be system alarms that will inform the operator of the disruption
- D. Performance
1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
  2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.
- E. Programmability
1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
  2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
  3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
  4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
  5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
  6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
  7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
  8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
    - a. Control processes
    - b. Energy management applications
    - c. Alarm management
    - d. Historical/trend data
    - e. Maintenance support applications
    - f. Custom processes
    - g. Manal override monitoring
  9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
  10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
  11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.

12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
- a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
    - 1) Universal Inputs – the following thermistors for use in the system without any external converters needed.
      - a) 10 kohm Type I (Continuum)
      - b) 10 kohm Type II (I/NET)
      - c) 10 kohm Type III (Satchwell)
      - d) 10 kohm Type IV (FD)
      - e) Linearized 10 kohm Type V (FD w/11k shunt)
      - f) Linearized 10 kohm (Satchwell)
      - g) 1.8 kohm (Xenta)
      - h) 1 kohm (Balco)
      - i) 20 kohm (Honeywell)
      - j) 2.2 kohm (Johnson)
      - k) PT100 (Siemens)
      - l) PT1000 (Sauter)
      - m) Ni1000 (Danfoss)
    - 2) Analog inputs
      - a) Current Input - 0-20 mA
      - b) Voltage Input 0-10 Vdc
    - 3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
    - 4) Digital outputs
    - 5) Analog outputs of 4-20 mA and/or 0-10 Vdc
13. Real Time Clock (RTC):
- a. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
  - b. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
  - c. No batteries may be used to for the backup of the RTC.
14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications
- a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer
  - b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of  $\pm 5\%$  at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., ensuring primary air flow conditions shall be controlled and maintained to within  $\pm 5\%$  of setpoint at the specified minimum and maximum air flow parameters
  - c. The BACnet/IP Fieldbus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
  - d. The BACnet/IP Fieldbus controller for VAV applications shall require no programming for air balancing algorithm
  - e. All balancing parameters shall be synchronized in NSC
15. The BACnet/IP Fieldbus controller for connected room solutions
- a. In addition, if applicable, the system shall include a BACnet/IP fieldbus controller that integrates control for HVAC, Lighting, Blind Control, BTL, and Zigbee wireless communication in a singular unit.
    - 1) HVAC IO as described above
    - 2) Lighting bus, with at minimum, DALI capabilities
    - 3) Bus for blind control applications

- 4) BTL (Bluetooth) wireless capabilities to allow for use of apps, such as commissioning tools and occupant apps for control of space
      - 5) Zigbee wireless for connection to wireless sensors within the room space, such as occ sensors, door contacts, and smart third party devices, such as trash bins, coffee makers, etc.
    - b. The controller shall work with any 3rd party BMS system and can be brought into the host system through the auto discovery mechanism.
  16. The BACnet/IP Fieldbus controller for remote IO
    - a. The system shall have available a BACnet/IP fieldbus controller to support inclusion of IO that is remote from the controller(s) that may need it.
    - b. As the controller is just an IO 'station' handling data to other controllers it still shall:
      - 1) Support local alarms and local trends
      - 2) No impact firmware update capabilities
      - 3) User defined fallback for outputs in case of network disruption
  17. The BACnet/IP Fieldbus room controller
    - a. For connected room solutions that do not require integrated lighting and blind busses built into a singular unit, the system shall include a BACnet/IP enabled controller specifically designed for room control.
    - b. The controller shall communicate via BACnet/IP via Wifi.
    - c. The controller shall be capable of controlling fan coil units, cooling VVT zones with reheat, fin-tube radiators, cabinet heaters, radiant panel heaters, electric re-heat zones, terminal reheats, rooftop units (1H1C, 2H2C, 3H2C, MH2C), or heat pumps, if necessary.
    - d. The controller shall house an onboard temperature sensor, and options for onboard humidity and occupancy sensor.
    - e. The controller shall utilize a touch screen interface and have multiple options for casings and fascias. The screen shall be a TFT transmissive LED backlit LCD touchscreen with atleast 5 color options.
    - f. Controller will have password protection to prevent unauthorized access to the configuration menu parameters.
    - g. The controller will have integrated Zigbee wireless communications with predefined profiles for Zigbee door and window switches, occupancy sensors, water leakage detectors, CO2 sensors, and additional temperature and humidity sensors.
    - h. The controller will be capable of hosting at least 10 Zigbee sub devices.
    - i. The controller will be capable of being programmed with customizable scripts via the open programming language Lua. It shall be equipped with at least 256KB of SRAM with 80KB configurable/reserved for Lua scripting purposes.
  18. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
  19. Power Requirements.: 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power
- F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout
1. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms
  2. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store

3. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN.
4. Functionality
  - a. Device Configuration – the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller.
  - b. Programming – The Commissioning Tool shall be able to load offline engineered applications directly into the controller directly.
  - c. Air Balancing
    - 1) The Commissioning Tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
    - 2) The Commissioning Tool shall be able to generate Air Balancing report
  - d. IO Checkout
    - 1) The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live.
    - 2) The Commissioning Tool shall be able to support generation of I/O checkout report.
  - e. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended.
- G. Intelligent Space Sensors - The BACnet/IP Fieldbus controller shall support a dedicated RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on board inputs or outputs.
  1. The Intelligent Space Sensor shall communicate with the BACnet/IP Fieldbus controller through the sensor port and via category 5 or category 6 cable
  2. The Intelligent Space Sensor shall provide 2 RJ45 communication ports that will allow communication with parent BACnet/IP Field controller upstream and additional Intelligent Space Sensors downstream
  3. The Intelligent Space Sensor shall provide ambient space condition sensing without the use of hardware I/O
- H. Each Intelligent Space Sensor shall provide a color touch display with:
  1. Minimum 61 mm (2.4”) by 61 mm (2.4”) display
  2. Backlit
- I. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 0 to 50 °C (32 to 122 °F) with accuracy of  $\pm 0.2$  °C ( $\pm 0.4$  °F) selectable for 0.1 or 1 degree display resolution of °F or °C
  1. Sensing Element: 10k Type 3 Thermistor
  2. Accuracy of  $\pm 0.2$  °C ( $\pm 0.4$  °F)
  3. Resolution: 0.1 or 1 degree display resolution
  4. Range: 0 to 50 °C (32 to 122 °F)
- J. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1 % RH with selectable display resolution of 0.1 or 1 % RH)
  1. Accuracy:  $\pm 2$  % RH
  2. Resolution: 0.1 or 1 % RH
  3. Range: 0 % RH to 100 % RH



- K. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution
  - 1. Accuracy:  $\pm 30$  ppm  $\pm 2\%$  of measured value
  - 2. Range: 0 to 2,000 ppm
  - 3. Operating elevation: 0 to 16,000 ft.
  - 4. Temperature dependence: 0.11% FS per °F
  - 5. Stability: <2% of FS over life of sensor (15 years)
  - 6. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling
- L. The Intelligent Space Sensor shall have the option for motion sensor
- M. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:
  - 1. Space temperature
  - 2. Cooling space temperature set point
  - 3. Heating space temperature set point
  - 4. Current heating or cooling mode
  - 5. Current occupancy mode
  - 6. Fan speed
  - 7. Current time

## 2.6 BACNET FIELDBUS AND BACNET SDCUS

- A. Networking
  - 1. IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.
  - 2. IP To Field Bus Routing Devices
    - a. A Network Server Controller shall be used to provide this functionality.
    - b. These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
    - c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the IP level of the architecture are forwarded.
- B. Field Bus Wiring and Termination
  - 1. The wiring of components shall use a bus or daisy chain concept with no tees, stubs, or free topology.
  - 2. Each field bus shall have a termination resistor at both ends of each segment.
  - 3. The field bus shall support the use of wireless communications.
- C. Repeaters
  - 1. Repeaters are required to connect two segments.
  - 2. Repeaters shall be installed in an enclosure. The enclosure may be in an interstitial space.
- D. Field Bus Devices
  - 1. General Requirements
    - a. Devices shall have a light indicating that they are powered.
    - b. Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.

- c. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)
- E. Advance Application Controllers (B-AAC)
- 1. The key characteristics of a B-AAC are:
    - a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
    - b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
    - c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool.
    - d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
    - e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
    - f. If local alarm message initiation is embedded, the B-AAC shall:
      - 1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the alarm message.
      - 2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement.
    - g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
    - h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
    - i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller.
    - j. Shall support the "Who is" and "I am." BACnet services.
    - k. Shall support the "Who has" and "I have." BACnet services.
  - 2. Analog Input Circuits
    - a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.
    - b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
    - c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
    - d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal.
  - 3. Binary Input Circuits
    - a. Dry contact sensors shall wire to the controller with two wires.
    - b. An external power supply in the sensor circuit shall not be required.

4. Pulse Input Circuits
    - a. Pulse input sensors shall wire to the controller with two wires.
    - b. An external power supply in the sensor circuit shall not be required.
    - c. The pulse input circuit shall be able to process up to 20 pulses per second.
  5. True Analog Output Circuits
    - a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).
    - b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.
  6. Binary Output Circuits
    - a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
    - b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.
  7. Program Execution
    - a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
    - b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second.
    - c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second.
    - d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second.
    - e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.
  8. Local Interface
    - a. The controller shall support the connection of a portable interface device such as a laptop computer or vendor unique hand-held device. The ability to execute any tasks other than viewing data shall be password protected. Via this local interface, an operator shall be able to:
      - 1) Adjust application parameters.
      - 2) Execute manual control of input and output points.
      - 3) View dynamic data.
- F. Application Specific Devices
1. Application specific devices shall have fixed function configurable applications.
  2. If the application can be altered by the vendor's application programmable tool, the device is an advanced application controller and not an application specific device.
  3. Application specific devices shall be BTL certified.
- G. Room controllers
1. For connected room solutions that do not require integrated lighting and blind busses built into a singular unit, the system shall include a BACnet MS-TP enabled controller specifically designed for room control.
  2. The controller shall communicate via BACnet MS-TP. It should also be capable of MODBUS RTU communication.

3. The controller shall be capable of controlling fan coil units, cooling VVT zones with reheat, fin-tube radiators, cabinet heaters, radiant panel heaters, electric re-heat zones, terminal reheats, rooftop units (1H1C, 2H2C, 3H2C, MH2C), or heat pumps, if necessary.
4. The controller shall house an onboard temperature sensor, and options for onboard humidity and occupancy sensor.
5. The controller shall utilize a touch screen interface and have multiple options for casings and fascias. The screen shall be a TFT transmissive LED backlit LCD touchscreen with at least 5 color options.
6. Controller will have password protection to prevent unauthorized access to the configuration menu parameters.
7. The controller will have integrated Zigbee wireless communications with predefined profiles for Zigbee door and window switches, occupancy sensors, water leakage detectors, CO2 sensors, and additional temperature and humidity sensors.
8. The controller will be capable of hosting at least 10 Zigbee sub devices.
9. The controller will be capable of being programmed with customizable scripts via the open programming language Lua. It shall be equipped with at least 256KB of SRAM with 80KB configurable/reserved for Lua scripting purposes.

## 2.7 DDC SENSORS AND POINT HARDWARE

### A. Temperature Sensors

1. Acceptable Manufacturers: Veris Industries
2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of – 30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
3. Room Sensor: Standard space sensors shall be available in an [off white][black] enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series
  - a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
  - b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series
5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F and 300 series stainless steel for all other applications. Basis of Design: Veris TI Series
7. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series

8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Wall Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory.
6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F.
7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available in an off white enclosure made of high impact ABS plastic for mounting on a standard electrical box.
10. Transmitter shall have option of having an LCD display.
11. Transmitter shall have option of being NIST certified.
12. Transmitter shall have option of an integrated temperature sensor.
13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to +/- 2 % at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory.
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F.
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified.
11. Transmitter shall have option of an integrated temperature sensor.
12. Basis of Design: Veris HD Series

D. Humidity Outdoor Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to +/- 2% at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory.
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F.
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall have option of being NIST certified.
11. Transmitter shall have option of an integrated temperature sensor.

12. Basis of Design: Veris HO Series

E. Carbon Dioxide Wall Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be  $\pm 30$  ppm  $\pm 2\%$  of measured value with annual drift of  $\pm 10$  ppm. Minimum five year recommended calibration interval.
4. Repeatability shall be  $\pm 20$  ppm  $\pm 1\%$  of measured value.
5. Response Time shall be  $< 60$  seconds for 90% step change.
6. Outputs shall be field selectable [Analog: 4-20mA or 0-5/0-10VDC][Protocol: Modbus or BACnet] with [SPDT Relay 1A@30VDC][temperature setpoint slider]
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: [32° to 122°F (CO2 only)][50° to 95°F (with humidity option)]
9. Output range shall be programmable 0-2000 or 0-5000 ppm.
10. Transmitter shall be available in an off white enclosure for mounting on a standard electrical box.
11. Transmitter shall have an option of an LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings.
12. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor.
13. Basis of Design: Veris CWL

F. Carbon Dioxide Duct Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be  $\pm 30$  ppm  $\pm 2\%$  of measured value with annual drift of  $\pm 10$  ppm. Minimum five year recommended calibration interval.
4. Repeatability shall be  $\pm 20$  ppm  $\pm 1\%$  of measured value.
5. Response Time shall be  $< 60$  seconds for 90% step change.
6. Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC.
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: 32° to 122°F
9. Output range shall be programmable 0-2000 or 0-5000 ppm.
10. Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor.
11. Enclosure lid shall require no screws and make use of snap on features for attachment.
12. Enclosure shall be made of high impact ABS plastic.
13. Transmitter shall have option of an LCD display.
14. Transmitter shall have option of an integrated temperature sensor and/or humidity sensor.
15. Basis of Design: Veris CDL

G. Air Pressure Transmitters

1. Acceptable Manufacturers: Veris Industries
2. Sensor shall be microprocessor profiled ceramic capacitive sensing element.
3. Transmitter shall have 14 selectable ranges from 0.1 – 10” WC.
4. Transmitter shall be  $\pm 1\%$  accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
5. Transmitter shall be field configurable to mount on wall or duct with static probe.

6. Transmitter shall be field selectable for Unidirectional or Bidirectional
7. Maximum operating pressure shall be 200% of design pressure.
8. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec.
11. Transmitter shall have an LCD display.
12. Units shall be field selectable for WC or PA
13. Transmitter shall have provision for zeroing by pushbutton or digital input.
14. Transmitter shall be available with a certification of NIST calibration.
15. Basis of Design: Veris model PXU.

H. Liquid Differential Pressure Transmitters

1. Acceptable Manufacturer: Veris Industries
2. Transmitter shall be microprocessor based.
3. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure.
4. Transmitter shall have 4 switch selectable ranges.
5. Transmitter shall have test mode to produce full-scale output automatically.
6. Transmitter shall have provision for zeroing by pushbutton or digital input.
7. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
8. Transmitter shall have field selectable electronic surge damping.
9. Transmitter shall have an electronic port swap feature.
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
11. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
12. Performance:
  - a. Accuracy shall be  $\pm 1\%$  F.S. and  $\pm 2\%$  F.S. for lowest selectable range.
  - b. Long term stability shall be  $\pm 0.25\%$
  - c. Sensor temperature operating range shall be  $-4^{\circ}$  to  $185^{\circ}\text{F}$
  - d. Operating environment shall be  $14^{\circ}$  to  $131^{\circ}\text{F}$ ; 10-90% RH noncondensing.
  - e. Proof pressure shall be 2x max. F.S. range.
  - f. Burst pressure shall be 5x max. F.S. range.
13. Transmitter shall be encased in a NEMA 4 enclosure.
14. Enclosure shall be white powder-coated aluminum.
15. Transmitter shall be available with a certification of NIST calibration.
16. Transmitter shall be preinstalled on a bypass valve manifold.
17. Basis of Design: Veris PW

I. Current Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris Industries.

J. Current Status Switches for Constant Load Devices

1. Acceptable Manufacturer: Veris Industries

2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
  3. Visual LED indicator for status.
  4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
  5. Normally open current sensor output. 0.1A at 30 VAC/DC.
  6. Basis of Design: Veris Model H608.
- K. Current Status Switches for Constant Load Devices (Auto Calibration)
1. Acceptable Manufacturer: Veris Industries.
  2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer.
  3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
  4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
  5. Nominal Trip Point:  $\pm 40\%$ ,  $\pm 60\%$ , or on/off (user selectable)
  6. Normally open current sensor output. 0.1A at 30 VAC/DC.
  7. Basis of Design: Veris Model H11D.
- L. Current Status Switches for Variable Frequency Drive Application
1. Acceptable Manufacturer: Veris Industries.
  2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
  3. Visual LED indicator for status.
  4. Alarm Limits:  $\pm 20\%$  of learned current in every 5 Hz freq. band.
  5. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
  6. Normally open current sensor output. 0.1A at 30 VAC/DC.
  7. Basis of Design: Veris Model H614.
- M. Liquid Flow, Insertion Type Turbine Flowmeter
1. Acceptable Manufacturer: Veris Industries
  2. General: Turbine-type insertion flow meter designed for use in pipe sizes 1 1/2" and greater. Available in hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain.
  3. Performance:
    - a. Accuracy  $\pm 1\%$  of rate over optimum flow range;  $\geq 10$  upstream and  $\geq 5$  downstream straight pipe diameters, uninterrupted flow
    - b. Repeatability  $\pm 0.5\%$
    - c. Velocity Range: 0.3 to 20 FPS
    - d. Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
    - e. Pressure Rating: 1000 psi @ 70°F
  4. Maximum Temperature Rating: 300°F
  5. Materials: Stainless Steel or Brass body; Stainless steel impeller



6. Transmitter:
    - a. Power Supply: 12 - 30VAC or 8 - 35VDC.
      - 1) Output: [Frequency][4-20 mA][Scaled Pulse]
    - b. Temperature Range: 14° to 150°F
    - c. Display: 8 character 3/8" LCD (Optional)
    - d. Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover
  7. Basis of Design: Veris SDI series
- N. Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on)
1. Acceptable Manufacturer: Veris Industries
  2. General: Clamp-on digital correlation transit-time ultrasonic flow meter designed for clean liquids or liquids containing small amounts of suspended solids or aeration. Optional temperature sensors for BTU calculations.
  3. Liquid: water, brine, raw sewage, ethylene, glycol, glycerin, and others. Contact manufacturer for other fluid compatibility
  4. Pipe Surface Temperature: Pipe dia 1/2" to 2": -40-185°F; Pipe dia > 2": -40-250°F
  5. Performance:
    - a. Flow Accuracy:
      - 1) Pipe dia 1/2" to 3/4" 1% of full scale
      - 2) Pipe dia 1" to 2" 1% of reading from 4-40 FPS
      - 3) Pipe dia 2" to 100" 1% of reading from 1-40 FPS
    - b. Flow Repeatability ±0.01% of reading
    - c. Velocity Range: (Bidirectional flow)
      - 1) Pipe dia 1/2" to 2" 2 to 40 FPS
      - 2) Pipe dia 2" to 100" 1 to 40 FPS
    - d. Flow Sensitivity 0.001 FPS
    - e. Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F
    - f. Temperature Sensitivity: 0.05°F
    - g. Temperature Repeatability: ±0.05% of reading
  6. Transmitter
    - a. Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC.
    - b. Output: [RJ45][Modbus TCP/IP][Ethernet/IP][BACnet/IP][Pulse][4-20 mA][RS-485 Modbus RTU}
    - c. Temperature Range: -40 to +185°F
    - d. Display: 2 line backlit LCD with keypad
    - e. Enclosure: NEMA 4, (IP65), Powder-coated aluminum, polycarbonate
  7. Agency Rating: UL 1604, EN 60079-0/15, CSA C22.2, CSA Class 1 (Pipe > 2")
  8. Basis of Design: Veris FST & FSR series
- O. Analog Electric/Pneumatic Transducer
1. Acceptable Manufacturer: Veris Industries
  2. General: Micro-controlled poppet valve for high accuracy and with no air loss in the system. Field configurable for pressure sensing in multiple applications.
  3. Power Supply: 22-30VDC, 20-30VAC
  4. Control Input: 4-20mA, 0-10V, 0-5V; jumper selectable
  5. Performance:
    - a. Accuracy: 1% full scale; combined linearity, hysteresis, repeatability

- b. Compensated Temperature Range: 25° to 140°F
  - c. Temp Coefficient:  $\pm 0.05\%$ °C
  - d. Operating Environment: 10-90% RH, non-condensing; 25° to 140°F
6. Supply Pressure: 45 psig max.
  7. Manual Override: Jumper selectable mode, digital pushbutton adjust
  8. Alarm Contact: 100mA@30VAC/DC (Optional)
  9. Control Range 0-20 psig or 3-15 psig; jumper selectable
  10. Pressure Differential 0.1 psig (supply to branch)
  11. Pressure Indication Electronic, 3-1/2 digit LCD
  12. Housing: Mounted on standard SnapTrack; Optional clear dust cover
  13. Basis of Design: Veris EP Series
- P. Pressure Independent Control Valves
1. Note: When selecting pressure independent valves the specifier should also revise spec to NOT include balancing valves and also modify to NOT require the individual balancing of each coil/valve combination.
  2. NPS 2 and Smaller: PN 16, stainless steel components.
  3. NPS 2½ through 10: Class 125 cast iron body per ASME B16.1-2010, Material class B per ASTM A 126-04 (2014), stainless steel components.
  4. Accuracy NPS ¾” and Smaller: The control valves shall accurately control the flow from 0...100% rated flow with a differential pressure range of 2.32...58 psi for low and standard flow units, 5...58 psi for high flow units within 5% of set flow value.
  5. Accuracy NPS 1 through 1¼: The control valves shall accurately control the flow from 0...100% rated flow with a differential pressure range of 2.9...58 psi for standard flow units, 5...58 psi for high flow units within 5% of set flow value.
  6. Accuracy NPS 1½ through 4: The control valves shall accurately control the flow from 0...100% rated flow with a differential pressure range of 4.35...58 psi within 5% of set flow value.
  7. Accuracy NPS 5 through 10: The control valves shall accurately control the flow from 0...100% rated flow with a differential pressure range of 5.8...58 psi for standard flow units, 8.7...58 psi for high flow units within 5% of set flow value.
  8. Flow Characteristics: Linear Control, selectable to equal percentage at the proportional valve actuator.
  9. Field adjustable flow by means of a percentage of rated valve flow.
  10. Position feedback output signal integrated into all proportional actuators.
  11. 100% authority with modulating below 1% regardless of flow settings.
  12. No cartridges requiring replacement or maintenance.
  13. Close ratings shall be 232 psi for all valve sizes.
  14. Basis of Design: Schneider Electric SmartX PICV, or approved equal.
- Q. Control Valve Actuators
1. ½” to ¾” Ball Valve Actuators
    - a. Size for torque required for valve close-off pressure for system design.
    - b. Coupling: Direct coupled to valve body without use of external devices/tools
    - c. Auxiliary End Switch (optional) to be SPST 24 Vac/Vdc, 101 mA to 5 mA maximum on selected two-position models.
    - d. Controller Signal Two-position, Floating or Proportional (0...5 Vdc, 0...10 Vdc, 5...10 Vdc, or 4...20 mA dc). Design allows for change via DIP switches without removal of cover.

- e. Manual operating lever and position indicator must be standard.
  - f. Power Requirements: 24 Vac for floating, proportional, and 110...230 Vac for two position multi-voltage types
  - g. Actuators must be available with either Spring Return (SR) or Non-Spring Return (NSR) models.
  - h. Operating Temperature Limit Floating is to be 32...140°F (0...60°C) Proportional 32...140°F (0...60°C) Two-Position 32...169°F (0...76°C)
  - i. Wiring (depending on model) Removable Terminal Block, 10 ft. (3.05 m) Plenum Cable, 18 in. (45 cm) Appliance Wire
  - j. Locations must be rated NEMA 2, IEC IP31. (Indoor Use Only.) Actuators with terminal block or plenum cable leads are plenum rated per UL file number E9429.
  - k. Agency Listings: ISO 9001, cULus, and CE.
  - l. Basis of Design: Schneider Electric VBB/VBS or approved equal.
2. ½” to 3” 2-way and ½” to 2” 3-way Ball Valves Actuators
- a. Size for torque required for valve close-off pressure for system design.
  - b. Actuators are to be available in spring return (SR) and non-spring return (NSR) models. Spring Return (SR) actuators are to provide a choice to return direction.
  - c. Actuators are to be available in models for two-position, floating and proportional control.
  - d. All actuator models are to be equipped with pigtail leads, manual override, and auxiliary switch(es)
  - e. Operating temperatures’ Floating Non-Spring Return (NSR) with 33 lb.-in. of torque must be -25 to 130 °F (-32 to 55°C). All other actuators are to -22 to 140 °F (-30 to 60 °C)
  - f. Actuators must be NEMA 2 rated.
  - g. Agency Listings: ISO 9001, cULus, and CE.
  - h. Basis of Design: Schneider Electric VB-2000, or approved equal.
3. ½” to 2” Bronze, Linear Globe Valve Actuators/67 or 78 lbs. force
- a. Actuator must have bi-color LED status indication for motion indication, auto calibration and alarm notification.
  - b. When the actuator is properly mounted must have a minimum of a NEMA 2 (IP53) rating.
  - c. Actuators are to be non-spring return.
  - d. Actuators are to be floating (used for two-position) or proportional models.
  - e. Proportional models will have optional models with a position output signal with field selectable 2...10 Vdc and 0...10 Vdc input signals and selectable input signal direct or reverse acting.
  - f. Actuator must have auto calibration which provides precise control by scaling the input signal to match the exact travel of the valve stem
  - g. Actuators must come in models with Pulse Width Modulated (PWM) with field selectable 0.59 to 2.93 sec and 0.1 to 25.5 sec input signal ranges with a position output signal
  - h. Actuators must have manual override with automatic release.
  - i. Models with position feedback output signal include field selectable 2...10 Vdc or 0...5 Vdc output signal
  - j. Removable wiring screw terminal with ½” conduit opening.
  - k. Actuator operating temperature ranges:
    - 1) When controlling fluid up to 266°F (130°C) = ambient air temperature is to be 23...131°F (-5...55°C)
    - 2) Fluid up to 281°F (138°C) = 23...127°F (-5...53°C)
    - 3) Fluid up to 340°F (171°C) = 23...115°F (-5...46°C)

- 4) Fluid up to 400°F (204°C) = 23...102°F (-5...39°C)
- l. Actuator agency Listings: cUL-us LISTED mark, NEMA 2, NEC class 2 FCC part-15 class B, Canadian ICES-003, ESA registered, Plenum rated per UL 20430
- m. Basis of Design: Schneider Electric MG350V, or approved equal.
4. ½” to 2” Bronze, Linear Globe Valve Actuators/105 lbs. force
  - a. Actuators must have Two- Position, Floating, and Proportional models.
  - b. Proportional models will a controller input signal of either a 0...10 Vdc, 2...10 Vdc, 4...20 mAdc, 0...3 Vdc, or 6...9 Vdc. Control function direct/reverse action is switch selectable on most models.
  - c. Actuator force is to be 105 lb. (467 newton) with ½” (13 mm) nominal linear stroke
  - d. Power requirements 24 Vac, 120 Vac or 230 Vac depending on model.
  - e. Actuator housings rated for up to NEMA 2/ IP54.
  - f. Actuator is to have overload protection throughout stroke.
  - g. Actuator Operating temperature -22...140°F (-30...60°C) up to a maximum valve fluid temperature of 366°F (186°C).
  - h. Actuator must automatically set input span to match valve travel.
  - i. Actuator must have manual override to allow positioning of valve and preload.
  - j. Actuator is to be spring return.
  - k. Actuator is to mount directly to valves without separate linkage.
  - l. Actuator agency Listings: UL 873, CUL: UL
  - m. Basis of Design: Schneider Electric SmartX Mx51-7103, or approved equal
5. ½” to 2” Bronze, Linear Globe Valve Actuators/220 lbs. force
  - a. Actuators must have Two- Position for a SPST controller, Floating for a SPST controller, and Proportional models will a controller input signal of either a 0...10 Vdc, 2...10 Vdc, 4...20 mAdc, or 6...9 Vdc. Control function direct/reverse action is jumper selectable
  - b. Actuator is to be spring return.
  - c. Actuator will have 220 lb. force (979 newton) with ½” (13 mm) or 1” (25 mm) nominal linear stroke
  - d. Feedback on proportional model with 2...10 Vdc (max. 0.5 mA) output signal or to operate up to four like additional slave actuators.
  - e. Actuator operating temperature is 0...140°F (-18...60°C) up to a maximum valve fluid temperature of 281°F (138°C), 0...120°F (-18...49°C) up to a maximum valve fluid temperature of 300°F (149°C), 0...100°F (-18...38°C) up to a maximum valve fluid temperature of 340°F (171°C), 0...90°F (-18...32°C) up to a maximum valve fluid temperature of 366°F (186°C).
  - f. Actuator must automatically set input span to match valve travel
  - g. Actuator is to have a 24 Vac power supply on Two-position and Proportional models and 120 Vac on Two-position models.
  - h. Actuator housings rated for up to NEMA 2/ IP54
  - i. Actuator must have manual override to allow positioning of valve and preload
  - j. Actuator is to mount directly to vales without separate linkage.
  - k. Actuator agency Listings: UL 873, CUL: UL
  - l. Basis of Design: Schneider Electric SmartX Mx51-720x, or approved equal.
6. ½” to 2” Bronze, Linear Globe Valve Actuators with linkage SR
  - a. Actuators with 35, 60, 133, or 150 lb.-in of force depending on model.
  - b. Actuator housings rated for up to NEMA 2/ IP54 with a 150 lb.-in. rated a NEMA 4.

- c. Actuators are to be spring return.
  - d. Actuators are to have Two-position, Floating and Proportional models.
  - e. Actuators must have overload protection throughout rotation.
  - f. Actuator have an optional built-in auxiliary switch to provide for interfacing or signaling on selected models.
  - g. Actuator agency listings: UL-873, C22-2 No.24-83, CUL0
  - h. Basis of Design: Schneider Electric SmartX, or approved equal.
7. ½” to 2” Bronze Body, Linear Globe Valve Actuators with linkage SR & NSR
- a. Actuators are to be either floating SPDT control or proportional control 0...10, 2...10 Vdc or 4...20 mA with a 500-ohm resistor included.
  - b. Actuators are to be direct/reverse with selectable DIP switches.
  - c. Actuators are to have 90 lb. (400N), 180 lb. (800N), or 337 lb. (1500N) of force on Non-Spring Return (NSR) 157 lb. of force on the Spring Return model. Note: Not every actuator is for every valve.
  - d. Actuators are to be powered with 24 Vac or 24 Vdc.
  - e. All Non-Spring Return (NSR) actuators are to be NEMA 2, vertical mount only. Spring Return (SR) actuators are to have NEMA 4 models.
  - f. Actuators must have manual override to allow positioning of the valve.
  - g. Actuators must have selectable valve sequencing and flow curves of either equal percentage or linear.
  - h. Actuators must have feedback.
  - i. Actuators must have internal torque protection throughout stroke.
  - j. Actuator operating temperature is 14...122°F (-10...50°C) for chilled water applications, 14...113°F (-10...45°C) up to a maximum valve fluid temperature of 281°F (138°C), 14...107°F (-10...42°C) up to a maximum valve fluid temperature of 300°F (149°C), 14...100°F (-10...38°C) up to a maximum valve fluid temperature of 340°F (171°C), 14...90°F (-10...32°C) up to a maximum valve fluid temperature of 366°F (186°C).
  - k. Actuator agency listings (North America) UL873, cULus, RCM, CE
  - l. Basis of Design: Schneider Electric Forta M400A-VB, M800A-VB, M900A and M1500x-VB screw mounted on Venta VB7000s, or approved equal.
8. 2 ½” to 6” Cast Iron Flanged Globe Valve Linear Actuators with linkage
- a. Actuators are to be either floating SPDT control or proportional control 0...10, 2...10 Vdc or 4...20 mA with a 500-ohm resistor included.
  - b. Actuators are to direct/reverse acting with selectable DIP switch.
  - c. Actuators are to have 180 lb. (800N) or 337 lb. (1500N) of force.
  - d. Actuators will need a 24 Vac or Vdc power supply.
  - e. Actuators are to be rated NEMA 2, vertical mount only.
  - f. Actuators must have manual override to allow positioning of the valve.
  - g. Actuators must have selectable valve sequencing and flow curves of either equal percentage to linear. A 2...10 Vac feedback.
  - h. Actuators must have Internal torque protection throughout stroke.
  - i. Actuator operating temperature is 14...122°F (-10...50°C) for chilled water applications, 14...113°F (-10...45°C) up to a maximum valve fluid temperature of 281°F (138°C), 14...107°F (-10...42°C) up to a maximum valve fluid temperature of 300°F (149°C).
  - j. Actuator agency listings (North America) UL873, cULus, RCM, CE
  - k. Basis of Design: Schneider Electric Forta M800A and M1500A or approved equal.

9. 2-½” to 6” Cast Iron Flanged Globe Valve Actuators/220 lbs. force.
  - a. Actuators must have Two- Position for a SPST controller, Floating for a SPST controller, and Proportional models will a controller input signal of either a 0...10 Vdc, 2...10 Vdc, 4...20 mAdc, or 6...9 Vdc. Control function direct/reverse action is jumper selectable.
  - b. Actuator is to be spring return.
  - c. Actuator will have 220 lb. force (979 newton) with ½” (13 mm) or 1” (25 mm) nominal linear stroke.
  - d. Feedback on proportional model with 2...10 Vdc (max. 0.5 mA) output signal or to operate up to four like additional slave actuators.
  - e. Actuator must automatically set input span to match valve travel.
  - f. Actuator Operating temperature 0...140°F (-18...60°C) up to a maximum valve fluid temperature of 300°F (149°C).
  - g. Actuator is to have a 24 Vac power supply on Two-position and Proportional models and 120 Vac on Two-position models.
  - h. Actuator housings rated for up to NEMA 2/IP54.
  - i. Actuator must have manual override to allow positioning of valve and preload.
  - j. Actuator is to mount directly to vales without separate linkage.
  - k. Actuator agency Listings: UL 873, CUL: UL.
  - l. Basis of Design: Schneider Electric SmartX Mx61-720x, or approved equal.
10. 2-½” to 6” Cast Iron Flanged Globe Valve Actuators with linkage SR.
  - a. Actuators with 60, 133, or 150 lb.-in of force depending on model.
  - b. Actuator housings rated for up to NEMA 2/ IP54 with a 150 lb.-in. rated a NEMA 4.
  - c. Actuators are to be spring return.
  - d. Actuators are to have Two-position, Floating and Proportional models.
  - e. Actuators must have overload protection throughout rotation.
  - f. Actuator have an optional built-in auxiliary switch to provide for interfacing or signaling on selected models.
  - g. Actuator agency listings: UL-873, C22-2 No.24-83, CUL0.
  - h. Basis of Design: Schneider Electric SmartX, or approved equal.
11. 2” to 18” 2-Way and 2” to 16” 3-Way Linear Butterfly Valve Actuator with linkage NSR
  - a. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0...10 Vdc or 4...20 mA models. All Actuators are to be NEMA 4, manual override (hand wheel), two auxiliary switches, and built-in heater.
  - b. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
  - c. Actuators must be available in 24 Vac and 120 Vac models.
  - d. Actuators must have Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
  - e. Proportional models must have feedback of 0...10 Vdc or 4...20 mA.
  - f. Actuator operating temperature shall be -40...150°F (-40...60°C).
  - g. Actuator agency listings (North America) UL, CSA and CE
  - h. Basis of Design: Schneider Electric S70, or approved equal.

12. 2" to 4" 2-Way and 3-Way Butterfly Valve Actuators SR
    - a. The butterfly valve actuators are to be Spring Return (SR) two-position and proportional taking 2...10 Vdc or 4...20 mA models. All Actuators are to be NEMA 2.
    - b. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
    - c. Actuators must be available in 24 Vac models.
    - d. Actuators shall have two SPDT auxiliary switch models.
    - e. Actuators must have [Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
    - f. Proportional models must have feedback of 2...10 Vdc or 4...20 mA.
    - g. Actuator operating temperature shall be -22...140°F (-12...60°C).
    - h. Actuator agency listings (North America) UL, CSA and CE
    - i. Basis of Design: Schneider Electric SmartX Mx-41-7153 or approved equal.
  13. 2" to 6" 2-Way and 3-Way Butterfly Valve Actuators NSR
    - a. The butterfly valve actuators are to be Non-Spring Return (NSR) two-position and proportional taking 0...10 Vdc or 4...20 mA models. All Actuators are to be NEMA 2.
    - b. Actuator close-offs and CVs must be appropriate for the valve size in a typical HVAC application.
    - c. Actuators must be available in 24 Vac models.
    - d. Actuators shall have two SPDT auxiliary switch models.
    - e. Actuators must have [Internal wiring isolation for parallel wiring multiple units that eliminates the risk of feedback from one actuator to another.
    - f. Proportional models must have feedback of 2...10 Vdc or 4...20 mA.
    - g. Actuator operating temperature shall be -4...122°F (-2...50°C).
    - h. Actuator agency listings (North America) UL, CSA and CE
    - i. Basis of Design: Schneider Electric SmartX NR-22xx-5xx or approved equal.
- R. Dampers
1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS system supplier. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
  2. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
  3. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
  4. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
  5. Control and smoke dampers shall be Ruskin or approved equal.
  6. Provide opposed blade dampers for modulating applications and parallel blade for two position control.
- S. Damper Actuators
1. Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque.
  2. Direct-coupled damper actuators must have a five-year warrantee.
  3. Size for torque required for damper seal at maximum design conditions and valve close-off pressure for system design.

4. Direct-coupled damper actuators should accommodate 3/8", 1/2" 1.05" round or 3/8"...1/2" and 3/4" square damper shafts.
5. Actuator operating temperature minimum requirements: 44, 88 and 133 lb.-in. are -25°F...130°F (-32°C...55°C). The 30, 35, 60, 150 and 300 lb.-in. are -25°...140°F (-30°C... 60 °C). The 270 are -22°...122°F (-30°C... 50 °C).
6. Overload protected electronically throughout rotation except for selected Floating actuators the have a mechanical clutch.
7. Spring Return Actuators: Mechanical fail safe shall incorporate a spring-return mechanism.
8. Non-Spring Return Actuators shall stay in the position last commanded by the controller with an external manual gear release to allow positioning when not powered.
9. Power Requirements: 24Vac/dc [120Vac][230Vac]
10. Proportional Actuators controller input range from 0...10 Vdc, 2...10 Vdc or 4...20 mA models.
11. Housing: Minimum requirement NEMA type 2 with NEMA type 4 available for applications requiring higher ratings.
12. Actuators with a microprocessor should not be able to be modified by an outside source (cracked or hacked).
13. Actuators of 133 and 270 lb.-in. of torque or more should be able to be tandem mount or "gang" mount.
14. Agency Listings: ISO 9001, cULus, CE and CSA
15. Basis of Design: Schneider Electric SmartX Actuators or approved equal.

T. Smoke Detectors

1. Air duct smoke detectors shall be by Air Products & Controls or approved equal. The detectors shall operate at air velocities from 300 feet per minute to 4000 feet per minute.
2. The smoke detector shall utilize a photoelectric detector head.
3. The housing shall permit mechanical installation without removal of the detector cover.
4. The detectors shall be listed by Underwriters Laboratories and meet the requirements of UL 268A.

U. Airflow Measuring Stations

1. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.
2. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

## 2.8 ELECTRICAL POWER MEASUREMENT

A. Electrical Power Monitors, Single Point (Easy Install)

1. Acceptable Manufacturer: Schneider Electric, Veris Industries.
2. General: Consist of three split-core CTs, factory calibrated as a system, hinged at both axes with the electronics embedded inside the master CT. The transducer shall measure true (rms.RMS) power demand real power (kW) consumption (kWh). Conform to ANSI C12.1 metering accuracy standards.
3. Voltage Input: Load capacity as shown on drawings. 208-480 VAC, 60 Hz
4. Maximum Current Input: Up to 2400A
5. Performance:
  - a. Accuracy: +/- 1% system from 10% to 100% of the rated current of the CT's
  - b. Operating Temperature Range: 32-140°F, 122°F for 2400A.
6. Output: 4 to 20 mA, Pulse. or Modbus RTU



7. Ratings:
    - a. Agency: UL508 or equivalent
    - b. Transducer internally isolated to 2000 VAC.
    - c. Case isolation shall be 600 VAC.
  8. Basis of Design: Similar to Enercept H80xx Series, E23 Series
  9. Accessories: Current transducers (CTs): split-core (E681/H681/U004) series, solid-core (E682/U004 series) and Rogowski Coils – rope style (E683 series); Communications gateways: Modbus to Ethernet (EGX150)
- B. Electrical Power Monitors, Single Point (High Accuracy)
1. Acceptable Manufacturer: Schneider Electric, Veris Industries.
  2. General: Revenue grade meter. Measures voltage, amperage, real power (kW), consumption (kWh), and reactive power (kVARar), and power factor (PF) per phase and total load for a single load. Factory calibrated as a system using split core CT's. Neutral voltage connection is required.
  3. Voltage Input: 208-480 VAC, 60 Hz
  4. Current Input: Up to 2400A
  5. Performance:
    - a. Accuracy: +/- 1% system from 2% to 100% of the rated current of the CT's
    - b. Operating Temperature Range: 32-122°F
  6. Output: Pulse, BACnet, Modbus RTU
  7. Display: Backlit LCD
  8. Enclosure: NEMA 1
  9. Agency Rating: UL508 or equivalent
  10. Basis of Design: Veris Industries H81xx00 series.
  11. Accessories: Current transducers (CTs): split-core (E681/H681/U004) series, solid-core (E682/U004 series)
- C. Electrical Power Monitors, Single Point (High Accuracy/Versatility)
1. Acceptable Manufacturer: Schneider Electric, Veris Industries.
  2. General: Revenue grade meter. Measures voltage, amperage, real power (kW), consumption (kWh), reactive power (kVAR), apparent power (kVA) and power factor (PF) per phase and total load for a single load. Available with data logging , Bi-directional (4-quadrant) metering, and pulse contact accumulator inputs.
  3. Voltage Input: 90-600 VAC, 50/60 Hz, 125-300 VDC
  4. Current Input: 5A – 32,000A, selectable 1/3V or 1V CT inputs
  5. Performance:
    - a. Accuracy shall be +/- [0.2%][0.5%] revenue grade
    - b. Operating Temperature Range: -22-158°F
  6. Output shall be [Pulse][BACnet][Modbus RTU][LON][Modbus TCP][BACnet/IP][Modbus RTU/TCP][SNMP]
  7. Display: Backlit LCD
  8. Enclosure: NEMA 4x optional
  9. Agency Rating: UL508, ANSI C12.20
  10. Basis of Design: Veris E50 series, Veris E60 Series or Schneider Electric PM5000 Series
  11. Accessories: Current transducers (CTs): split-core (E681/H681/U004) series, solid-core (E682/U004 series) and Rogowski Coils – rope style (E683 series)

- D. Electrical Power Monitors, Multiple Point (92 loads, High Accuracy)
  - 1. Acceptable Manufacturer: Schneider Electric, Veris Industries.
  - 2. General: Revenue grade meter. Measures volts, amps, power and energy for each circuit. 1/4 amp to 200 amp monitoring. 4 configurable alarm threshold registers
  - 3. Voltage Input: 90-277 VAC, 60 Hz
  - 4. Current Input: 5A – 32,000A, 1/3V CT inputs
  - 5. Performance:
    - a. Accuracy: +/- 0.5% meter (split core), +/- 1% system from 1/4-100A (solid core)
    - b. Operating Temperature Range: 32-140°F
  - 6. Output: [BACnet] [Modbus RTU] [ModbusTCP] [BACnet/IP] [Modbus RTU/TCP] [SNMP]
  - 7. Agency Rating: UL508, ANSI C12.10, IEC Class 1
  - 8. Basis of Design: Veris E3xxx series.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section 23 00 00 and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.
- G. Demolition
  - 1. Remove controls which do not remain as part of the building automation system, all associated abandoned wiring and conduit, and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by the Contractor.
- H. Access to Site
  - 1. Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's Representative.
- I. Code Compliance
  - 1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

J. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

**3.2 SYSTEM ACCEPTANCE TESTING**

- A. All application software will be verified and compared against the sequences of operation.
- B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
- C. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.
- D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
- E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

**3.3 INSTALLATION**

- A. Hardware Installation Practices for Wiring
  1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
  2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
  3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
  4. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
  5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
  6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
  7. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
  8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
  9. Wire will not be allowed to run across telephone equipment areas.
  10. Provide fire caulking at all rated penetrations.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.

C. Wiring, Conduit, and Cable

1. All wire will be copper and meet the minimum wire size and insulation class listed below:
  - a. Power - 12 Gauge - 600 Volt
  - b. Class One - 14 Gauge Std. - 600 Volt
  - c. Class Two - 18 Gauge Std. - 300 Volt
  - d. Class Three - 18 Gauge Std. - 300 Volt
  - e. Communications - Per Mfr.
2. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
3. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
4. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
5. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be used in exterior locations and interior locations subject to moisture.
6. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
7. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.
8. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.
9. Only glass fiber is acceptable, no plastic.
10. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS system supplier shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

D. Enclosures

1. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

E. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
5. All I/O field devices inside FIP's shall be labeled.

F. Existing Controls.

1. Existing controls which are to be reused must each be tested and calibrated for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

G. Location

1. The location of sensors is per mechanical and architectural drawings.
2. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
3. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
4. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

H. Software Installation

1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

### 3.4 SEQUENCES OF OPERATION

#### A. VRF System Ductless Split (serving Ceiling Cassette & Ducted Fancoil Units)

##### 1. Point List

- a. Space Temperature
- b. Occupied/Unoccupied
- b. VRF Space Temperature Setpoint
- d. VRF Indoor Mode (Heating/Cooling)
- e. VRF Indoor Unit fan speed
- e. Energy Recovery Unit Status (if applicable)
- f. Baseboard Fin Tube/Convactor/Cabinet Heater Control Valve Status (if applicable)
- g. VRF Outdoor Unit Mode/Status

(Provide all required hardware and software to interface the BMS with the VRF system and baseboard fintube. Provide third party space thermostat and LG (or equal) dry contact (LG #PDRYCB320 for thermostat interface.)

##### 2. Sequence of Operation

- a. Unoccupied Mode: Cooling shall not operate. Baseboard radiation/convactor/cabinet heater (if applicable) shall operate as Stage 1 heating. Room cassette VRF heat pump and heat recovery heating shall operate as stage 2 as required to satisfy space temperature setback setpoint.
- b. Occupied Mode: Heating or cooling shall operate as required based upon the thermostat setpoint. In heating mode, baseboard radiation/convactor/cabinet heater shall operate as Stage 1 heating. Room cassette VRF heat pump and heat recovery heating shall operate as Stage 2 as required to maintain space thermostat setpoint. In cooling mode, room cassette VRF cooling shall operate as required to maintain space thermostat setpoint (72°F adjustable). Heat recovery mode shall operate, providing heating or cooling as required. Unoccupied/Occupied scheduling will be via BMS.
- c. The ducted fan coil units shall start and run in the occupied mode, and the outdoor air intake dampers shall open fully.
- d. Alarms: In this mode:
  - Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
  - Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

#### B. Rooftop Ventilation/Energy Recovery Unit (Gymnasium)

##### 1. Point List

- a. Supply Fan VFD (Speed and Status)
- b. Exhaust Fan VFD (Speed and Status)
- c. Energy Recovery Wheel VFD (Speed and Status)
- d. Space Temperature
- e. Space Temperature Setpoint(s)
- f. OA, EA Temperatures
- g. Heating Coil Valve(s) Modulation (Remote)
- h. OA, EA Damper Modulation

- i. Freeze-stat
  - j. Discharge Temperature
  - k. DX Cooling Start/Stop/Status (future cooling)
  - l. Occupied/Unoccupied
  - m. CO2 Sensor Status
2. Sequence of Operation
- a. Unoccupied: In this mode:  
Supply and Exhaust fans off, OA and EA dampers closed. If the respective unoccupied space temperature is not maintained by the baseboard radiation or VRF units, the rooftop ventilation unit shall cycle on. The heating coil valve shall modulate to satisfy the space heating setpoint. Upon satisfaction, the rooftop unit shall stop until the next cycle, if required.
  - b. Occupied: The OA and EA dampers will open
    - Supply fan will start and ramp up slowly to its' preset speed via VFD. The return fan will follow and track the supply fan as needed.
    - Perimeter Radiation Valves will be the first stage of heating and open as needed to maintain the space temperature setpoint (adj.).
    - Hot water coil valve will modulate as stage two as needed to maintain occupied heating setpoint (adjustable).
    - An adjustable dead band offset will prevent short cycling.
    - Note: the energy recovery wheel will be on when the unit is on and rotate as needed to maintain exhaust air temperature. Energy wheel freeze protection is integral to the unit.
    - Minimum outdoor air shall be as scheduled on drawings.
    - Unoccupied/Occupied scheduling will be via BMS.
  - c. Economizer - In this mode:
    - If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
    - If the outside air temperature is less than the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel shall stop.
  - d. Alarms: In this mode:
    - The freezestat mounted after the hot water coil will protect the coils from freezing. Should the freezestat go into alarm the supply and return fans will shut off. The OA and EF, dampers will be closed. The OA and EA bypass dampers will be closed. The RA damper shall be open. The hot water coil valve will be open. An alarm will be generated at the operators work station. Note: The freezestat will be able to be reset from the operator's workstation.
    - Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
    - Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.
  - d. Ventilation Control:
    - Outdoor air ventilation shall be controlled by carbon dioxide sensors. Ventilation rate shall vary from minimum cfm to maximum cfm at full occupancy of people.

- e. Demand Control Ventilation:
  - Ventilation method shall be by demand controls. There shall be no provision to remove CO2 by any other method other than dilution. Prior to space occupancy, a pre-occupancy purge cycle shall be initiated for a minimum 30 minutes. Fan shall start and run and the outdoor air intake rate shall ramp up to 100 percent of unit capacity. Upon conclusion of space occupancy, a post occupancy flush cycle shall occur. The fan shall run and the outdoor air intake rate shall ramp up to 100 percent of the unit capacity until indoor CO2 concentrations in the space are reduced to outdoor air levels. Upon such occurrence, the fan shall shutdown. During occupancy, the outdoor air damper shall start to modulate open beyond the minimum setpoint, starting at an interior CO2 concentration of not greater than 100 PPM over that of the outdoor air concentration. The outdoor air damper shall be open for full occupancy when CO2 concentrations reach the upper limit of 200 PPM over that of the outdoor air. The economizer system shall override the CO2 control system when conditions permit free cooling of the space.

C. Cabinet Heaters/Unit Heaters

- 1. Point List
  - a. Space Temperature
  - b. Valve Modulation
  - c. Fan Start/Stop
- 2. Sequence of Operation
  - a. Unoccupied Mode (Heating Season): Modulate heating control valve to maintain night setback temperature set-point (adjustable).
  - b. Occupied Mode (Heating Season): Modulate heating control valve to maintain occupied temperature set-point (adjustable). Fan shall not operate if hot water above 150 degrees F is not available. For corridors (excluding those located near exterior doors), the VRF system shall be the first stage of heating and the cabinet heater shall be stage two heating.

A. Exhaust Fans

- 1. Point List
  - a. Fans Start/Stop
  - b. Fans Status
  - c. Occupied/Unoccupied
- 2. Sequence of Operation
  - a. Unoccupied Mode: Fans Off, Dampers Closed.
  - b. Occupied Mode: Fans On, Dampers Open.
  - d. Alarms generated at operator's workstation: Exhaust Fan Status.

E. Outdoor Energy Recovery Units

- 1. Point List
  - a. Supply Fan Status
  - b. Exhaust Fan Status



- c. OA, EA, Air Temperatures
  - d. OA, EA, Damper
  - e. Discharge Temperature
  - f. Occupied/Unoccupied
2. Sequence of Operation
- a. Unoccupied - In this mode:  
Supply and Exhaust fans off, OA and EA dampers closed. If additional heat is required, the respective energy recovery unit shall start and run to maintain the night setback temperature (60°F). The respective hot water coil control valve shall modulate as required.
  - b. Occupied - In this mode:
    - The OA and EA dampers will open and thru a hard wired interlock the Supply and Exhaust fans will start.
    - Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
    - The hot water coil control valve shall modulate as required to maintain occupied heating discharge setpoint (72°F adjustable) as sensed by the duct discharge temperature sensor.
    - An adjustable dead band offset will prevent short cycling.
    - In cooling mode, the respective condensing unit (if applicable) shall vary its capacity as required to maintain occupied cooling discharge setpoint (72° adjustable) as sensed by the duct discharge sensor.
    - Unoccupied/Occupied scheduling will be via BMS.
  - c. Economizer - In this mode:
    - If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
    - If the outside air temperature is less than the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel shall stop.
- F. Hot Water Heating Pumps (HWP-1 & 2)
1. Point List
    - a. Pump Start/Stop
    - b. Pump Status
  2. Sequence of Operation
    - a. Occupied Mode: Pump HWP-1 or HWP-2 shall start when the outdoor air temperature drops below 60 ° F. (adjustable).
    - b. Unoccupied Mode: Pump HWP-1 or HWP-2 shall start when the outdoor air temperature drops below 40 ° F. (adjustable).
    - c. Lead / Lag: When the system calls for heat, the lead pump shall start, if the pump current sensor does not sense proper current within 4 minutes, the lead pump shall shutdown and the lag pump shall become lead and an alarm shall be generated at the OWS.
    - d. Pump speed shall modulate through the respective VFD as required to satisfy the system differential pressure control sensor.

G. Boiler Room Ventilation

1. Whenever the boilers or domestic water heater operate, the room ventilation damper shall open and the combustion air fan shall start and run.

H. Hot Water Heating Pumps (HWP-3 & 4)

1. Point List
  - a. Pump Start/Stop
  - b. Pump Status
2. Sequence of Operation
  - a. Boiler Run Mode: Pump HWP-3 or HWP-4 shall start when the respective boiler runs.

I. Two-Way Mixing Valve (HW Coils)

1. Point List
  - a. HWS Temperature
  - b. HWR Temperature
  - c. HW Mixed Temperature
  - d. Valve Modulation
2. Sequence of Operation:

The respective two-way control valve will modulate through the DDC system to modulate the hot water supply to satisfy low limit and room temperature setpoints.

  - a. Provide a point-to-point wiring diagram.

J. Indoor Energy Recovery Unit (Cafeteria)

1. Point List
  - a. Supply Fan Status
  - b. Exhaust Fan Status
  - c. OA, EA, Air Temperatures
  - d. OA, EA, Damper
  - e. Discharge Temperature
  - f. Occupied/Unoccupied
  - g. CO2 Sensor Status
2. Sequence of Operation
  - a. Unoccupied - In this mode:

Supply and Exhaust fans off, OA and EA dampers closed. The baseboard fin-tube heat shall operate as stage 1 to satisfy the night setback setpoint. If additional heat is required, the energy recovery unit shall start and run to maintain the night setback temperature (60°F). The hot water coil control valve shall modulate as required.

b. Occupied - In this mode:

- The OA and EA dampers will open and through a hard wired interlock The Supply and Exhaust fans will start.
- Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
- The hot water coil control valve shall modulate as required to maintain occupied heating discharge setpoint (72°F adjustable) as sensed by the duct discharge temperature sensor. In heating mode, the VRF heat pump condensing unit shall vary its capacity as required to maintain occupied D/X duct coil heating discharge setpoint (72°adjustable) as sensed by the duct discharge sensor. The hot water coil shall be stage 1, and the VRF system shall be stage 2, if required.
- An adjustable dead band offset will prevent short cycling.
- In cooling mode, the VRF heat pump condensing unit shall vary its capacity as required to maintain occupied D/X duct coil cooling discharge setpoint (72°adjustable) as sensed by the duct discharge sensor.
- Unoccupied/Occupied scheduling will be via BMS.

c. Economizer - In this mode:

- If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
- If the outside air temperature is less than the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel shall stop.

d. Alarms: In this mode:

- The freeze-stat mounted after the hot water coil will protect the coils from freezing. Should the freeze-stat go into alarm the supply and return fans will shut off. The OA and EF, dampers will be closed. The OA and EA bypass dampers will be closed. The RA damper shall be open. The hot water coil valve will be open. An alarm will be generated at the operators work station. Note: The freeze-stat will be able to be reset from the operator's workstation.
- Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
- Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

e. Ventilation Control:

- Outdoor air ventilation shall be controlled by carbon dioxide sensors. Ventilation rate shall vary from minimum cfm to maximum cfm at full occupancy of people.

f. Demand Control Ventilation:

- Ventilation method shall be by demand controls. There shall be no provision to remove CO2 by any other method other than dilution. Prior to space occupancy, a pre-occupancy purge cycle shall be initiated for a minimum 30 minutes. Fan shall start and run and the outdoor air intake rate shall ramp up to 100 percent of unit capacity. Upon conclusion of space occupancy, a post occupancy flush cycle shall occur. The fan shall run and the outdoor air intake rate shall ramp up to 100 percent of the unit capacity until indoor CO2 concentrations in the space are

reduced to outdoor air levels. Upon such occurrence, the fan shall shutdown. During occupancy, the outdoor air damper shall start to modulate open beyond the minimum setpoint, starting at an interior CO2 concentration of not greater than 100 PPM over that of the outdoor air concentration. The outdoor air damper shall be open for full occupancy when CO2 concentrations reach the upper limit of 200 PPM over that of the outdoor air. The economizer system shall override the CO2 control system when conditions permit free cooling of the space.

K. Boiler with Associated Pumps and Appurtenances (B-1, 2)

1. Point List

- a. Outdoor Air Temperature
- b. Outdoor Relative Humidity
- c. HW Supply Header Temperature
- d. HW Return Header Temperature
- e. HW Pump HWP-1, 2, 3, 4 Start/Stop
- g. HW Flow Status
- h. Boiler Start/Stop
- i. Boiler Auto Signal
- j. Boiler Trouble Signal
- k. Boiler No.1 Supply Temperature
- l. Boiler No.1 Return Temperature
- m. Boiler No.2 Supply Temperature
- n. Boiler No.2 Return Temperature

2. Sequence of Operation

- a. Boilers will be optimized on for occupied schedule when outside air temperature is below 60 degrees (adjustable) and average room temperature is below 70 degrees (adjustable). Boilers will be off during unoccupied schedule unless outside air temperature drops below 38 degrees (adjustable). Whenever outside air is below 38 degrees, boilers will sequence on to maintain desired water temperature in the main header.
- b. The boiler start/stop and firing rate will be controlled by the stand-alone direct digital controller mounted in the new hot water system programmable local control panel. Boiler monitoring and alarming will be done at the central panel touch screen. The boiler and boiler pumps shall operate to schedule the hot water supply through an outside air sensor.
- c. Boiler Lead-Lag shall be optimized so that the Boiler(s) have equal run time.

L. VRF System Split, (serving energy recovery air handler ERU-6 duct coil)

1. Point List

- a. Space Temperature
- b. Occupied/Unoccupied
- b. Discharge Temperature Setpoint
- c. Discharge Air Temperature
- c. Return Air Temperature
- d. Mode (Heating/Cooling)
- e. Energy Recovery Unit Status
- f. VRF Outdoor Unit Mode/Status
- g. AHU Communication Kit

(Provide all required hardware and software to interface the BMS with the VRF system. Provide electronic expansion valve kit and AHU/EEV communication control kit)

2. Sequence of Operation
    - a. Unoccupied Mode: Ventilation unit shall not normally operate, therefore the VRF outdoor unit shall not operate.
    - b. Occupied Mode: VRF heating or cooling shall operate as required based upon the discharge air thermostat setpoint (72°F adjustable).
- M. Space Temperature Setpoints
1. Heating mode
    - a. Occupied temperature setpoint shall be maximum 72 degrees F.
    - b. Unoccupied temperature setpoint shall be minimum 55 degrees F.
  2. Cooling mode
    - a. Occupied temperature setpoint shall be minimum 78 degrees F.
    - b. Unoccupied temperature setpoint shall be maximum 85 degrees F.
- N. Packaged Rooftop /Energy Recovery Unit (Library)
1. Point List
    - a. Supply Fan VFD (Speed and Status)
    - b. Exhaust Fan VFD (Speed and Status)
    - c. Energy Recovery Wheel VFD (Speed and Status)
    - d. Space Temperature
    - e. Space Temperature Setpoint(s)
    - f. OA, EA Temperatures
    - g. Heating Coil Valve Modulation (Remote)
    - h. OA, EA Damper Modulation
    - i. Freeze-stat
    - j. Discharge Temperature
    - k. DX heat pump Heating/Cooling Start/Stop/Status
  2. Sequence of Operation
    - a. Unoccupied: In this mode:  
Supply and Exhaust fans off, OA and EA dampers closed. If the respective unoccupied space temperature is not maintained by the baseboard radiation or VRF units, the rooftop unit shall cycle on. The heating coil valve shall modulate to satisfy the space heating setpoint. Upon satisfaction, the rooftop unit shall stop until the next cycle, if required.
    - b. Occupied: The OA and EA dampers will open
      - Supply fan will start and ramp up slowly to its' preset speed via VFD. The return fan will follow and track the supply fan as needed.
      - Direct expansion heating/cooling system shall operate as needed to maintain occupied heating/cooling setpoint (adjustable).
      - Hot water coil valve will modulate as needed to maintain occupied heating setpoint (adjustable). The hot water coil shall be stage 1, and the VRF heat pump system shall be stage 2
      - An adjustable dead band offset will prevent short cycling.
      - Note: the energy recovery wheel will be on when the unit is on and rotate as needed to maintain exhaust air temperature. Energy wheel freeze protection is integral to the unit.

- Minimum outdoor air shall be as scheduled on drawings.
- c. Alarms: In this mode:
- The freezestat mounted after the hot water coil will protect the coils from freezing. Should the freezestat go into alarm the supply and return fans will shut off. The OA and EF, dampers will be closed. The OA and EA bypass dampers will be closed. The RA damper shall be open. The hot water coil valve will be open. An alarm will be generated at the operators work station. Note: The freezestat will be able to be reset from the operator's workstation.
  - Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
  - Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.
- d. Economizer - In this mode:
- Differential dry-bulb temperature control.
  - If the outside air dry-bulb temperature is greater than the return air dry-bulb temperature, the system will operate as described in the occupied mode.
  - If the outside air dry-bulb temperature is less than the return air dry-bulb temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), free cooling shall be utilized to satisfy the space loads. The ERU heat transfer wheel shall stop. Unit shall operate according to its own packaged controls to control the outdoor air/mixed air dampers when outdoor conditions are favorable for economizer operation. The outdoor air dampers shall modulate from their minimum position to maintain the discharge air required until the space temperature is reached. Space pressurization shall be maintained through the unit barometric relief system.
- O. Fin-Tube Radiation, Convectors
1. Point List
    - a. Space Temperature
    - b. Valve Modulation
  2. Sequence of Operation
    - a. Unoccupied Mode (Heating Season): Modulate control valve to maintain night setback temperature set-point (adjustable).
    - b. Occupied Mode (Heating Season): Modulate control valve to maintain daytime temperature set-point (adjustable).
- P. Make-up Air Unit (Kitchen)
1. Point List
    - a. Space Temperature
    - b. Discharge Air Temperature
    - c. Fan Start/Stop
    - d. Occupied/Unoccupied
    - e. Hot Water Coil Valve Modulation
    - f. Fan Status
    - g. Filter dirty
    - h. Kitchen exhaust fan status

- i. Supply Fan VFD Status
2. Sequence of Operation
    - a. Unoccupied Mode: Supply fan off, Kitchen exhaust fan off.
    - b. Occupied Mode: Supply fan starts, Kitchen hood exhaust fan starts. Hot water control valve shall modulate to maintain discharge temperature/space temperature set-point (adjustable). The Kitchen exhaust hood fan shall be interlocked with the make-up air unit MA-1. Make-up air unit fan speed shall ramp up to match exhaust rate of main exhaust hood fan. The appropriate fan RPM shall be set based upon air balance measurements. Unoccupied/Occupied scheduling will be via BMS.
    - c. All adjustments and alarm will be at remote touch screen display controller. The room sensor will reset discharge air sensor to maintain room temperature. It is this Contractor's responsibility to coordinate all packaged unit controls with field installed controls and provide a point-to-point wiring diagram.

### **3.5 CONTROL DIAGRAMS**

- A. Complete new control diagrams showing type of apparatus, cycles of operation and details of all equipment must be submitted for checking and be approved before installation is started.
- B. Submit three (3) preliminary copies of the control diagrams, sequence descriptions, and equipment shop drawings for checking and submit six (6) copies, complete for final approval.
- C. At the completion of installation, control manufacturer shall furnish non-fading original; plastic laminated copies of all control diagrams as they apply to the particular instruments thereon. One complete set of non-fading plastic laminated diagrams shall be mounted on wall as directed.

### **3.6 CERTIFICATION**

- A. After completion of installation and after equipment has been placed on operation, the temperature control manufacturer shall submit in writing, a complete and detailed report and certification that the entire installation is operating exactly as specified and shall be guaranteed for one year. Report shall state temperature and throttling range readings and settings of all control instruments. Submit to the Engineer preliminary for checking and approval.

### **3.7 INSTALLATION**

- A. All work under the automatic temperature control Sub-Contract shall be done by competent skilled mechanics regularly in the employ of the temperature control manufacturer.
- B. Bidder must be a control manufacturer currently involved in the production of commercial pneumatic/electric temperature controls. Franchises and associations are not considered control manufacturers.

### **3.8 TRAINING**

- A. The Contractor shall supply personnel to train key customer personnel in the operation and maintenance of the installed system. The training program shall be designed to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistance. On-line context sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.
- B. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.

1. Training time shall not be less than a total of 40 hours, and shall consist of:
  - a. 16 hours during normal day shift periods for system operators. Specific schedules shall be established at the convenience of the customer.
  - b. 24 hours of system training shall be provided to customer supervisory personnel so that they are familiar with system operation.
  - c. The specified training schedule shall be coordinated with the customer and will follow the training outline submitted by the Contractor as part of the submittal process.
  - d. Provide an as built Video training tape, showing and explaining all animated graphics in detail, all controllers and equipment the FMS operates (Four (4) Copies shall be supplied).
  - e. If further training is needed, the Contractor shall provide another 40 hours at no extra cost.
2. All training sessions shall be scheduled by the Construction Manager. The Contractor shall provide sign-in sheets and distribute minutes of each session prior to the subsequent session. This documentation shall be included in the Operation and Maintenance manuals.

**END OF SECTION**



**SECTION 23 0470**

**TESTING, START-UP AND ADJUSTMENTS**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 TESTING, START-UP AND ADJUSTMENTS**

- A. Furnish all materials, supplies, labor and power required for testing. Make preliminary tests and prove work satisfactory. Notify Architect and all authorities having jurisdiction in ample time to be present for final testing of all piping. Test before insulating or concealing any piping. Repair defects disclosed by tests, or if required by Architect, replace defective work with new work without additional cost to Owner. Make tests in stages if so ordered by Architect to facilitate work of others. Use of wicking in tightening leaking joints not permitted.
- B. HVAC Contractor is responsible for work or other trades disturbed or damaged by tests and/or repair and replacement of his work and shall cause work so disturbed or damaged to be restored to its original condition at his own expense.
- C. Unless otherwise specified, all piping systems shall be hydrostatically tested to 150 psig. Tests shall be of four (4) hour duration during which time piping shall show no leaks and during time no sealing of leaks will be permitted.
- D. HVAC Contractor shall balance out system and submit test reports showing operating data to include the following:
  - 1. C.F.M. of all air handling equipment.
  - 2. C.F.M. at each air outlet.
  - 3. G.P.M. for equipment.
  - 4. R.P.M. for each fan and fan motor.
  - 5. Motor power consumption.
  - 6. Air temperature readings before and after coils.
  - 7. Water temperature readings in and out of coils and through equipment.
  - 8. Pressure gauge readings before and out of all pertinent equipment.
- E. HVAC Contractor shall furnish services of qualified personnel, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This shall include adjustment/replacement of sheaves/impellers to achieve design performance. Adjustments shall be made including balancing of water and air systems in cooperation with qualified representatives of mechanical equipment manufacturers and temperature control manufacturer. This shall include any required adjustment/replacement of sheaves, belts, impellers, etc. to achieve design performance. Architect/Engineer is to be notified when this balancing is to be performed.

- F. Functional testing and system commissioning shall focus on key areas. Balancing of air and water flow rates in HVAC systems must meet requirements. Systems must be tested for functionality which includes installation, component operation and system to system interfacing. HVAC controls must be commissioned for proper calibration and operation in accordance with approved plans. Air economizers shall be tested to meet manufacturer's specifications. Comply with all requirements of the Energy Conservation Construction Code of New York State.
- G. When all work is in an acceptable operating condition, furnish operating and maintenance manuals as specified in General Requirements.
- H. All HVAC equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces.
- I. Contractor shall include in his Bid, adjustment of air quantity below scheduled C.F.M. for air systems deemed "noisy" by Owner subsequent to initial balancing.
- J. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.
- K. Final inspection and approval shall be made only after proper completion of all of above requirements.
- L. If the performance of the systems does not conform to the design parameters the Contractor shall return to the site until the systems perform as designed.

**END OF SECTION**

**SECTION 23 0480**

**GENERAL LABELING, VALVE CHARTS AND PIPING IDENTIFICATION**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 GENERAL LABELING AND VALVE CHARTS**

- A. This Contractor shall have appropriate descriptive labels, identification tags and nameplates of equipment, valves, etc. furnished and installed under this Contract and shall be properly placed and permanently secured to (or adjacent to) the item being installed. All such labels, identifications, tags, nameplates, etc. shall be selected by the Architect/Engineer.
- B. In general, labels shall be the lamacoid type of sufficient size to permit easy identification, black coated, white edged, with letters 3/16" high. Major equipment, apparatus, control panels, etc. shall have 8" x 4" lamacoid plates with lettering of appropriate size.
- C. Provide tags for all valves, automatic and manual dampers. Tags shall be Type #2020 anodized aluminum of #1420 lamacoid engraved. Tags may not necessarily be standard. Fasten tags to valve or damper with brass chain.
- D. All nameplates, labels, identifications and tags shall be as manufactured by the Seton Name Plate Co., of New Haven, CT or approved equal. Submit complete schedules, listings and descriptive data together with samples for checking and approval before purchasing. Labeling shall include the "number" of the equipment, valve, dampers, switch, etc. and service of the valve.
- E. Mount on laminated plastic boards with transparent surface all valves, wiring diagrams, control diagrams, instruction charts, permits, etc. Valve chart shall be non-fading with original copies laminated.

**1.2 IDENTIFICATION OF PIPING**

- A. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.
- B. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.
- C. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.
- D. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment.
- E. Indoor gas piping shall be painted yellow, with appropriate markers. Outdoor piping shall be painted gray, per the utility.

**END OF SECTION**



**SECTION 23 0485**

**HVAC SYSTEMS COMMISSIONING**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 RELATED DOCUMENTS**

- A. Section 01 9114 – Commissioning Requirements, including drawings and general provisions of the Contract, including General and Supplementary Conditions, and other Division 01 Specification Sections.
- B. In the case of a conflict between this and any other section in the project specifications, the more stringent or detailed requirements shall apply.

**1.2 DEFINITIONS**

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.

**1.3 DESCRIPTION**

- A. The systems that shall be commissioned in this project include but are not limited to the following:
  - 1. Central Building Automation System including packaged unitary controllers.
  - 2. Equipment of the heating, ventilating and air conditioning systems.

**1.4 OVERVIEW OF CONTRACTOR'S RESPONSIBILITIES**

- A. Perform commissioning inspections and tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing (TAB) review and coordination meetings.
- D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide detailed startup procedures.
- H. Provide copies of all submittals, including all changes thereto, with details as required in the appropriate subsection of 3.1 Responsibilities.
- I. Facilitate the coordination of the commissioning process and incorporate commissioning activities into overall project schedule (OPS).

- J. Ensure all subcontractors and vendors execute their commissioning responsibilities according to the contract documents and the OPS.
- K. Provide required demonstration and training of owner's personnel.
- L. Review and accept construction checklists provided by commissioning authority (CxA).
- M. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built/as-tested conditions.
- N. Cooperate with the CxA for resolution of issues recorded in the "Issues Log"
- O. Prepare and provide all documentation as necessary for the compilation of the Systems Manual.

## **PART 2 - PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. The HVAC Contractor shall provide all standard testing equipment required to perform startup, initial checkout, and testing requirements of Division 23.
- B. The Controls Contractor shall provide all standard testing equipment required to test the Building Automation and Automatic Temperature Control System (BAS), including calibration of valve and damper actuators and all sensors. Trend logs for functional testing shall be generated through the BAS interface as requested by the CxA.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the following tolerances. Temperature sensors and digital thermometers shall have a certified calibration, performed within the past year, to an accuracy of 0.5°F and a resolution of ± 0.1 °F. Pressure sensors shall have an accuracy of ± 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

## **PART 3 - EXECUTION**

### **3.1 RESPONSIBILITIES**

- A. HVAC, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the HVAC, Controls and TAB Contractors of Division 23 are follows:
  - 1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and all commissioning team meetings.
  - 2. Provide a copy of approved shop drawings and startup reports for all commissioned equipment to the CxA. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
  - 3. The Operation and Maintenance Manuals shall be submitted to the CM prior to the start of training (three (3) weeks before startup and training and at least sixty (60) days before substantial completion).
  - 4. Perform and document results of Pre-functional Inspections at the direction of the CxA. Ensure that the inspection checklists are completed before startup or as specified by the CxA.

5. During the startup and initial checkout process, execute all portions of the manufacturer's start-up checklists for all commissioned HVAC equipment.
  6. Perform and clearly document all completed startup and system operational checkout procedures and provide a copy to the CxA.
  7. Perform and document results of equipment functional testing at the direction of the CxA. Ensure that the testing is completed in the timeline specified by the CxA.
  8. Address current A/E punch list items and Commissioning corrective action items on the "Issues Log" before functional testing. Air and water TAB shall be completed, with discrepancies and problems remedied, before functional testing of the respective air-or water-related systems.
  9. Provide skilled technicians to execute starting of equipment and to perform tests in accordance with all Division 23 sections. Where specified, startup shall be performed by a factory authorized service representative. Ensure that they are available and present during the agreed-upon schedules for the sufficient duration to complete the necessary tests, adjustments and problem-solving.
  10. Correct deficiencies (differences between specified and observed performance as interpreted by the CxA and A/E) and retest the equipment.
  11. Provide training of Owner's operating staff as specified in Division 23 Sections. Use expert qualified personnel.
  12. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
  13. Correct deficiencies and make necessary adjustments to O&M manuals for applicable issues identified in any seasonal testing.
- B. HVAC Contractor. The responsibilities of the HVAC Contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startup for all HVAC equipment.
  2. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the PM and CxA. Update the schedule as appropriate.
  3. Notify the PM and CxA when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment, and TAB will occur. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently facilitate the commission process.
  4. Calibrations: The HVAC Contractor is responsible to calibrate all factory-installed sensors and actuators. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated by the HVAC Contractor.
  5. Supervise all commissioning activities executed by subcontractors, including the Controls Contractor.
  6. List and clearly identify on the as-built duct and piping drawings the locations of all flow meters, fire and smoke dampers, duct detectors, temperature sensors, relative humidity sensors, CO2 sensors, static and differential pressure sensors (air, water and building pressure).

C. Controls Contractor - The commissioning responsibilities of the Controls Contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. The submitted sequences shall generally include the following, but can vary according to project needs:
  - a. An overview narrative of the system (one or two paragraphs) generally describing its purpose, components and function.
  - b. Logic diagrams detailing the flow of information for each control algorithm. These diagrams should include all inputs, outputs, and computations.
  - c. All interactions and interlocks with other systems.
  - d. Detailed delineation of control between any packaged controls and the building automation system, listing which points the only monitored at the BAS, and which points can be controlled by and adjusted at the BAS.
  - e. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
  - f. Start-up sequences.
  - g. Warm-up mode sequences.
  - h. Normal operating mode sequences.
  - i. Unoccupied mode sequences.
  - j. Shutdown sequences.
  - k. Capacity control sequences and equipment staging.
  - l. Temperature and pressure control: setbacks, setups, resets, etc.
  - m. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
  - n. Effects of power or equipment failure with all standby component functions.
  - o. Sequences for all alarms and emergency shut downs.
  - p. Seasonal operational differences and recommendations.
  - q. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
  - r. Daily/weekly/monthly schedules, as appropriate, if known.
  - s. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. Where possible, the numbering sequence shall correspond with Section 23 0460 Automatic Temperature Controls.
2. Control Drawings Submittal:
  - a. The control drawings shall have a key to all abbreviations.
  - b. The control drawings shall contain graphic schematic depictions of the system and each component.
  - c. The schematics shall include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
  - d. Provide a full points list with at least the following included for each point:
    - 1) Controlled system.
    - 2) Point abbreviation
    - 3) Point description
    - 4) Display unit.
    - 5) Control point or setpoint (Yes/No)
    - 6) Input point (Yes/No)
    - 7) Output point (Yes/No)
  - e. The controls contractor shall keep the A/E, CxA, HVAC and TAB Contractor informed, in a timely manner, of all changes to this list during programming and setup.



3. Submit a written checkout plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional testing. At minimum, the checkout plan shall include for each type of equipment controlled by the building automationsystem:
    - a. System name.
    - b. List of devices.
    - c. Step-by-step procedures for testing each controller after installation, including:
      - 1) Process of verifying proper hardware and wiring installation.
      - 2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
      - 3) Process for performing and documenting point-to-point checkout for each digital and analog input and output.
      - 4) Process of performing operational checks of each controlled component.
      - 5) Plan and process for calibrating valve and damper actuators and all sensors.
      - 6) A description of the expected field adjustments for transmitter, controllers and control actuators should control responses fall outside of expected values.
    - d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor, controller or command has “passed” and is operating within the contract parameters.
    - e. A description of the instrumentation required for testing.
    - f. Indicate the portion of the controls checkout plan that should be completed prior to TAB using the controls system for TAB work. Coordinate with the CxA and TAB Contractor for this determination.
  4. Point-to-Point Checkout: Include in the checkout plan a point-to-point checkout. Each control point tied to a central control system shall be verified to be commanding, reporting and controlling according to its intended purpose. For each output, commands shall be initiated and verified to be functioning by visually observing and documenting the status of the controlled device in the field (e.g. valve or damper actuator response, pump or fan status). For each input, the system or conditions shall be altered to initiate the input response being tested and the response in the control system observed and recorded (e.g. high duct static pressure alarm).
  5. Calibrations: The Controls Contractor is responsible to calibrate all field installed sensors and actuators using test and documentation methods approved by the CxA. The HVAC Contractor is responsible to calibrate all factory installed sensors and actuators.
    - a. Sensors installed in the unit at the factory, with a calibration certification provided, need not be field calibrated by the HVAC Contractor.
    - b. Valve leak-by tests shall be conducted by the Contractor when shown on a construction checklist.
    - c. All procedures used shall be fully documented by the Controls Contractor on suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
  6. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as indicated in the Specifications.
  7. Provide an official notice to proceed to the CxA and project team upon completion of the Building Automation System (BAS) and Automatic Temperature Control System (ATC) installation, including checkout and calibration of each controlled device, to confirm that all system programming is complete as to all respects of the Contract Documents. This shall be submitted by the Controls Contractor prior to the start of functional testing by the CxA.
- D. TAB Contractor: The scope of work for the TAB Contractor is provided in Section 230460.

### 3.2 SUBMITTALS

- A. The Contractor shall send one copy of product data, shop drawings and similar submittals to the CxA at the same time they are submitted to the A/E. The CxA will review the submittals and provide any comments to the A/E for inclusion in their comments. The Architect will transmit to the CxA, for the CxA's use in preparing functional test procedures; one reviewed and approved copy of product data, shop drawings and similar submittals received from the HVAC, Controls and TAB Contractors, pertinent to equipment and systems to be commissioned.

### 3.3 STARTUP

- A. The HVAC, Controls and TAB Contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Equipment start-up is required to complete systems and sub-systems so they are fully functional, in compliance with the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility, or partially shift that responsibility to any extent onto the Commissioning Agent or Owner.
- B. Testing is intended to begin upon completion of a system. Refer to Section 019100 for additional information related to scheduling.

### 3.4 TESTS

- A. The HVAC and Controls Contractors shall provide the necessary support to the CxA to complete functional testing. The Controls Contractor shall fully test and verify all aspects of the BAS Contract Work on a point / system / integrated operational basis for all points, features and functions specified. The following requirements apply to all mechanical and control systems and features that are to be commissioned when referenced below. Tests shall:
  - 1. Verify functionality and compliance with the basis of design for each individual sequence module in the sequence of operations. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Tests shall include startup, normal operation, shutdown, scheduled 'on' and 'off', unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.
  - 2. Verify operation of systems and components that may be impacted during low, normal and high load conditions and during combinations of environmental and interacting equipment conditions that could reasonably exist and potentially result in adverse system reaction.
  - 3. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.
  - 4. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.
  - 5. Verify shutdown and restart capabilities for both scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).
  - 6. Verify proper sequencing of heat transfer elements as required to prevent simultaneous heating and cooling, unless specifically required for dehumidification operation.
  - 7. Verify system response and stability of control loops under different load conditions and determine if additional loop tuning is required for dehumidification operation.
  - 8. When applicable, demonstrate a full cycle from 'off' to 'on' and 'no load' to 'full load' and then to 'no load' and 'off'.
  - 9. Verify time of day schedules and setpoints.
  - 10. Verify all energy saving control strategies.
  - 11. Verify that all control system graphics are complete, that graphics are representative of the systems, and that all points and control elements are shown in the same location on the graphics as they are located in the field.
  - 12. Verify operation control of all adjustable system control points, including proper access level as agreed to during the controls system demonstration.

- B. In addition to specific details, and/or standards referenced for acceptance testing indicated in other Division 23 sections, the following common acceptance criteria shall apply to all mechanical equipment, assemblies, and features:
1. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequence of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications.
  2. Systems shall accomplish their intended function and performance (e.g. provide supply air and water at designated temperature and flow rate, etc., and maintain space conditions in terms of air temperature, relative humidity, and CO2 concentration) at specified levels at varying conditions.
  3. Control loops shall be stable under all operating conditions. Control loops shall exhibit a quarter decay ratio type response to a step change or other upset and return to stable operation in a time frame that is reasonable and realistic for the system that they are associated with.
  4. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.
  5. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass etc.).
  6. Additional acceptance criteria may be defined by the CxA when detailed tested procedures are developed.
  7. At the CxA's discretion, if large numbers of deficiencies or repeated deficiencies are encountered, the CxA shall suspend functional testing until the Contractor corrects the deficiencies and troubleshoots all remaining systems at issue on their own. The Contractor shall be responsible for any resulting schedule delays that increase the overall time period to complete functional testing.
  8. Retesting: The CxA will direct the retesting of the equipment once at no charge to the Owner for their time. The CxA's time and expenses incurred for a second retest, if required due to no fault of the CxA, will be reviewed by the Owner to determine the appropriate means of compensation to the CxA for extension of services. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during construction checkout by the installing contractors and spot-checked by the CxA during functional testing.

### **3.5 WRITTEN WORK PRODUCTS**

- A. Written work products of Contractors shall consist of the filled out start-up, initial checkout, and test documentation in accordance with all Division 23 sections.

**END OF SECTION**



**SECTION 230490**

**GUARANTEE**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 GUARANTEE**

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

**END OF SECTION**



**SECTION 26 0100**

**GENERAL CONDITIONS**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section.

**1.1 DESCRIPTION OF WORK**

- A. It is the intention of the Specification and Drawings to call for finish work, tested and ready for operation.
- B. Any apparatus, appliance material or work not shown on the Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories or ancillary devices necessary to make ready for operation even if not particularly specified, shall be furnished, delivered and installed under their respective Division without additional expense to the Owner.
- C. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work as though they were hereinafter specified or shown.
- D. Work under each section shall include giving written notice to the Architect of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules and regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each section has included the cost of all necessary items for the approved satisfactory functioning of the entire system without extra compensation.
- E. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working of the project.

**1.2 DRAWINGS**

- A. Drawings are diagrammatic and indicate the general arrangement of the system and work included in the Contract. (Do not scale the drawings). Consult the Architectural Drawings and details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the general construction supervisor.
- B. Work under each section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; do not begin work until unsatisfactory conditions are corrected.
- C. Make reasonable modifications in the layout as needed to prevent conflict with work of other Sections of the Specifications or for proper execution of the work.
- D. It shall be understood that the right is reserved by the Architect/Engineer to change the location of equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

**1.3 SURVEYS AND MEASUREMENTS**

- A. Base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
- B. Before proceeding with the work resolve discrepancies between actual measurements and those indicated, which prevent following good practice or intent of the Drawings or Specifications.

#### **1.4 CODES AND STANDARDS**

- A. The Codes and Standards listed below apply to all Electrical work codes or standards that are mentioned in these Specifications; the latest edition or revision shall be followed:
1. NEMA - Standards
  2. ANSI CI - National Electrical Code (NFPA 70)
  3. ANSI C50.13 - Rotating Electrical Machinery
  4. NEMA MG2 - Construction and guide for selection, installation and use of electric motors.
  5. NEMA MG1 - Motors and Generators
- B. The following State and Local Codes shall apply: New York State Uniform Fire Prevention and Building Code, and Local Building Codes.
- C. The following abbreviations are used within this Division of the Specifications:
1. IES - Illuminating Engineering Society.
  2. NEC - National Electrical Code
  3. ANSI - American National Standards Institute
  4. ASTM - American Society for testing and materials
  5. EPA - Environmental Protection Agency
  6. IEEE - Institute of Electrical and Electronic Engineers
  7. NEMA - National Electrical Manufacturers Association
  8. NFPA - National Fire Protection Association.
  9. OSHA - Occupational Safety and Health Administration
  10. UL - Underwriter's Laboratories

#### **1.5 PERMITS AND FEES**

- A. Give all necessary notices, obtain all permits and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with work of this Division. File all necessary plans, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction; obtain all necessary certificates of inspections for his work and deliver a copy to the Architect before request for acceptance and final payment for the work. Pay fees for utility construction/connections.
- B. Include in the work, without extra cost to the Owner, any labor, materials, services, and apparatus, Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.
- C. All materials furnished and all work installed shall comply with the rules and recommendations of the National Fire Protection Association, with the requirements of the local utility companies, with the recommendations of fire insurance rating organization having jurisdiction and with the requirements of all governmental departments having jurisdiction.
- D. All materials and equipment for the electrical portion of the mechanical systems shall bear the approval label of or shall be listed by the Underwriter's Laboratories, Inc.

#### **1.6 TEMPORARY LIGHT AND POWER**

- A. The Contractor shall furnish, install, maintain and, upon direction to do so, remove system of temporary lighting and power for the use of all construction trades.
- B. The Electrical Contractor shall provide adequate electrical service for the needs of all Contracting Trades.



- C. Wiring shall be provided for temporary use during building construction, including grounding and fused main cut-off switches. Temporary electric lines with branch switches shall be provided for lighting and for taps for electric tools, pumps and other temporary equipment; all connected to a main line looped through floor spaces and up stair wells or shafts. All power outlets shall be grounded to an equipment ground wire in an approved manner. Electric lines shall be extended to power tools, which cannot be located within reach of extension cords.
- D. Light bulbs shall be provided in sufficient quantity to light the building for safety purposes. Extension cords shall be provided as may be essential to the proper execution of the work. Temporary lighting shall be provided for all stairs and other locations where needed for safety or the proper execution of the work.
- E. The Electrical Contractor shall maintain temporary lighting and power systems in good working condition, including the relocation and reinstallation when required to avoid interference with the progress of construction.
- F. Provide ground-fault personnel ampere protection for all single phase, 15 and 20 ampere receptacles. All receptacles and portable cord connectors shall have NEMA standard locking type configurations.
- G. The Electrical Contractor shall turn lights on and off at the beginning and end of each working day of any trade unless otherwise directed. He shall arrange for all temporary light and power for all trades which do not have holidays (days off) similar to the electrical trade. The Electrical Contractor shall patch and repair all openings left damaged by the installation and removal of the temporary light and power.

#### **1.7 MANUFACTURER'S IDENTIFICATION**

- A. Manufacturer's nameplate, name or trademark and address shall be attached permanently to all equipment and materials furnished under this Division. The nameplate of a contractor or distributor may not be used.

#### **1.8 SHOP DRAWINGS**

- A. Submit for approval detailed shop drawings of all equipment and materials in accordance with working procedures.
- B. Furnish all necessary templates and patterns for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as necessary.
- C. Submit shop drawings for the following:
  - 1. Light Fixtures.
  - 2. Receptacles, Switches, Occupancy Sensors.
  - 3. Overcurrent Protective Devices.
  - 4. Panelboards and Switchboard.
  - 5. Public Address system.
  - 6. Fire Alarm system components.
  - 7. Generator and Automatic Transfer Switch.

#### **1.9 MATERIALS AND WORKMANSHIP**

- A. All materials and apparatus necessary for the work, except as specifically indicated otherwise, shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first class standard article as accepted by the Architect shall be furnished.
- B. Furnish the services of an experienced Superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen, helpers, and labor to unload, transfer, erect, connect up, adjust, start, operate and test each system.

- C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

#### **1.10 PROTECTION**

- A. Work under each Section shall include protecting the work and materials of all other Sections from damage from work or workmen and shall include making good all damage thus caused. Be responsible for work and equipment until finally inspected, tested, and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing or other foreign material.
- B. Work under each section includes receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment supplied under each section. Work under each section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect on the part of the Contractor.

#### **1.11 BASES AND SUPPORTS**

- A. Unless specifically noted otherwise, provide all necessary supports, pads, bases, and piers required for all equipment under this Division. Provide all temporary bases and supports as required.
- B. All equipment, unless shown otherwise, shall be securely attached to the building structure. Attachments shall be of a strong and durable nature; any attachments that are, insufficient, shall be replaced as directed by the Architect.

#### **1.12 SLEEVES, INSERTS AND ANCHOR BOLTS**

- A. All conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter one inch larger than the outside diameter of the conduit, or insulation enclosing the conduit.
- B. Furnish all sleeves, inserts, and anchor bolts necessary to be installed under other sections of the Specifications to accommodate work of this section.
- C. Sleeves through outside walls shall be cast iron sleeves with intermediate integral flange. Sleeves shall be set with ends flush with each face of wall. The remaining space shall be packed with oakum to within 2 inches of each face of the wall. The remaining shall be packed and made watertight with a waterproof compound.
- D. Sleeves through concrete floors or interior masonry walls shall be schedule 40 black steel pipe, set flush with finished walls or ceiling surfaces but extending 2 inches above finished floors.
- E. Sleeves through interior partitions shall be 22 gauge galvanized sheet steel, set flush with finished surfaces or partitions.
- F. Inserts shall be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4" inch diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2" diameter to be passed through the insert body. Strip inserts shall have attached rods having hooked ends to allow fastening to reinforcing rods. Inserts shall be as manufactured by Carpenter and Patterson, Inc. or Grinnell Co., Inc.
- G. Penetrations through fire-rated walls, ceilings and floors in which cables, conduits pass, shall be sealed by a UL approved fire stop fitting classified for an hourly rating equal to the fire rating of the floor, wall or ceiling shall be Gedney Fire Seal Type CFSF of CAPS.

**1.13 PAINTING**

- A. All finish painting in finished areas shall be performed by others.
- B. All materials shipped to the job site under the Division, such as panels and plates, shall have a prime coat and standard manufacturer's finish unless otherwise specified.
- C. Inaccessible conduits, hangers, supports and anchors and ducts shall be coated prior to installing.
- D. All components of the fire alarm system raceway shall be painted red. This includes but is not limited to conduit, junction boxes, pull boxes.

**1.14 CUTTING AND PATCHING**

- A. All cutting and patching required for the work of this Division shall be done by this Division.
- B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves. Do all drilling and cutting necessary for the installation.
- C. All holes cut through concrete slabs and structural steel shall be punched or drilled from the underside. No structural member shall be cut without the written acceptance of the Architect and all such cutting shall be done in a manner directed by him.
- D. Refer to Division 1 for additional requirements.

**1.15 SCAFFOLDING, RIGGING, HOISTING**

- A. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer needed.

**1.16 EXCAVATING AND BACKFILLING**

- A. All excavation and backfilling for the work of this Division shall be performed by Division 2.

**1.17 WATERPROOFING**

- A. Where any work penetrates waterproofing, including waterproof concrete and floors in wet areas. Submit proposed method of installation for review by the Architect before beginning work. Furnish all necessary sleeves, caulking and flashing necessary to make opening absolutely watertight.

**1.18 ACCESSIBILITY AND ACCESS PANELS**

- A. Be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work of this Division.
- B. Locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Minor deviations from Drawings may be allowed for better accessibility with approval of the Architect.

**1.19 SHUTDOWNS**

- A. When installation of a new system necessitates the temporary shutdown of an existing utility operating system the connection of the new system shall be performed at such time as designated by and in consultation with the Utility Company. Work required after normal business hours shall be done so at no additional cost to the Owner.

**1.20 CLEANING**

- A. Thoroughly clean all equipment of all foreign substances inside and out before being placed in operation.
- B. If any foreign matter should stop any part of a system after being placed in operation, the system shall be disconnected, cleaned and reconnected whenever necessary to locate and remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
- C. Upon completion of work remove from the premises all rubbish, debris, and excess materials. Any oil or grease stains on floor areas caused by work of this Division shall be removed and floor areas left clean.

**1.21 RECORD DRAWINGS**

- A. Maintain at the job site a record set of Electrical Drawings on which any changes in location of equipment, panels, devices, and major conduits shall be recorded. Indicate dimensions of all items installed underground or in concrete.

**1.22 OPERATING INSTRUCTIONS**

- A. Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Give at least 7 days' notice to the Owner in advance of this period.
- B. Furnish four complete bound sets for delivery to the Architect of typewritten or blueprinted instructions for operating and maintaining all systems and equipment included in this Division. All instruction shall be submitted in draft for review prior to final issue. Manufacturer's advertising literature or catalogs may not be used for operating and maintenance instruction.
- C. In the above-mentioned instructions, include the maintenance schedule for the principal items of equipment furnished under this Division.
- D. The manufacturer shall attest in writing that his equipment has been properly installed prior to start. The following is some of the equipment necessary for this inspection: fire alarm system. These letters will be bound into the operating and maintenance books.

**1.23 ADJUSTING AND TESTING**

- A. After all equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests as will assure the Architect that they are in proper adjustment and in satisfactory permanent operating condition.
- B. This particular work shall include the services of a factory engineer to inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, there shall be furnished the service of said engineer for the purpose of supervising the initial operation of the equipment and to instruct the personnel responsible for operation and maintenance of the equipment.
- C. At the completion of the job when all panels, devices, etc. are at full working load the Contractor shall provide infrared scan thermographic inspection test of all connection points, terminals, etc. of wires #8 AWG and larger to detect "hot-spots" in the electrical current flow. Correct all hot-spots.

**1.24 UNDERWRITER'S LABEL**

- A. All electrical equipment and materials shall be new and shall comply with the standards of and shall bear the label of the Underwriter's Laboratories.

**1.25 ELECTRICAL SAFETY INSPECTION**

- A. Electrical Contractor shall arrange for an Electrical Safety Inspection to be performed by the Local Inspection Agency (i.e.: New York Electrical Inspection Services, Atlantic Inland, Middle Department Inspection Agency). A Certificate of Compliance "Underwriter's Certificate" shall be issued to the Owner. All costs and coordination required shall be included in this Contractors Base Bid.

**1.26 REMOVALS**

- A. The scope of removals shown on the Drawings are diagrammatic only and indicate the intent of the work to be performed and not the complete scope of demolition and/or removal work. It shall be the responsibility of this Contractor to remove any electrical devices even if not specifically indicated to be removed on these Drawings in order to accommodate new work.
- B. All power conductors, control wiring and conduit associated with mechanical equipment such as fans, pumps, etc. designated for removal on the HVAC Drawings shall be removed clear back to the source of power and disconnected. All motor starters, disconnect switches, control devices, etc. shall be removed. Refer to HVAC Drawings for extent of HVAC removals.
- C. Any device removed shall include (but shall not be limited to) the removal of all associated wiring, conduit, boxes, and auxiliary devices back to the previous device on the circuit, or back to the panelboard or origin of the circuit or any other items that are not incorporated in new layout, until such removal is complete. If the removal of any device interrupts service of any other device that is to remain, the Contractor shall provide all materials and labor to ensure continuity of service to those devices to remain.
- D. Junction boxes, pullboxes, wireways, conduits, or any other devices required to reconnect circuitry shall be installed concealed within the ceilings, partitions and/or walls, floors, no surface or exposed circuiting shall be permitted, unless specifically indicated.
- E. The Electrical Contractor shall patch all openings in walls, ceilings or roof that are left open as a result of removals. Refer to cutting and patching section. Any electrical device removed including but not limited to disconnect switches, panelboards, etc. shall be cleaned, protected and turned over to the Owner or disposed of as directed by Owner.

**END OF SECTION**



**SECTION 26 0125**

**SCOPE OF WORK**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 SCOPE OF WORK**

- A. The work under this section includes all labor, materials, equipment, tools, transportation and the performance of all work necessary and required for furnishing and installing all Electrical work shown on the Contract Documents, as specified herein and as otherwise required by job conditions or reasonably implied, including, but not necessarily limited to the following:
1. The addition of new fire alarm devices (i.e., automatic fan shutdown, for new HVAC equipment) and the replacement of the existing ones as shown on Drawings.
  2. Removal of existing utility vault mounted transformer along with the associated incoming and outgoing cables.
  3. Installation of a new utility pad mounted transformer lineup (provide platform).
  4. Installation of new service cables in underground duct bank.
  5. Installation on new medium voltage cables in underground duct bank, supplying the new utility stepdown transformer from the last utility pole.
  6. Relocation or replacement of existing utility poles along with the overhead lines, as necessary.
  7. Installation of new generator and load bank.
  8. The contractor shall dispose of all debris, including but not limited to fixtures, equipment, lamps, ballast, wiring devices and the like in accordance with, as defined by governing law and regulations of the jurisdiction where the work is being performed.
  9. Removal of existing public address system in the existing to be renovated building.
  10. Provisions for temporary fire prevention actions to be taken during the period of construction until the new fire alarm system is operational.
  11. New electrical service as indicated on drawings.
  12. Modifications to existing electrical distribution system as indicated on the Drawings.
  13. Service switchboards, distribution panelboard, circuit breaker panelboards, feeder, conduit, cables and branch circuit wiring with all connections complete.
  14. Conduit, conduit fittings, junction and pull boxes and all appurtenances necessary for the raceway systems including necessary supports and fasteners.
  15. Electrical conductors, connectors, fittings and connection lugs.
  16. Branch circuit devices, outlet boxes, pull boxes, motor disconnect switches, etc.

17. Power wiring to HVAC and Plumbing equipment including disconnect switches as shown and/or required by NEC.
  18. Empty conduit for computer and telephone.
  19. Lighting fixtures and lamps including site lighting and occupancy sensor.
  20. New public address system and components.
  21. Temporary electric power while existing electrical service is being removed until the new electrical service is being installed.
  22. Core drilled holes for conduit passing through walls, ceilings and floors.
  23. All necessary cutting, patching and core drilling incidental to the electrical work.
  24. Call to Aid system.
  25. Temporary light and power.
  26. Licenses, permits, inspection and approvals.
  27. Grounding as required as per NEC.
  28. Sleeves for conduit and watertight caulking between conduit and sleeve.
  29. Testing.
  30. Cutting, patching and drilling.
  31. Excavation and backfill by others. Sand bedding by Electrical Contractor.
- B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both “time” and “money”.

## **1.2 WORK NOT INCLUDED**

- A. The following related items will be done by others:
1. Furnishing motors and controllers.
  2. Concrete work.
  3. Excavation and backfill.

**END OF SECTION**



**SECTION 26 0150**

**APPROVED MANUFACTURERS**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 APPROVED MANUFACTURERS**

A. The following list of manufacturers constitutes an approved list:

- |     |                          |   |
|-----|--------------------------|---|
| 1.  | Panelboards              | Siemens, Square D, GE   |
| 2.  | Disconnect Switches      | Siemens, Square D, GE   |
| 3.  | Conduit (steel)          | Walker, Youngstown, Steelduct, Triangle   |
| 4.  | Conduit Fittings (steel) | Appleton, Crouse-Hind, O-Z, T & B, M & W  |
| 5.  | Wire and Cable           | General, South Wire, Triangle, Rome, Hatfield, Crescent, Cerro                          |
| 6.  | Splicing Connectors      | 3M, O-Z, Thomas & Betts   |
| 7.  | Outlet Boxes             | Appleton, National, Steel City, Raco  |
| 8.  | Wiring Devices           | Arrow-Hart, Hubbell, P & S  |
| 9.  | Fuses                    | Bussman, Ferraz-Shawmut, Littlefuse   |
| 10. | Motion Sensors           | Watt Stopper, Sensorswitch  |
| 11. | Fire Alarm System        | Simplex, Pyrotronics or approved equal<br>Edwards System Technologies or approved equal |
| 12. | Public Address System    | Rauland-Borg, Bogen or approved equal   |
| 13. | Generator                | Cummins or Caterpillar  |

B. All materials and appliances shall have listing of Underwriters Laboratories, Inc. and be so labeled, or shall conform to their requirements, in which case certified statements to that effect shall be furnished by the manufacturer with a copy of an examination report by a recognized independent testing laboratory acceptable to the Architect and his Engineer. Use new materials and appliances throughout.

C. Where several types or makes of materials are specified, the Contractor has the option of using any of these, but after a type or make has been selected and has received the approval of the Architect, it shall be used throughout.

D. The Contractor shall provide all structural supports for the proper attachment of equipment supplied by him and also for all equipment supplied to him under other sections of the Specifications for mounting and connections.

- E. Secure all equipment to the building structure independently. Do not secure to work of other trades such as ceiling lath, piping racks, etc., unless specified or noted otherwise.
- F. Wall mounted equipment shall be directly secured to wall by means of steel bolts. Maintain at least 1/4" air space between equipment and supporting wall. Pre-fabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf and Unistrut, shall be used for mounting arrays of equipment.
- G. All fastening, supports, hangers, anchors, etc., shall be of a type made for the specific purpose. On masonry walls, metallic expansion shield and machine screws shall be used. Screws with wooden plugs or anchors will not be acceptable on any part of the work.

**END OF SECTION**

## **SECTION 26 0200**

### **CONDUIT**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all material, labor, tools, and services necessary to install rigid metal conduit, electrical metallic tubing and liquid tight flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

##### **1.2 RELATED WORK**

- A. Cutting and patching.
- B. Trenching: Excavation and backfill for conduit and utility on site.
- C. Sheet metal flashing and trim.

#### **PART 2 - PRODUCTS**

##### **2.1 RIGID STEEL CONDUIT**

- A. Industry standard heavy wall conduit.
- B. Minimum 3/4" trade size.
- C. Threaded.
- D. Hot dipped galvanized finish by means of plating after cutting of threads.

##### **2.2 INTERMEDIATE METAL CONDUIT**

- A. Industry standard steel conduit.
- B. Minimum 3/4" trade size.
- C. Threaded.
- D. Hot dipped galvanized finish by means of plating after cutting of threads.

##### **2.3 ELECTRICAL METALLIC TUBING**

- A. Industry standard thin wall conduit of galvanized steel only.
- B. Minimum 3/4" trade size.
- C. Maximum 4" trade size.

## **2.4 FLEXIBLE METAL CONDUIT**

- A. Galvanized steel tape formed into an industry standard interlocking coil.
- B. Minimum 3/4" trade size except for connection of lighting fixtures.
- C. Grounding type.
- D. Separate ground conductor.
- E. Use for short connections to motor terminal box, other vibrating equipment using a minimum length of 18" with 50% slack and a maximum of 6'.
- F. From outlet box to recessed lighting fixtures with a maximum length of 6'.

## **2.5 WIREWAYS**

- A. Lay-in type, UL listed as wireway or auxiliary gutter.
- B. Wireway shall be of code gauge steel construction (UL standard for Wireway Auxiliary Gutters and Associated Fittings) with removable cover. Tamperproof screws shall be provided for sealing covers to prevent access by unauthorized personnel. Wireway shall be provided with knockouts.
- C. Connector and covers shall be attached so that removal of connectors is not necessary to utilize the lay-in feature.
- D. Finish: All sheet metal parts shall be provided with a rust inhibiting phosphating coating and baked enamel finish. All hardware shall be plated to prevent corrosion. All screws extending into the wireway shall be protected by spring nuts or otherwise guarded to prevent wire insulation damage.

## **2.6 CONDUIT SUPPORTS**

- A. Conduit clamps, straps and supports: Steel or malleable iron.

## **2.7 CONDUIT FITTINGS**

- A. Use compression fittings for all EMT in exposed areas. Utilize set screw fittings only above hung ceilings and concealed areas.

## **2.8 SURFACE METAL RACEWAY**

- A. Metal raceway shall be of a two-piece design with a base and snap-on cover.
- B. Raceway and all components shall be listed by Underwriters Laboratories
- C. Single Channel: Steel, zinc plated, off-white finish suitable for repainting. Two piece design with metal base and snap-on cover. Provide Wiremold V700, Hubbell Inc. 750 Series, or Panduit PMR5/PMR7.
- D. Dual Channel: Steel, galvanized, off-white finish but suitable for repainting. Two-piece design with metal base and snap-on cover, minimum 0.04" thick base and cover. Base shall be divided by a removable barrier section. Provide duplex receptacles mounted in top cell and communication outlets in the bottom cell. Coordinate communications jack requirements with owner's IT personnel. Provide Wiremold V4000, Wiremold DS4000 Series, Hubbell Inc. 4000 Series or Panduit PMR40.

### **PART 3 - EXECUTION**

#### **3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT**

- A. Minimum size - 3/4". Provide grounding bushings on all conduits 1-1/4" and larger.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Draw up couplings and fittings full and tight. Protect threads cut in field from corrosion. Paint newly threaded joints of steel conduit with T & B "Kopershield" compound before installation. Running threads prohibited; use three-piece unions or split couplings instead. Use only compression fittings for all EMT in areas where it will be exposed in finished and unfinished areas. Provide set screw fittings only when installed above hung ceilings.
- E. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues; steam pipes and heating appliances.
- F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- H. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction before conductors are pulled.
- I. Exposed conduit on ceiling shall be parallel or perpendicular to wall and vice versa to ceiling when installed on wall. Secure conduit clamps and supports to masonry materials by toggle bolt, expansion bolt or steel insert. Spacing or conduit supports shall not exceed 7 feet.

#### **3.2 CONDUIT INSTALLATION**

- A. Cut conduit square using a saw or pipe cutter, Deburr cut ends.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than the equivalent of three 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.

- J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.
- K. Where conduit penetrates fire-rated walls and floors, provide pipe sleeves two sizes larger than conduit; Pack void around conduit with fire-stop fittings with UL listed fire rating equal to wall or floor ratings; Seal opening around conduit with UL listed foamed silicone elastomer compound.
- L. Installation of conduit in slab shall comply with ACI 318.
- M. Route conduit through roof openings for piping and duct work where possible; otherwise, route through roof with pitch pocket.
- N. Maximum size conduit in slabs above grade: 1 inch. Do not route conduits to cross each other in slabs above grade. Conduits crossing each other may not be larger than 3/4 inch.
- O. All conduit used for fire alarm system shall be painted red.

### **3.3 CONDUIT INSTALLATION OF SCHEDULE**

- A. Underground installations: PVC minimum Schedule 40 conduit, unless otherwise noted on Drawings.
- B. Installations in or under concrete slab: PVC minimum Schedule 40 conduit, unless otherwise noted on Drawings.
- C. Exposed outdoor locations: Rigid galvanized steel conduit.
- D. Wet interior locations: Rigid galvanized steel conduit.
- E. Concealed dry interior locations and above accessible ceiling for receptacle and lighting branch wiring: Electrical metallic tubing up to first junction box and flexible metallic tubing (MC cable only) thereafter.
- F. Concealed dry interior locations other than receptacle and lighting branch wiring: Electrical metallic tubing.
- G. Concealed dry interior locations and above accessible ceiling for fire alarm runs: Fire alarm armored cable type MC with red stripe as manufactured by AFC series 1800.
- H. Concealed and exposed dry interior location for feeder runs: Electric metallic tubing.
- I. Exposed dry interior in unfinished locations other than Boiler Rooms: Electric metallic tubing.
- J. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 10" to maximum of 6' for connections to motors.
- K. Existing exposed dry interior locations (finished spaces), for branch wiring and fire alarm wiring, one-piece steel raceway (similar to Wiremold V-500, V-700).
- L. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 18" to maximum of 6' for connections to motors.
- M. All conduit installed in boiler room up to 10'-0" AFF and lower shall be rigid galvanized steel conduit. All conduit above 10'-0" shall be electric metallic tubing.
- N. Final connections to equipment and/or motors in boiler room, outdoors and potentially wet indoor areas: liquid tight, flexible; minimum of 18" to maximum 6'-0" connections.

**END OF SECTION**

**SECTION 26 0250**

**DUCT BANK**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 SECTION INCLUDES**

- A. PVC conduit.
- B. Duct.
- C. Manholes.

**1.2 REFERENCES**

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- B. ASTM A48 - Gray Iron Castings.
- C. ASTM C857 - Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
- D. ASTM C858 - Underground Precast Concrete Utility Structures.
- E. ASTM C891 - Installation of Underground Precast Utility Structures.
- F. ASTM C1037 - Inspection of Underground Precast Utility Structures.
- G. IEEE C2 - National Electrical Safety Code.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- I. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- J. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- K. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.
- L. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
- M. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.
- N. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.
- O. NFPA 70 - National Electrical Code.
- P. UL 651A - Type EB and A PVC Conduit and HDPE Conduit.

**1.3 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc.

#### **1.5 FIELD MEASUREMENTS**

- A. Verify that field measurements are as indicated.
- B. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- C. Verify locations of manholes prior to excavating for installation.
- D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete duct bank system.

### **PART 2 - PRODUCTS**

#### **2.1 PVC CONDUIT**

- A. Manufacturers: Carlon.
- B. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, with fittings and conduit bodies to NEMA TC 3.
- C. Rigid Plastic Underground Conduit: UL 651A, Type A PVC High-density polyethylene, Schedule 40.

#### **2.2 PRECAST CONCRETE MANHOLES**

- A. Manufacturers: A.C. Miller or equal.
- B. Description: Precast manhole designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.
- C. Loading: ASTM C857, Class A-16.
- D. Shape: Rectangular with truncated corners.
- E. Nominal Inside Dimensions: 10 feet x 6 feet.
- F. Corner Panel Dimensions: 3 feet wide.
- G. Inside Depth: 6 feet.
- H. Wall Thickness: 6 inches.
- I. Base Section: Include 3 inches deep x 14 inches round sump with cast sleeve, and two 1 inch ground rod openings. Provide 4 inches diameter hole in bottom of manhole.
- J. Top Section: Include 39 inches diameter grooved opening for frame and cover.
- K. Riser Casting: 12 inches with manhole step cast into frame.



- L. Frames and Covers: ASTM A48; Class 30B gray cast iron, 30 inches size, machine finished with flat bearing surfaces. Provide cover marked ELECTRIC OR TELEPHONE.
- M. Duct Entry Provisions: Window knockouts.
- N. Duct Entry Locations: As indicated.
- O. Duct Entry Size: 6 inches.
- P. Cable Pulling Irons: Use galvanized rod and hardware. Locate opposite each duct entry. Provide watertight seal.
- Q. Cable Rack Inserts: Minimum load rating of 800 pounds. Locate on center.
- R. Cable Rack Mounting Channel: 1-1/2 x 3/4 inch steel channel, 48 inch length. Provide cable rack arm mounting slots on 1-1/2 inch centers.
- S. Cable Racks: Steel channel, 1-1/2 x 3/4 x 14 inches, with fastener to match mounting channel.
- T. Cable Supports: Porcelain clamps and saddles.
- U. Manhole Steps: Cast steps at 12 inches on center vertically.
- V. Sump Covers: ASTM A48; Class 30B gray cast iron.
- W. Source Quality Control: Inspect manholes in accordance with ASTM C1037.

### **2.3 ACCESSORIES**

- A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.
- B. Install a 6" deep bed of 3/4" crushed stone under each manhole.

### **2.4 CAST-IN-PLACE MANHOLE ACCESSORIES**

- A. Sump Covers: ASTM A48; Class 30B gray cast iron.

## **PART 3 - EXECUTION**

### **3.1 DUCT BANK INSTALLATION**

- A. Install duct to locate top of duct bank at depths as indicated on drawings.
- B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.
- C. Cut duct square using saw or pipe cutter; de-burr cut ends.
- D. Insert duct to shoulder of fittings; fasten securely.
- E. Join nonmetallic duct using adhesive as recommended by manufacturer.
- F. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

- G. Install no more than equivalent of three 90-degree bends between pull points.
- H. Provide suitable fittings to accommodate expansion and deflection where required.
- I. Terminate duct at manhole entries using end bell.
- J. Stagger duct joints vertically in concrete encasement 3 inches minimum.
- K. Use suitable separators and chairs installed not greater than 5 feet on centers.
- L. Band ducts together before placing concrete.
- M. Securely anchor duct to prevent movement during concrete placement.
- N. Place 3,000 psi concrete around PVC conduits. Use mineral pigment to color concrete red.
- O. Provide minimum 3" concrete cover at bottom, top, and sides of duct bank.
- P. Provide two (2) No. 4 steel reinforcing bars in top of bank under paved areas.
- Q. Connect to manhole wall using dowels.
- R. Provide 2 at pull rope in each empty duct except sleeves and nipples.
- S. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.
- T. Backfill trenches with clean tamped soil.
- U. Interface installation of underground warning tape with backfilling. Install tape 6 inches below finished surface.

### **3.2 PRE-CAST MANHOLE INSTALLATION**

- A. Excavate for manhole installation.
- B. Install and seal precast sections in accordance with ASTM C891.
- C. Install manholes plumb.
- D. Use precast neck and shaft sections to bring manhole cover to finished elevation.
- E. Attach cable racks to inserts after manhole installation is complete.
- F. Install 4" diameter drains in manholes and connect to site drainage system 4 inch pipe terminating in 1/3 cu yd crushed gravel bed.
- G. Damp-proof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days.
- H. Backfill manhole excavation.

**END OF SECTION**

**SECTION 26 0275**

**15 KV MEDIUM VOLTAGE CABLE**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 SECTION INCLUDES**

- A. Medium voltage cable.
- B. Cable terminations.

**1.2 REFERENCES**

- A. ANSI/IEEE C2 - National Electrical Safety Code.
- B. ANSI/NFPA 70 - National Electrical Code.
- C. IEEE 48 - Test Procedures and Requirements for High- Voltage Alternating-Current Cable Terminations.
- D. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- E. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- F. NEMA WC 8 - Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

**1.3 PURPOSE AND INTENT**

- A. This specification covers the construction and testing of 15KV solid dielectric ethylene propylene insulated distribution cables. These cables utilizing a copper tape shield and a black heavy-duty jacket shall be used in conduits and in transformer vaults for primary wiring on 15KV systems.
- B. Engineer to verify compatibility with existing utility cables as necessary.

**1.4 ABBREVIATIONS**

- A. AEIC - Association of Edison Illuminating Companies
- B. ICEA - Insulated Cable Engineering Association
- C. NEMA - National Electrical Manufacturers Association
- D. ASTM - American Society of Testing Manufacturers
- E. EPR - Ethylene - Propylene Rubber
- F. HTK - High Temperature Kerite
- G. UL - Underwriters Laboratories

## 1.5 SHOP DRAWINGS

- A. Shop drawings shall be submitted and approved prior to ordering cables. The following shall be the minimum submitted for approval.
- B. Complete manufacturer's construction details and specifications for the cables, including physical and electrical characteristics of insulation, shields and jackets.
- C. Overall dimension and ampacity of cable.
- D. Splicing and termination data, including the following:
  - 1. Written statement from cable manufacturer that splices and terminations submitted are acceptable.
  - 2. Written statement from splicing/termination manufacturer that splices and terminations submitted are suitable for the proposed application.
  - 3. Details of cable preparation.
  - 4. Method of connecting conductors.
  - 5. List of Materials
  - 6. Method of applying materials (including quantities).
  - 7. Precautionary measures.
  - 8. Drawings showing method of splicing, complete with dimensions.
- E. Testing certificates as required in Section 1.6.
- F. Written statement from the cable manufacturer consenting to the terms of the warranty, Section 1.12.

## 1.6 QUALIFICATION TESTING

- A. Qualification tests shall be performed by the manufacturer initially on each design of cable and whenever any change occurs in the insulation system or in any other cable component. These tests shall be performed in accordance with AEIC No. CS6 prior to shipment, as applicable.
- B. The completed Kerite cable, while on the shipping reel, shall be tested at room temperature at 94KV DC and 47KV AC for five minutes. The insulation resistance shall also be measured and the insulation resistance constant shall not be less than 21,000 mega-ohms/1000 ft. corrected to 60 degrees F.

### OR

- C. The completed Ethylene Propylene Rubber (EPR) cable shall be subjected to a partial discharge test and an insulation resistance test for each reel. The partial discharge corona test shall be as outlined in ICEA standard S-68-516, AEIC CS6-87, and meet the following:
  - 1. Vt/Vg Ratio      1.0 1.5 2.5 3.0 4.0
  - 2. Maximum particle    5 5 5 5 10  
discharge in pico coulombs
  - 3. Test voltage in    8.5 13.0 21.5 26.0 35.0  
KV for 15 KV Cable
  - 4. See typical manufacturer's form attached.
- D. The insulation resistance shall not be less than 50,000 megohm-1000 ft. at 60°F with an applied voltage of 44KVAC for 5 minutes and 80KV dc for 15 minutes.

- E. The conductor shield, conductor shield-insulation interface, insulation, and insulation-insulation shield interface shall be tested according to AEIC No. CS6 to determine the size and magnitude of voids and contaminants. The contact area between the insulation and the shield extrusions shall be tested according to AEIC No. CS6 to determine the size of protrusions. The test results shall meet the requirements of AEIC No. CS6.
- F. Certification shall be provided to show that test samples of cable insulated with the same insulating system as that to be supplied have been subjected to and passed the following test:
  - 1. As described in ICEA S-68-516, Paragraph 6.23.3, with the energy source equal to a minimum of 250 volts/mil of insulation thickness, cable shall withstand this test for a minimum of 200 hours without failure. EPR cables employing single or double extrusions must apply this test and withstand it for a minimum of 200 hours. However, EPR cables employing triple tandem extrusion need not comply with this test.
  - 2. The tests shall be made on #2 (7 stranded) AWG copper conductor insulated with an inner stress control layer and 175 mil minimum average wall of insulating material.
- G. The conductor resistance and shield continuity shall be measured on each shipping length of cable and recorded. Each end of every shipping length shall also be inspected for water in strands and checked dimensionally for conformance with the above standards.
- H. Each length of completed cable on the shipping reel shall be tested dry and shall pass an ac voltage withstand test applied for one minute at a test voltage of 47kV, and dc voltage test at 94 KV.
- I. The insulation resistance shall again be measured according to the criteria stated above.
- J. The Engineer reserves the right to witness all tests. Schedule of testing to be provided to the Owner two weeks before the test date.
- K. Visual examination of both ends of every shipping length of cable shall be made to assure that no water is in the completed cable when shipped.

## 1.7 QUALIFICATIONS

- A. All manufacturers shall have a minimum successful track record in production and use of their materials as proposed as follows:
  - 1. Cable - 20 years
  - 2. Terminations - 10 years
  - 3. Splices - 10 years
- B. Any workers performing splices or terminations on high voltage cable shall have a minimum of 10 years' experience.
- C. Contractor shall submit manufacturers and splicers experience as specified above including references to projects completed. Five (5) installations shall be provided and considered only if no failures have occurred.

**1.8 CABLE APPROVAL: Submit the following for final approval:**

- A. Cable manufacturers certified test data, including full documentation package.
- B. Two 2' samples of each cable, taken from reels at jobsite prior to installation. Reseal cable on reel. Additional samples may be required during the contract period. Include the following additional information on the sample labels; the maximum voltage at which the conductor is designed to be used, date of manufacturer. Certify ethylene content if EPR cable is furnished.
- C. Samples of all splicing and termination materials. Samples of complete kits will be returned and if approved may be used in the work. Samples shall include a full roll of all tapes in original box or container, with the date of manufacture indicated thereon, other materials in sufficient quantity to construct a complete splice and labeled for identification, entire factory packaged kit if splice or termination is of the kit type. Provide three (3) spare splice kits of each type to owner.
- D. Written statement from cable manufacturer indicating recommended pulling compounds and pulling tensions.
- E. Product Data: Submit manufacturer's catalog sheets for all products.

**1.9 QUALITY ASSURANCE**

- A. Manufacturer's Representative: Secure the services of cable manufacturer's representative for minimum of 3 days (not necessarily consecutive) for the consultation on method of installing cable, inspection of equipment for installing cable, witness representative amount of cable pulling, witness construction of at least one splice and one termination by each cable splicer, certify to the Engineer in writing that the aforementioned particulars are satisfactory and the cable has been installed in accordance with cable manufacturer's recommendations.
- B. If the splices or terminations are other than the cable manufacturers, secure the services of the splice and termination manufacturer's representative to concurrently witness construction of the splices and terminations and also certify with an affidavit that the splices and terminations were constructed in accordance with the splice and termination manufacturer's recommendation.
- C. Testing Company: Secure the services of one of the following companies for performing a high voltage after installation test on cables having a rated voltage of 5000 volts or higher:
  - 1. Electrical Testing Laboratories, 2 East End Avenue, New York, N.Y. 10021, Phone No. 212-288-2600.
  - 2. General Electric Co., Installation and Service Engineering Div., 3532 James Street, P.O. Box 1021, Syracuse, N.Y. 13201, Phone No. 315-456-7718.
  - 3. Westinghouse Electric Corp., Apparatus Service Center, P.O. Box 270, Utica, N.Y. 13503, Phone No. 315-736-3021.
  - 4. Advanced Testing Systems, Inc., P.O. Box 27, Carmel, N.Y. 10512, Phone No. 914-225-3110
  - 5. Submit names and addresses for approval of or equal companies.

**1.10 MANUFACTURER'S REPRESENTATIVE**

- A. The cable manufacturer shall designate a Manufacturer's Representative to insure compliance with the provisions of the warranty specified in Section 1.12. The Manufacturer's Representative shall be designated by full name, title, business address, and telephone number. In the event of any change in representation, the manufacturer shall notify the Owner in writing as follows: INSERT ADDRESS

**1.11 HIGH VOLTAGE CABLE WARRANTY**

- A. The cable manufacturer shall warranty the cable and installation as follows:
- B. The cable manufacturer \_\_\_\_\_ (state manufacturer name) warrants solely to the \_\_\_\_\_ its successors and assigns, hereinafter collectively known as "Purchaser" that any wire or cable of its own manufacture ("Product") supplied for Project No. XX Project DESCRIPTION to follow XX will be free from defects in material and workmanship provided the wire and cable is employed under conditions contemplated and covered by the design specifications, and provided further that the wire and cable is installed, spliced, terminated, maintained and operated in accordance with the manufacturers recommended standards and procedures.
- C. If a product fails electrically while in service, Purchaser shall notify the manufacturer within five (5) days of the discovery of such failure, and shall permit a representative of the manufacturer a reasonable opportunity to inspect the Product. If the failure is the result of defective material or workmanship, the manufacturer's sole responsibility under this Warranty shall be to repair or replace the defective Product, the choice of which will be at the manufacturer's option. If the manufacturer chooses to replace the defective Product, the new Product will be delivered free of charge to the above noted project site.
- D. THE FOREGOING WARRANTY SUPPLEMENTS ALL OTHER WARRANTIES. THIS WARRANTEE SHALL BE EFFECTIVE FOR A PERIOD OF FORTY (40) YEARS FROM DATE OF ACCEPTANCE BY PURCHASER.
- E. The manufacturer, in signing this document, additionally declares that they have inspected all installations, splices, terminations, tests, etc. and have deemed the installation acceptable. Any further testing by the purchaser will also be witnessed by the manufacturer.
- F. This warranty is executed by an employee of the manufacturer with full authority to bind the manufacturer to the terms hereof.

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Name	Title	Date
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Notary Public and Corporate Seal Required

**1.12 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle Products to site.
- B. Accept cable and accessories on site in manufacturer's packaging. Inspect for damage.
- C. Store and protect in accordance with manufacturer's instructions.
- D. Protect from weather. Provide adequate ventilation to prevent condensation.

**1.13 PROJECT CONDITIONS**

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of cable bank prior to rough-in.
- C. Cable routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Kerite.
- B. Okonite.
- C. Rome.

### **2.2 CABLES**

- A. Grouping shall be three single conductor cables making up a 3-phase circuit, unless otherwise indicated on the drawings. Each cable shall consist of a copper conductor, semi conducting layer, insulation, semi conducting layer, shield, jacket separator, if required and outer jacket. Grounding wire shall be 600 volt insulated copper wire, type RHW, THW, THWN, or XHHW.

### **2.3 CABLE CONSTRUCTION**

- A. Cables shall be single conductors, shielded, jacketed. Keep ends of cables sealed at all times, except when making splices or terminations. Use heat shrinkable plastic end caps with sealant as manufactured by Raychem Corp., Thomas & Betts Co., or other methods approved by cable manufacturer. Cable shall be UL listed, type MV-90, and comply with UL 1072 Medium Voltage Cable.
- B. Marking and Tagging: Mark and tag cables for delivery to the site. Entire length of cable shall be color labeled or color-coded.
- C. Date of Manufacture: No insulated cable OVER ONE YEAR OLD, FROM DATE OF MANUFACTURE WHEN INSTALLED, will be acceptable.
- D. Conductor
  - 1. The copper wire to be used for stranding shall be annealed uncoated in accordance with ASTM B-3 and B-8.
  - 2. Central conductor shall be Class B concentric copper in accordance with the current ASTM Standard B-8.
  - 3. The conductor sizes shall be from 2 AWG up to 1000 kcmil.
- E. Insulation - Insulation shall be as follows:
  - 1a. Kerite insulated conductors shall be rated 15KV between phases, ungrounded, 133% insulation level, Permashield insulation system shall consist of a permashield and a high temperature kerite (HTK) insulation, insulation shield, copper tape shield minimum 5.0 mils thick, uncoated, fabric separator tape over metal tape shield as required, outer heavy duty black jacket. Kerite insulated cable shall meet the intent for testing cables per ICEA S-68-516/NEMA WC-8. Manufacturer shall be Kerite Company, a subsidiary of Hubbell Corporation.

### OR

- 1b. Ethylene Propylene Rubber (EPR) insulated conductors shall be rated 15 KV between phases, ungrounded 133% insulation level, insulation shall be a high-quality, heat, moisture, impact and ozone-resistant flexible thermosetting ethylene-propylene rubber based elastomer. The content of the elastomer used in the insulation compound shall not exceed 72% by weight of ethylene. The insulation shall be concentrically extruded directly over the semi conducting conductor shield.



2. All insulation must be compounded and mixed by the cable manufacturer in its own facilities to ensure maximum control and continuity of quality.
3. The insulation thickness on all conductor sizes 2 AWG through 1000 kcmil shall be 220 mils, and a minimum at any one point shall not be less than 90% of this value.
4. The insulation shield shall be an extruded semi conducting compound with a volume resistivity not in excess of 500 ohm-meters at 90° when tested per AEIC No. CS6. The insulation shield shall also be an ethylene propylene rubber, clean stripped and shall have a peel strength from the insulation between 6 and 24 lbs./0.5 inch width when tested per AEIC No. CS6.
5. Kerite insulated cables shall employ single extrusions while EPR cables shall be triple tandem extruded for conductor shield, insulation, and insulation shield.
6. Cables shall utilize a metallic tape shield, consisting of a 5.0 mil bare copper tape applied over the insulation shield. The tape shall be helically applied with a minimum overlap of 12-1.2%.
7. Cross linked polyethylene (XLP) insulated cables will not be accepted.

F. Jacket

1. The overall jacket over the copper shielding tape shall be heavy duty black (neoprene, Hypalon, or polyvinyl chloride) in accordance with ICEA S-68-516 (NEMA WC-8). The jacket thickness on complete size range from 2 AWG up to 500 kcmil shall be 80 mils and 110 mils for larger conductors.

G. The conductor temperatures shall not exceed 90°C (194°F) under normal operating temperature, 130°C (266°F) for emergency overload, and 250°C (482°F) for short circuit conditions.

H. Listing Agency: Cable types for which Underwriters Laboratories, Inc. provides product listing service shall be listed and bear the listing mark.

## 2.4 TERMINATIONS

A. Provide cable manufacturer's terminations. If cable manufacturer does not fabricate terminations, provide terminations by one of the manufacturers listed below if acceptable to the cable manufacturer. All materials shall be the standard products of one manufacturer. Ampere rating of termination shall not be less than ampere rating of cable. Voltage rating of termination shall not be less than voltage rating of cable.

B. Terminations:

1. Elastimold 166CR with test point and cable shield adapter.
2. G&W Slip-On-Terminators CA1-10 with adapter.
3. Raychem Corp. Thermofit Heat-Shrinkable High Voltage Termination System
4. RTE
5. Mac Products

C. Hand applied terminations shall be 166CR with test point and with voltage rated stress cones.

## 2.5 SPLICES

A. The high voltage cable splice shall be a factory engineered kit containing all necessary components to reinsulate the primary cable installation, metallic shielding/grounding system and overall jacket.

B. Each splice shall consist of a linear stress relief system with a high outer conductive layer for shielding.

- C. Each splice shall pass the following electrical tests IEEE-48-1975, and IEEE-404-1986 and shall pass ANSI-C 119.2-1974 water immersion test. The splice manufacturer shall provide test reports demonstrating compliance with the above requirements.
- D. All splices shall have the following ratings:
1. Voltage Class 15KV
  2. Minimum corona extinction voltage less than or equal to 3pc at 13KV, for EPR cables.
  3. AC with stand 1 minute 50KV
  4. DC with stand 15 minutes 75KV
  5. Impulse with stand 1.2 x 50 110KV microseconds
  6. Continuous current rating equal to cable capacity.
- E. Furnish splices of type that are capable of being disconnected, deadened, or reconnected at future times without destruction to original splices. All materials shall be the standard products of one manufacturer. Ampere rating of splice shall not be less than ampere rating of cable. Field made epoxy-resin unit are not acceptable. Provide one set of special tools required for the assembly of premolded splices to facility.
- F. All applications:
1. Elastimold Premolded Splices
  2. G & W Electric Specialty Co. Universal Splice System
  3. Raychem Thermofit Heat-Shrinkable High Voltage Termination System
- G. All splice kits to be approved by cable manufacturers.

## 2.6 CABLE DEAD ENDS (Full Voltage)

- A. All applications:
1. Elastimold Premolded Splice with Dead-End Plug

## 2.7 PULLING COMPOUNDS

- A. As recommended by cable manufacturer

## 2.8 ARC PROOFING TAPES

- A. Arc Proofing Tape: 3M Scotch 7700; Plymouth Rubber Co. Plyarc; Quelcor Inc. Quelpyre;

## 2.9 POTHEADS

- A. Manufacturers:
1. G&W.
  2. A.B. Chance Company
- B. Description: IEEE 48; Class 1 termination. Pothead with porcelain insulators, cable connector and aerial lug, sealed cable entrance and support, and insulating compound.
- C. Conductors: One.

## 2.10 TAGS

- A. Phenolic Type: Standard phenolic nameplates with 3/8" minimum size lettering engraved thereon.
- B. Embossed Aluminum: Standard stamped or embossed aluminum tags: Tech Products, Inc., Seton Name Plate Corp.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Provide and install all high voltage cables with all connections complete, as specified herein and as indicated on the drawings.
- B. Install cables in conduit after conduit system is complete and cleaned.
- C. Keep ends of cables sealed watertight at all times, except when making splices and terminations.
- D. No grease, oil, lubricant other than approved pulling compound may be used to facilitate the pulling-in of cables.
- E. Use pulling eye factory installed to conductor(s) for pulling in cables. Cable grip will not be allowed. Seal pulling eye attachment watertight.
- F. Pull all cables with a dynamometer or strain gauge incorporated into the pulling equipment. Do not pull cables unless the designated representative is present to observe readings on the dynamometer or strain gauge during the time of actual pulling. Total strain shall not exceed manufacturer recommendations.
- G. Splice and terminate primary cables in accordance with manufacturers approved installation instructions. Ground shield at all splices and terminations. Incorporate solder dam or other method to prevent moisture from entering splices through grounding conductor.
- H. Arc Proofing - Arc proof new feeders installed in a common pullbox or manhole, arc proof each feeder as a unit with half-lapped layer of arc proofing tape and random wrapped or laced with glass cloth tape or glass-fiber cord.
- I. Identification of Feeders: Identify feeders in manholes, pullboxes and in equipment to which they connect with phenolic or embossed aluminum tags.
- J. Install tags on each insulated conductor indicating phase leg. Attach tags with non-ferrous metal wire. Install phase leg tags under arc proofing tapes. Install tags on each feeder indicating feeder number, date installed, (month, year), type of cable, voltage rating, size, and manufacturer. Attach tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes.
- K. Phase Relationship: Connect feeders to maintain phase relationship through system. Phase legs of feeders shall match bus arrangements in equipment to which the feeders are connected.
- L. High Voltage After Installation Test - Perform test after cable has been installed complete with all splicing, bonding, etc., and prior to placing cable into service. Perform test with potential and duration specified by the manufacturer after approval of manufacturers certified test data. Test methods shall be in accordance with latest applicable ICEA and AEIC Specification. Do not make tests until test voltages and duration have been specified in writing by the manufacturer. List results of the tests on standard form supplied by the testing company. Leakage during test shall be read on a micro-ammeter. Perform test in the presence of the Designated Representative. Send results to Engineer and manufacturer for approval and Designated Representative for informational purposes.

### 3.2 INSTALLATION TESTING

- A. Sample Field Test Instructions - Direct current acceptance tests on cable after installations (Hi-Potential Proof Test).
- B. After installation and prior to connecting into service, test cables with a direct potential of 55KV for fifteen (15) consecutive minutes.
1. Test Procedure
  2. Set up test equipment. Do not connect test lead to cables, but temporarily hang the lead free with a plastic bag over the clip. Raise the voltage to the same final level at which the cables are to be tested. The leakage current seen on the DC meter is leakage in the test lead, and should be subtracted from the readings taken later during the cable test. Shut the set off and discharge the lead.
  3. Clear the circuit of any connected equipment so as to preclude damage to such equipment during the test, i.e., remove pothead taps, disconnect transformers, accessible switch taps, etc.
  4. Seal and protect cable ends from moisture to prevent high leakage readings.
  5. Check that adequate clearance exists between the circuit ends under test and ground and to other equipment to prevent flashovers.
  6. Megger cable with minimum 1000 volts.
  7. Perform insulation resistance test phase to phase and phase to ground on all cables. If satisfactory, proceed with current leakage test.
  8. Ground circuit phases not under test.
  9. Apply the direct current voltage slowly, increasing in steps of 10KV. Record the micro-ampere leakage at each step. When the specified test voltage is reached, record current leakage at required durations on current leakage test chart.
  10. Reduce test voltage control to zero. Permit residual voltage on circuit to reduce to about 50% to 20% of test value before discharging by application of manual grounds.
  11. Repeat steps "4" to "9" for remainder of phases of each feeder to be tested.
  12. It should be recognized that d.c. charges remaining on a cable can build up to potentially dangerous voltages if grounds have not been applied for a sufficient length of time. The cable shall remain grounded for as long a period as possible but in no case, for less than one hour.
  13. Copies of all hi-potential proof tests shall be sent to the following parties within three (3) working days after the test via first class mail.
    - a. Engineer
    - b. Facility Superintendent
    - c. Cable Manufacturer
- C. If the cable does not pass any of the tests, the contractor and manufacturer shall remedy the situation and/or replace defective cable. If not, installation will not be accepted.
- D. An additional high potential proof test will be required one month before one year has passed since original acceptance. Test results shall be sent to owner for approval.

**END OF SECTION**

## **SECTION 26 0300**

### **WIRE AND CABLE**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to wire and cable in raceway specified in other sections to complete all work shown on the Drawings or specified herein.

#### **PART 2 - PRODUCTS**

##### **2.1 BUILDING WIRE**

- A. Thermoplastic-insulated building wire: Type THHN.
- B. Rubber insulated building wire: NEMA WC 3.
- C. Feeders and branch circuits larger than number 6 AWG: Copper, stranded conductor, 600 volt insulation, type THHN.
- D. Feeder and branch circuits 6 AWG and smaller: Copper conductor, 600 volt insulation, THWN/THHN, 6 and 8 AWG, stranded conductor; Smaller than 8 AWG, solid conductor.
- E. Service feeders and branch circuits in conduit in contact with earth shall be type XHHW.
- F. Control circuits: Copper, stranded conductor 600 volt insulation, THHN.

##### **2.2 ARMORED CABLE**

- A. BX or pre-manufactured cables are not acceptable except for Type MC for branch wiring after the first junction box (for receptacle and lighting branch circuits) and final connections to motors in interior dry accessible locations, minimum length shall be 18" with a maximum length of 6' for motors.
- B. Type MC fire alarm cable with red stripe for concealed fire alarm wiring as manufactured by AFC series 1800.
- C. Armored cable, Type MC size 14 through 6 AWG: Copper conductor, 600 volt thermoplastic insulation, rated 90 degrees C., with separate green ground conductor.

##### **2.3 REMOTE CONTROL AND SIGNAL CABLE**

- A. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts and plenums. Verify wiring type with manufacturer.

## 2.4 COLOR CODING

- A. All wiring shall be color-coded. Neutral wire shall be white throughout and each phase wire shall be identified any place in the system by its color code. All conductors in panel boxes and junction boxes shall be properly tagged with red non-flammable tags properly attached.
- B. Wire shall be color coded as follows:
- | <u>120/208 volt system</u> |       | <u>Fire Alarm</u> |
|----------------------------|-------|-------------------|
| A Phase                    | Black | Red               |
| B Phase                    | Red   |                   |
| C Phase                    | Blue  |                   |
- C. Equipment ground wires or ground jumpers shall be Green.
- D. In addition to the basic color-coding described the following additional identification and tagging shall apply.
1. The switch legs for the local wall switches and in switch panel shall have distinctive stripes. In instances where color-coding is not practicable, such as short runs of heavy feeder cables, taping the ends of the cable with coded colors as indicated above or tagging will be permitted.
  2. Cables shall be tagged in all pull boxes, wireways and wiring gutters of panels.
  3. Where two (2) or more circuits run to or through a control device, outlet box or junction box, each circuit shall be tagged as a guide in making connections.
  4. Tags shall identify wire or cable by number and/or piece of equipment served as shown on the Drawings.

## PART 3 - EXECUTION

### 3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere.
- C. Use 10 AWG conductor for 20 ampere, 277 volt branch circuit home runs longer than 200 feet for 20 ampere.
- D. Place an equal number of conductors for each phase of a circuit in same raceway or cable. No more than one of each phase shall be supported by a single neutral.
- E. Splice only in junction or outlet boxes.
- F. Neatly tag, identify, train and lace wiring inside boxes, equipment and panelboards.
- G. Make conductor lengths for parallel circuits equal.

### **3.2 WIRING INSTALLATION IN RACEWAYS**

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.
- B. Completely and thoroughly swab raceway system before installing conductors.
- C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

### **3.3 CABLE INSTALLATION**

- A. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or metal cable ties to support cables from structure (not ceiling suspension system). Include bridle rings or drive rings.
- B. Use suitable cable fitting and connectors.

### **3.4 WIRING CONNECTIONS AND TERMINATIONS**

- A. Splice only in accessible junction boxes.
- B. Use solderless pressure connections with insulating covers for copper wire splices and tape, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- C. Provide extended gutters and tap blocks or pull boxes with tap rail systems similar to Burndy MT Series or Burndy Electroraill system for wire splices 6 AWG and larger.
- D. Tape uninsulated conductors with electrical tape to 150 percent of the insulation value of conductor.
- E. Thoroughly clean wires before installing lugs and connectors.
- F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- G. Terminate spare conductors with electrical tape.

### **3.5 FIELD QUALITY CONTROL**

- A. Field inspection and testing will be performed under provisions of the Specifications.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque test conductor connections and terminations to manufacturer's recommended values.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

### **3.6 WIRE AND CABLE INSTALLATION SCHEDULE**

- A. All wiring and cable shall be installed in conduit unless otherwise noted. Refer to conduit section 26 0200 for conduit types at various location.

**END OF SECTION**





**SECTION 26 0320**

**OVERCURRENT PROTECTIVE DEVICES**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. Work of this section includes all labor, materials, equipment and services necessary to complete the electrical work as shown of the Drawings and specified herein, including, but not limited to, the following:
- B. Fuses
  - 1. Current limiting cartridge fuses.
  - 2. Time delay cartridge fuses.
- C. Circuit Breakers
  - 1. Standard molded case circuit breakers "bolted in" type.
  - 2. Solid state circuit breakers.
  - 3. Current limiting circuit breakers.
  - 4. Enclosed circuit breakers.

**1.2 SUBMITTALS**

- A. Shop drawings showing dimensions, location of equipment and method of installation.
- B. Product Data: Manufacturer's printed data, catalog cuts.

**1.3 DISCONNECT SWITCHES**

- A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position. Fuse clips shall be designed to accommodate Class R, J fuses.
- B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA Type 1, 3R or 4 as required.

**1.4 FUSES**

- A. Voltage ratings of fuses shall be suitable for the supply characteristics to which they are applied.
- B. Fuse type and size shall be suitable for installation in related disconnect switch or circuit breaker.

C. Current limiting fuses shall be as follows:

1. Regardless of actual available fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 280,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.
2. They shall have average melting time-current characteristics to meet the Underwriters' Laboratories requirements for "Class RK-1" 0-600 amp fuses.

D. Regardless of actual available fault current, they shall be capable of limiting peak let through current to the following values based on 200,000 amperes RMS symmetrical or 280,000 amperes asymmetrical being available:

<u>Rating In Amperes</u>	<u>Peak Let Through Current In Amps</u>
15-30	6,000
35-50	8,000
70-100	12,000
125-200	20,000
225-601	38,000

E. Fuses shall be rejection type. Fuse clip shall be rejection type.

F. Fuse Type and Application Table:

<u>Category of Application</u>	<u>Acceptable Fuse Types</u> (Bussman Designations @ 600V)
Motor feeder	LPS below 600A
Power panel feeders	LPS below 600A
Safety switches	LPS

### 1.5 CIRCUIT BREAKERS

- A. "Bolted-In" type, manually operated, quick-make, quick-break, mechanically trip-free operating mechanisms for simultaneous operation, of all poles, with contacts, arc interrupters and trip elements for each pole. "Plug-in" breakers are not permitted.
- B. Tripping units shall be "thermal-magnetic" type having bimetallic elements for time delay overload protection, and magnetic elements for short circuit protection.
- C. Manually operable by mean of toggle type operating handles having tripped positions midway between the "on-off" position. Handle to be clearly labeled as to breaker rating.
- D. Minimum frame size for all circuit breakers, 1, 2, or 3 pole shall be 100 amperes.
- E. Their interrupting rating shall not be less than 25,000 amperes RMS symmetrical at 208 volt for distribution panels and 10,000 amperes for power panels.

## **1.6 APPLICATIONS**

- A. Category of Application for Fuses
  - 1. Feeders on switchboards.
  - 2. Branch fused switch unit in distribution panel.
  - 3. Fused safety switch.
  - 4. Combination motor starters.
- B. Category of Application for Circuit Breakers
  - 1. Panelboards.
  - 2. Switchboards.
  - 3. Individual enclosures.
  - 4. Combination motor starters.

## **1.7 SPARE FUSES**

- A. Upon Engineer's acceptance of the electrical distribution system, provide spare fuses as follows: 10% of each type and rating installed 600 amperes and smaller (minimum of 3). Provide spare fuse cabinet with directory to store all spare fuses. Locate as directed by Engineer and/or Owner.

## **1.8 APPROVED MANUFACTURERS**

- A. Fuses: Bussman, Ferraz-Shawmut.
- B. Circuit Breakers: Siemens, General Electric, Square D.

## **1.9 INSTALLATION**

- A. All material installation shall be in accordance with manufacturer recommendations and the provisions of all applicable codes.
- B. All fuses and circuit breakers shall be selectively coordinated.
- C. Install disconnect switches where indicated on Drawings.
- D. Install fuses in fusible disconnect switches.
- E. Disconnects shall have NEMA 3R enclosure.

## **1.10 RECORD DRAWINGS**

- A. Shop drawings showing dimensions, location of equipment and method of installation.
- B. Product Data: Manufacturer's printed data, catalog cuts, performance curves.

**END OF SECTION**



## **SECTION 26 0350**

### **BOXES**

#### **PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install wall and ceiling outlet boxes, floor boxes, pull and junction boxes to complete all work shown on the Drawings or specified herein.

##### **1.2 RELATED WORK**

- A. Access doors.
- B. Wiring devices: Service fittings and fire-rated poke-through fittings for floor boxes.
- C. Cabinets and enclosures.

#### **PART 2 - PRODUCTS**

##### **2.1 OUTLET BOXES**

- A. Sheet metal outlet boxes: ANSI/NEMA OS 1; Galvanized steel, with 1/2 inch male fixture studs where required.
- B. Cast boxes: Cast ferroalloy, deep type, gasketed cover, threaded hubs.
- C. Typical receptacle box shall be 4" square metal boxes, 30.8 cubic inch capacity with brackets as required. Provide 4" square raised device covers.

##### **2.2 PULL AND JUNCTION BOXES**

- A. Sheetmetal boxes: ANSI/NEMA OS 1; Galvanized steel.
- B. Sheetmetal boxes larger than 12 inches in any dimension: Hinged enclosure in accordance with Section 26 0450.
- C. Cast metal boxes for outdoor and wet location installations: NEMA 250; Type 4 and type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast metal boxes for underground installation: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless cover screws.

#### **PART 3 - EXECUTION**

##### **3.1 COORDINATION OF BOX LOCATIONS**

- A. Provide electrical boxes as required in excess of that shown on Drawings and as required for splices, taps, wire pulling, equipment connections and code compliance.

- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Where installations are accessible, coordinate locations and sizes of required access doors with Division 1.
- D. Locate and install to maintain headroom and to present neat appearance.

### **3.2 OUTLET BOX INSTALLATION**

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings.
- D. Support boxes independently of conduit except for cast iron boxes that are connected of rigid metal conduits, both supported within 12 inches of box.
- E. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- F. Install boxes in wall without damaging wall insulation.
- G. Coordinate mounting heights and locations of outlets mounted above counters, benches and backspaces.
- H. Position outlets to locate luminaries as shown on reflected ceiling plans.
- I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- L. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.

### **3.3 PULL AND JUNCTION BOX INSTALLATION**

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.

### **3.4 FLOOR BOX INSTALLATION**

- A. Set boxes level and flush with finish flooring material.
- B. Use cast iron floor boxes for installation in slab on grade.

**END OF SECTION**

**SECTION 26 0400**

**WIRING DEVICES**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install receptacles, service fittings device plates and box covers to complete all work shown on the Drawings or specified herein.

**1.2 REFERENCES**

- A. FS W-C-596 - Electrical power connector, plug, receptacles and cable outlet.
- B. FS W-S-896 - Switch, toggle.
- C. NEMA WD 1 - General purpose wiring devices.
- D. NEMA WD 5 - Specific-purpose wiring devices.

**1.3 SUBMITTALS**

- A. Submit product data under Provisions of Contract and Division 1.
- B. Provide product data showing configurations, finishes, dimensions and manufacturer's instructions.

**PART 2 - PRODUCTS**

**2.1 RECEPTACLES**

- A. Convenience and straight-blade receptacles: 125 V, 2 pole, 3 wire, 20 ampere specification grade, ground fault interrupting or isolated ground type.
- B. Internal ground clip of receptacles shall be in one piece with the receptacle mounts.
- C. Receptacles with riveted ground clips will not be accepted.
- D. Isolated ground type receptacle shall be orange in color.

**2.2 WALL SWITCHES**

- A. Wall switches for lighting circuits and motor loads under 1/2 hp: AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC.
- B. Handle: Ivory plastic.
- C. Pilot light type: Lighted handle. Pilot strap in adjacent gang.
- D. Locator type: Lighted handle.

**2.3 COVER PLATES**

- A. Decorative cover plate: Stainless steel 302/304 smooth Hubbell "S" series.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install receptacles on roof along parapet wall.
- B. Install specific use receptacles at heights shown on contract drawings.
- C. Drill opening for poke - through fitting installation in accordance with manufacturer's instructions.
- D. Install plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.
- F. Install devices and wall plates flush and level.

**END OF SECTION**



**SECTION 26 0425**

**DIGITAL LIGHTING CONTROL SYSTEM**

**PART 1 – GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 SUMMARY**

- A. Section Includes
  - 1. Digital Lighting Controls
  - 2. Relay Panels
  - 3. Emergency Lighting Control (if applicable)
  
- B. Related Sections
  - 1. Section 26 0400 Wiring Devices: Receptacles
  - 2. Section 26 0575 Interior Luminaires.
  - 3. Electrical Sections, including wiring devices, apply to the work of this Section.
  
- C. Control Intent – Control Intent includes, but is not limited to:
  - 1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
  - 2. Initial sensor and switching zones
  - 3. Initial time switch settings
  - 4. Task lighting and receptacle controls
  - 5. Emergency Lighting control (if applicable)

**1.2 REFERENCES**

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. Underwriter Laboratories of Canada (ULC)
- C. International Electrotechnical Commission (IEC)
- D. International Organization for Standardization (ISO)
- E. National Electrical Manufacturers Association (NEMA)
- F. WD1 (R2005) - General Color Requirements for Wiring Devices.
- G. Underwriters Laboratories, Inc. (UL)
  - 1. 20 – Plug Load Controls
  - 2. 508– Industrial Controls
  - 3. 916 – Energy Management Equipment.
  - 4. 924 – Emergency Lighting

### 1.3 SYSTEM DESCRIPTION AND OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
  2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
  3. Handheld remotes for personal control – One-button dimming, two-button on/off, or five-button scene remotes provide control using infrared communications. Remote may be configured in the field to control selected loads or scenes without special tools.
  4. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.
  5. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
  6. Digital Plug-Load Controllers – Self-configuring, digitally addressable, single relay, plenum-rated application-specific controllers. Selected models include integral current monitoring capabilities.
  7. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.
  8. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
  9. Digital Lighting Management (DLM) segment network – Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded,) to connect multiple DLM local networks for centralized control
  10. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
  11. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
  12. Programming and Configuration software – Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
  13. LMCP Digital Lighting Management Relay Panel – provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).
  14. LMZC-301 – Digital Zone Controller. Accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming. Provides BACnet MS/TP-compliant digital networked communication between other lighting controls and/or building automation system (BAS).
  15. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

## 1.4 LIGHTING CONTROL APPLICATIONS

- A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
  2. Bi-Level Lighting – Provide multi-level controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
  3. Task Lighting / Plug Loads – Provide automatic shut off of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic-ON of plug loads whenever spaces are occupied. For spaces with multiple occupants a single shut off consistent with the overhead lighting may be used for the area.
  4. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
    - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
    - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
    - c. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
    - d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.
  5. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

## 1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings
1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
  2. Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
  3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
  4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Product Data: Catalog sheets, specifications and installation instructions.

- D. Include data for each device which:
  - 1. Indicates where sensor is proposed to be installed.
  - 2. Prove that the sensor is suitable for the proposed application.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum [10] years' experience in manufacture of lighting controls.

## 1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - 1. Ambient temperature: 0° to 40° C (32° to 104° F).
  - 2. Relative humidity: Maximum 90 percent, non-condensing.

## 1.8 WARRANTY

- A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

## 1.9 MAINTENANCE

- A. Spare Parts
  - 1. Provide spares of each product to be used for maintenance as listed below: Refer to design documents. Coordinate with owner for quantity prior to purchase order.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer
  - 1. WattStopper
    - a. System: Digital Lighting Management (DLM)
  - 2. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, one of the following:
    - a. Refer to design documents.
- B. Substitutions: [If Permitted]
  - 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
  - 2. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted for review and approval prior to rough-in.

## 2.2 DIGITAL LIGHTING CONTROLS

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

## 2.3 DIGITAL WALL SWITCH OCCUPANCY SENSORS

- A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
  - 1. Digital calibration and pushbutton configuration for the following variables:
    - a. Sensitivity – 0-100% in 10% increments
    - b. Time delay – 1-30 minutes in 1 minute increments
    - c. Test mode – Five second time delay
    - d. Detection technology – PIR, Dual Technology activation and/or re-activation.
    - e. Walk-through mode
    - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
  - 2. Programmable control functionality including:
    - a. Each sensor may be programmed to control specific loads within a local network.
    - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
    - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      - i Ultrasonic and Passive Infrared
      - ii Ultrasonic or Passive Infrared
      - iii Ultrasonic only
      - iv Passive Infrared only
  - 3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
  - 4. Two RJ-45 ports for connection to DLM local network.
  - 5. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
  - 6. Device Status LEDs including:
    - a. PIR detection
    - b. Ultrasonic detection
    - c. Configuration mode
    - d. Load binding
  - 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
  - 8. Assignment of local buttons to specific loads within the room without wiring or special tools.

9. Manual override of controlled loads.
  10. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.
- C. BACnet object information shall be available for the following objects:
1. Detection state
  2. Occupancy sensor time delay
  3. Occupancy sensor sensitivity, PIR and Ultrasonic
  4. Button state
  5. Switch lock control
  6. Switch lock status
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:
1. Left button
    - a. Press and release - Turn load on
    - b. Press and hold - Raise dimming load
  2. Right button
    - a. Press and release - Turn load off
    - b. Press and hold - Lower dimming load
- G. Low voltage momentary pushbuttons shall include the following features:
1. Load/Scene Status LED on each switch button with the following characteristics:
    - a. Bi-level LED
    - b. Dim locator level indicates power to switch
    - c. Bright status level indicates that load or scene is active
  2. The following button attributes may be changed or selected using a wireless configuration tool:
    - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
    - b. Individual button function may be configured to Toggle, On only or Off only.
    - c. Individual scenes may be locked to prevent unauthorized change.
    - d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
    - e. Ramp rate may be adjusted for each dimmer switch.
    - f. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- H. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

## 2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
  1. Digital calibration and pushbutton configuration for the following variables:
    - a. Sensitivity – 0-100% in 10% increments
    - b. Time delay – 1-30 minutes in 1 minute increments
    - c. Test mode – Five second time delay
    - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - e. Walk-through mode
    - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
  2. Programmable control functionality including:
    - a. Each sensor may be programmed to control specific loads within a local network.
    - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
    - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
      - i Ultrasonic and Passive Infrared
      - ii Ultrasonic or Passive Infrared
      - iii Ultrasonic only
      - iv Passive Infrared only
  3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
  4. One or two RJ-45 port(s) for connection to DLM local network.
  5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
  6. Device Status LEDs, which may be disabled for selected applications, including:
    - a. PIR detection
    - b. Ultrasonic detection
    - c. Configuration mode
    - d. Load binding
  7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
  8. Manual override of controlled loads.
  9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

- C. BACnet object information shall be available for the following objects:
  - 1. Detection state
  - 2. Occupancy sensor time delay
  - 3. Occupancy sensor sensitivity, PIR and Ultrasonic
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

## 2.5 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
  - 1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
  - 2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  - 3. Configuration LED on each switch that blinks to indicate data transmission.
  - 4. Load/Scene Status LED on each switch button with the following characteristics:
    - a. Bi-level LED
    - b. Dim locator level indicates power to switch
    - c. Bright status level indicates that load or scene is active
  - 5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
  - 6. Programmable control functionality including:
    - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
    - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
  - 7. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. BACnet object information shall be available for the following objects:
  - 1. Button state
  - 2. Switch lock control
  - 3. Switch lock status
- C. Two RJ-45 ports for connection to DLM local network.
- D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.



- E. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
  2. Individual button function may be configured to Toggle, On only or Off only.
  3. Individual scenes may be locked to prevent unauthorized change.
  4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
  5. Ramp rate may be adjusted for each dimmer switch.
  6. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- F. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

## 2.6 HANDHELD REMOTE CONTROLS

- A. Battery-operated handheld devices in 1, 2 and 5 button configurations for remote switching or dimming control. Remote controls shall include the following features:
1. Two-way infrared (IR) transceiver for line of sight communication with DLM local network within up to 30 feet.
  2. LED on each button confirms button press.
  3. Load buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
  4. Inactivity timeout to save battery life.
- B. A wall mount holster and mounting hardware shall be included with each remote control.
- C. WattStopper part numbers: LMRH-101, LMRH-102, LMRH-105.

## 2.7 DIGITAL PARTITION CONTROLS

- A. Partition controls shall enable manual or automatic coordination of lighting controls in flexible spaces with up to four moveable walls by reconfiguring the connected digital switches and occupancy sensors.
- B. Four-button low voltage pushbutton switch for manual control.
1. Two-way infrared (IR) transceiver for use with configuration remote control.
  2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  3. Configuration LED on each switch that blinks to indicate data transmission.
  4. Each button represents one wall; Green button LED indicates status.
  5. Two RJ-45 ports for connection to DLM local network.
  6. WattStopper part number: LMPS-104. Available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening.
- C. Contact closure interface for automatic control via input from limit switches on movable walls (by others).
1. Operates on Class 2 power supplied by DLM local network.
  2. Includes 24VDC output and four input terminals for maintained third party contract closure inputs.
    - a. Input max. sink/source current: 1-5mA
    - b. Logic input signal voltage High: >18VDC
    - c. Logic input signal voltage Low: <2VDC

3. Four status LEDs under hinged cover indicate if walls are open or closed; supports LMPS-104 as remote status indicator.
4. Two RJ-45 ports for connection to DLM local network.
5. WattStopper part number: LMIO-102

## 2.8 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot candles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
  - a. Light level
  - b. Day and night setpoints
  - c. Off time delay
  - d. On and off setpoints
  - e. Up to three zone setpoints
  - f. Operating mode – on/off, bi-level, tri-level or dimming

14. One RJ-45 port for connection to DLM local network.
  15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
  16. Any load or group of loads in the room can be assigned to a daylighting zone
  17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
  18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.
- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
  2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
  3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
  4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
  2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
  3. Each of the three discrete daylight zones can include any non-overlapping group of loads in the room.
  4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this cone
  2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
  3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
  4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
  5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
  6. Device must include extendable mounting arm to properly position sensor within a skylight well.
  7. WattStopper product number LMLS-600

## 2.9 DIGITAL ROOM CONTROLLERS AND PLUG-LOAD CONTROLLERS

- A. Digital controllers for lighting and plug loads automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room and plug load controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
  2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
  3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
  4. Device Status LEDs to indicate:
    - a. Data transmission
    - b. Device has power
    - c. Status for each load
    - d. Configuration status
  5. Quick installation features including:
    - a. Standard junction box mounting
    - b. Quick low voltage connections using standard RJ-45 patch cable
  6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    - a. Turn on to 100%
    - b. Remain off
    - c. Turn on to last level
  7. Each load shall be configurable to operate in the following sequences based on occupancy:
    - a. Auto-on/Auto-off (Follow on and off)
    - b. Manual-on/Auto-off (Follow off only)
  8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
  9. BACnet object information shall be available for the following objects:
    - a. Load status
    - b. Electrical current
    - c. Total watts per controller
    - d. Schedule state – normal or after-hours
    - e. Demand response control and cap level
    - f. Room occupancy status
    - g. Total room lighting and plug loads watts
    - h. Total room watts/sq ft
    - i. Force on/off all loads
  10. UL 2043 plenum rated

11. Manual override and LED indication for each load
  12. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.
  13. Zero cross circuitry for each load
  14. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
1. One or two relay configuration
  2. Efficient 150 mA switching power supply
  3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
  4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
  2. Multiple relay configurations
    - a. One, two or three relays (LMRC-21x series)
    - b. One or two relays (LMRC-22x series)
  3. Efficient 250 mA switching power supply
  4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
  5. One dimming output per relay
    - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
    - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
    - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
    - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
    - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
    - f. Calibration and trim levels must be set per output channel.
    - g. Devices that set calibration or trim levels per controller are not acceptable.
    - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
8. The following dimming attributes may be changed or selected using a wireless configuration tool:
  - a. Establish preset level for each load from 0-100%
  - b. Set high and low trim for each load
  - c. Set lamp burn in time for each load up to 100 hours
9. Override button for each load provides the following functions:
  - a. Press and release for on/off control
  - b. Press and hold for dimming control
10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222

D. Plug Load Room Controllers shall include:

1. One relay configuration with additional connection for un-switched load
2. Configurable additive time delay to extend plug load time delay beyond occupancy sensor time delay (e.g. a 10 minute additive delay in a space with a 20 minute occupancy sensor delay ensures that plug loads turn off 30 minutes after the space is vacated).
3. Factory default operation is Auto-on/Auto-off, based on occupancy
4. Real time current monitoring of both switched and un-switched load (LMPL-201 only)
5. Efficient switching power supply
  - a. 150mA (LMPL-101)
  - b. 250mA (LMPL-201)
6. RJ-45 DLM local network ports
  - a. Three RJ-45 ports (LMPL-101)
  - b. Four RJ-45 ports (LMPL-201)
7. WattStopper product numbers: LMPL-101, LMPL-201.

**2.10 DLM LOCAL NETWORK (Room Network)**

- A. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
- B. Features of the DLM local network include:
  1. Plug n' Go® automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
  2. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
  3. Push n' Learn® configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
  4. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- C. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.

- D. If manufacturer's pre-terminated Cat 5e cables are not used for the installation, the contractor is responsible for testing each cable following installation and supplying manufacturer with test results.
- E. WattStopper Product Number: LMRJ-Series

## **2.11 DLM SEGMENT NETWORK (Room to Room Network)**

- A. The segment network shall be a linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms) and LMCP relay panels for centralized control.
  - 1. Each connected DLM local network shall include a single network bridge (LMBC-300), and the network bridge is the only room-based device that is connected to the segment network.
  - 2. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
  - 3. The segment network shall utilize 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. The maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
  - 4. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
  - 5. Substitution of manufacturer-supplied cable must be pre-approved: Manufacturer will not certify network reliability, and reserves the right to void warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
  - 6. Segment networks shall be capable of connecting to BACnet-compliant BAS (provided by others) either directly, via MS/TP, or through NB-ROUTERS, via BACnet/IP or BACnet/Ethernet. Systems whose room-connected network infrastructure require gateway devices to provide BACnet data to a BAS are unacceptable.
- B. WattStopper Product Number: LM-MSTP, LM-MSTP-DB

## **2.12 CONFIGURATION TOOLS**

- A. A wireless configuration tool facilitates optional customization of DLM local networks using two-way infrared communications, while PC software connects to each local network via a USB interface.
- B. Features and functionality of the wireless configuration tool shall include but not be limited to:
  - 1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
  - 2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
  - 3. Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
  - 4. Save up to eight occupancy sensor setting profiles and apply profiles to selected sensors.
  - 5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
  - 6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.

7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
8. Verify status of building level network devices.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

### 2.13 NETWORK BRIDGE

A. The network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. The network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.

1. The network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
2. Provide Plug n' Go operation to automatically discover room devices connected to the local network and make all device parameters visible to the segment manager via the segment network. No commissioning shall be required for set up of the network bridge on the local network.
3. The network bridge shall automatically create standard BACnet objects for selected room device parameters to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM room devices on each local network. BACnet objects will be created for the addition or replacement of any given in-room DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
  - a. Read/write the normal or after hours schedule state for the room
  - b. Read the detection state of each occupancy sensor
  - c. Read the aggregate occupancy state of the room
  - d. Read/write the On/Off state of loads
  - e. Read/write the dimmed light level of loads
  - f. Read the button states of switches
  - g. Read total current in amps, and total power in watts through the room controller
  - h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
  - i. Activate a preset scene for the room
  - j. Read/write daylight sensor fade time and day and night setpoints
  - k. Read the current light level, in foot candles, from interior and exterior photosensors and photocells
  - l. Set daylight sensor operating mode
  - m. Read/write wall switch lock status
  - n. Read watts per square foot for the entire controlled room
  - o. Write maximum light level per load for demand response mode
  - p. Read/write activation of demand response mode for the room
  - q. Activate/restore demand response mode for the room

B. WattStopper product numbers: LMBC-300



## 2.14 SEGMENT MANAGER

- A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).
- B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manager via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the plans.
- C. Operational features of the Segment Manager shall include the following:
1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
  2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. Shall not require installation of any lighting control software to an end-user PC.
  3. Log in security capable of restricting some users to view-only or other limited operations.
  4. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
  5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
  6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
  7. Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.
  8. Ability to group rooms and loads for common control by schedules, switches or network commands.
  9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
  10. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control.
  11. The Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.
- D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 900 digital in-room devices (LMSM-3E).
  2. Support up to 300 network bridges and 2,200 digital in room devices, connected via network routers and switches (LMSM-6E).
- E. WattStopper Product Numbers: LMSM-3E, LMSM-6E, NB-ROUTER, NB-SWITCH, NB-SWITCH-8, NB-SWITCH-16.

## 2.15 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

- A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.
1. Additional parameters exposed through this method include but are not limited to:
    - a. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
    - b. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
    - c. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
    - d. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
    - e. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
    - f. Load control polarity reversal so that on events turn loads off and vice versa.
    - g. Per-load DR (demand response) shed level in units of percent.
    - h. Load output pulse mode in increments of 1second.
    - i. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.
  2. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
    - a. Device list report: All devices in a project listed by type.
    - b. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
    - c. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
    - d. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
    - e. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
    - f. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100%, 2 = all loads 75%, 3 = all loads 50%, 4 = all loads 25%, 5-16 = same as scene 1).
    - g. Occupancy sensor report: Basic settings including time delay and sensitivity(ies) for all occupancy sensors.
  3. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
    - a. Set, copy/paste an entire project site of sensor time delays.
    - b. Set, copy/paste an entire project site of sensor sensitivity settings.
    - c. Search based on room name and text labels.
    - d. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
    - e. Filter by parameter value to search for product with specific configurations.
  4. Network-wide firmware upgrading remotely via the BACnet/IP network.
    - a. Mass firmware update of entire rooms.
    - b. Mass firmware update of specifically selected rooms or areas.
    - c. Mass firmware upgrade of specific products.
- B. WattStopper Product Number: LMCS-100, LMCI-100

## 2.16 LMCP LIGHTING CONTROL PANELS

- A. Provide lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:
1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.
  2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
  3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
    - a. Removable, plug-in terminal blocks with connections for all low voltage terminations.
    - b. Individual terminal block, override pushbutton, and LED status light for each relay.
    - c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.
    - d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.
    - e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
    - f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
    - g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.
    - h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
    - i. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:
      - a) Electrical:
        - i 30 amp ballast at 277V
        - ii 20 amp ballast at 347V
        - iii 20amp tungsten at 120V
        - iv 30 amp resistive at 347V
        - v 1.5 HP motor at 120V
        - vi 14,000 amp short circuit current rating (SCCR) at 347V
        - vii Relays shall be specifically UL 20 listed for control of plug-loads
      - b) Mechanical:
        - i Replaceable, ½" KO mounting with removable Class 2 wire harness.
        - ii Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.
        - iii Dual line and load terminals each support two #14 - #12 solid or stranded conductors.
        - iv Tested to 300,000 mechanical on/off cycles.

4. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
5. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
6. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700.
7. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.
  - a. Each panel shall include digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
  - b. The clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.
  - c. The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery backup for the clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
  - d. The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:
    - i Scheduled ON / OFF
    - ii Manual ON / Scheduled OFF
    - iii Astro ON / OFF (or Photo ON / OFF)
    - iv Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
  - e. The user interface shall be a portable IR handheld remote control capable of programming any panel in the system (LMCT-100)
  - f. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
  - g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.
8. The lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.
9. The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet® protocol.
  - a. The panel shall have provision for an individual BACnet device ID and shall support the full  $2^{22}$  range (0 – 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
  - b. The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
  - c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
  - d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.

- e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the afterhours mode.
  - f. Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:
    - i. Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.
    - ii. Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after-hours schedule control.
    - iii. Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.
    - iv. Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.
    - g. The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.
    - h. The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object described in addendum. (<http://www.bacnet.org/Addenda/Add-135-2010aa.pdf>)
    - i. Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.
    - j. Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.
10. WattStopper Product Number: LMCP8, LMCP24 or LMCP48
- B. User Interface: Each lighting control panel system shall be supplied with at least (1) handheld configuration tool (LMCT-100). As a remote programming interface the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following panel-specific functions as a minimum.
- 1. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
  - 2. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
  - 3. Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.

4. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.
5. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
6. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.
7. An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as determined by the end user's representative.
8. WattStopper Product Number: LMCT-100

## **2.17 EMERGENCY LIGHTING CONTROL DEVICES**

- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
  1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
  2. Push to test button
  3. Auxiliary contact for remote test or fire alarm system interface
- B. WattStopper Product Numbers: ELCU-100, ELCU-200.

## **PART 3 – EXECUTION**

### **3.1 PRE-INSTALLATION MEETING**

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
  1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
  2. Review the specifications for low voltage control wiring and termination.
  3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
  4. Discuss requirements for integration with other trades.

### **3.2 CONTRACTOR INSTALLATION AND SERVICES**

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.
- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturers with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start-up, contractor shall test all devices to ensure proper communication.
- D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
- E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
  - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
  - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
  - 3. Load Parameters (e.g. blink warning, etc.)
- F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

### **3.3 FACTORY SERVICES**

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
- B. The Electrical Contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

### **3.4 COMMISSIONING SERVICES**

- A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.
- B. The commissioning agent shall work with the Electrical Contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

**END OF SECTION**





**SECTION 26 0450**

**CABINETS AND ENCLOSURES**

**PART 1 - GENERAL**

Applicable Provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install hinged cover enclosures to complete all work shown on the Drawings or specified herein.

**1.2 REFERENCES**

- A. NEMA 250 - Enclosures for electrical equipment (1000 volts maximum).
- B. Submittals - Submit product data under Provisions of Contract and Division 1.

**PART 2 - PRODUCTS**

**2.1 HINGED COVER ENCLOSURES**

- A. Construction: NEMA 250; Type 1 and 3R steel.
- B. Finished: Manufacturer's standard enamel finish.
- C. Covers: Continuous hinge, held closed by operable by key.
- D. Provide barriers between normal and emergency wiring. Barriers shall be of non-current carrying material of adequate thickness for mechanical strength but in no case less than 1/4". Each barrier shall have an angle iron framing support all around.

**2.2 FABRICATION**

- A. Shop assemble enclosures in accordance with ANSI/NEMA ISC 6.
- B. Provide knockouts on enclosures.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install enclosures plumb; Anchor securely to wall and structural supports at each corner, minimum.
- B. Provide necessary feet for free-standing equipment enclosures.
- C. Install trim plumb.

**END OF SECTION**



**SECTION 26 0500**

**SUPPORTING DEVICES**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

**1.2 RELATED WORK**

- A. Conduit and equipment supports.
- B. Fastening hardware.

**1.3 REFERENCES**

- A. Conduit supports.

**1.4 QUALITY ASSURANCE**

- A. Support system shall be adequate for weight of equipment and conduit, including wiring, which they carry.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Support channel: Galvanized or painted steel.
- B. Hardware: Corrosion resistant.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Fasten hanger rods, conduit clamps, outlet, junction boxes to building structure using preset inserts, beam clamps and spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; Expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors.
- E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

- F. In wet locations install free-standing electrical equipment on concrete pads.
- G. Install surface mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.
- H. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

**END OF SECTION**

**SECTION 26 0550**

**GENERAL LABELING AND IDENTIFICATION**

**PART 1 - GENERAL**

Applicable Provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install nameplates, tape labels, wire markers, conduit color coding to complete all work shown on the Drawings or specified herein.

**1.2 RELATED WORK**

- A. Painting.

**1.3 SUBMITTALS**

- A. Submit shop drawings under provisions of Division 1.
- B. Include schedule for nameplates and tape labels.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Tape labels: Embossed adhesive tape with 3/16 inch black letters on a white background.
- C. Wire and cable markers: Cloth markers, split sleeve or tubing type.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

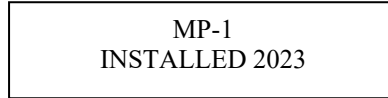
- A. De-grease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application. Use embossed tape only for identification of individual wall switches and receptacles and control device stations.

**3.2 WIRE IDENTIFICATION**

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes and at load connection. Identify each branch circuit or feeder number for power and lighting circuits and each control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

### 3.3 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates to identify all electrical distribution, control equipment and loads served including year of installation. Letter height: 1/2 inch for individual switches, loads served, distributions and control equipment identification. For example:



- B. Panelboards: 3/4 inch, identify equipment designation. 1/2 inch, identify voltage rating and source of power.
- C. Individual circuit breakers, switches and motor starters in panelboards, switchboards and motor control centers: 1/4 inch, identify circuit and load served, including location.
- D. Individual circuit breakers, enclosed switches and motor starters: 1/2 inch, identify load served.

### 3.4 FIRE ALARM

- A. All fire alarm raceway components shall be painted red and identified.

**END OF SECTION**

**SECTION 26 0575**

**INTERIOR LUMINAIRES**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. Interior luminaires and accessories.
- B. Emergency lighting units.
- C. Exit signs.
- D. LED Driver.
- E. LED dimming and controls.
- F. LED emergency power supply.
- G. Lamps.
- H. Luminaire accessories.

**1.2 REFERENCES**

- A. ANSI/IES RP-16-10 – Nomenclature and Definitions for Illuminating Engineering.
- B. ANSI C78.37 7 – Specifications for the Chromaticity of Solid-State Lighting (SSL) Products.
- C. IES LM-79-08 – Electric and Photometric Measurements of Solid-State Lighting Products.
- D. IES LM-80-08 – Measuring Lumen Maintenance of LED Light Sources.
- E. IES 7M-21-11 – Projecting Long Term Lumen Maintenance of LED Light Sources.
- F. IES LM-82-11 – IES Approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
- G. UL 8750 – LED Equipment for Use in Lighting Products.
- H. NEMA WD 6 - Wiring Devices – Dimensional Requirements.
- I. NFPA 70 - National Electrical Code.
- J. NFPA 101- Life Safety Code.

**1.3 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

#### **1.4 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70 and to requirements of NFPA 101.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. (UL), American National Standards Institute (ANSI) and Illuminating Engineering Society (IES).

#### **1.5 SUBSTITUTIONS**

- A. All proposed substitutions must be submitted with each light fixture specification cutsheet, accompanied with footcandle calculation for all spaces, provided for Architect and Engineer's review, prior to approval.
- B. If the substitution is accepted, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

### **PART 2 - PRODUCTS**

#### **2.1 LUMINAIRES**

- A. Furnish Products as scheduled.

#### **2.2 EXIT SIGNS**

- A. Manufacturers: As scheduled.
- B. Description: Exit sign fixture suitable for use as emergency lighting unit.
- C. Housing: Extruded aluminum or steel as per schedule.
- D. Face: Aluminum stencil face with red letters, unless otherwise noted.
- E. Directional Arrows: Universal type for field adjustment, direction per drawing.
- F. Mounting: Universal, for field selection or per drawing.
- G. Lamps: L.E.D.
- H. Input Voltage: As scheduled.

#### **2.3 LED DRIVERS**

- A. Manufacturers: As scheduled.
- B. Voltage: As scheduled.

#### **2.4 LAMPS**

- A. Lamp Types: As specified for luminaire. LED source.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.



- B. Support luminaires 2 x 4 foot (600 x 1200 mm) and larger in size independent of ceiling framing.
- C. All lay-in luminaries shall be supported with chains to building structure.
- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- F. Install wall mounted luminaires, emergency lighting units and exit signs at 80" above finished floor, unless otherwise noted.
- G. Install accessories furnished with each luminaire.
- H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

### **3.2 FIELD QUALITY CONTROL**

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

### **3.3 ADJUSTING**

- A. Aim and adjust luminaires as indicated.
- B. Position exit sign directional arrows as indicated.

### **3.4 CLEANING**

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finished and touch up damage.

### **3.5 PROTECTION OF FINISHED WORK**

- A. Relamp luminaires that have failed lamps as substantial completion.

**END OF SECTION**



**SECTION 26 0600**

**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install disconnect switches, fuses and enclosures to complete all work shown on the Drawings or specified herein.

**1.2 SUBMITTALS**

- A. Submit product data under Provisions of Contract and Division 1.
- B. Include outline Drawings with dimensions, equipment ratings for voltage, capacity, horsepower and short circuit.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES**

- A. Siemens.
- B. Square 'D'.
- C. General Electric.
- D. Or approved equal.

**2.2 DISCONNECT SWITCHES**

- A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch is in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate class R, J fuses.
- B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA Type 1; 3R; 4 as indicated on Drawings.

**2.3 ACCEPTABLE MANUFACTURERS - FUSES**

- A. Bussman.
- B. Ferraz-Shawmut.
- C. Or approved equal.

**2.4 FUSES**

- A. Fuses 600 amperes and less: ANSI/UL 198E, class RK1; RK5; Dual element, current limiting, time delay, 250 volt.
- B. Interrupting rating: 200,000 rms amperes.
- C. An additional fuse of each size required to be supplied.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install disconnect switches where indicated on Drawings.
- B. Install fuses in fusible disconnect switches.
- C. Disconnects installed outdoors shall have NEMA 3R enclosures.
- D. Disconnects installed indoors in dry locations shall have NEMA 1 enclosure.

**END OF SECTION**

## **SECTION 26 0650**

### **GROUNDING**

#### **PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

##### **1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the power system grounding to complete all work shown on the Drawings or specified herein.

##### **1.2 RELATED WORK**

- A. Panelboards.
- B. Raceways.
- C. Connection Equipment.
- D. Electric Equipment.
- E. Tests and Acceptance.
- F. Transformers.
- G. Electric Service.

##### **1.3 SUBMITTALS**

- A. Manufacturers' data, catalog cuts of ground rods, connectors, bushings, etc., along with recommended installation procedures.

#### **PART 2 - PRODUCTS**

##### **2.1 WIRING**

- A. All wiring used for grounding shall be insulated copper, unless otherwise noted. Size shall be in accordance with code for the application, minimum #12.
- B. Where used in conjunction with computer equipment, grounding conductors shall be equal in size to the phase conductors.
- C. Avoid splices in ground conductors.

##### **2.2 RACEWAY**

- A. Grounding continuity shall be maintained for all metallic raceways.
- B. Provide bonding jumpers across metal parts separated by non-conducting materials.
- C. Where a grounding conductor is installed as a supplement to metallic raceway serving as the equipment grounding conductor, bonding conductor to the raceway at each end.
- D. All raceway accessories, such as locknuts, bushings, expansion fittings, etc. shall be installed to provide maximum metal-to-metal bonding.

### **2.3 CLAMPS**

- A. Provide approved ground clamps for connecting grounding conductors to pipe, conduits, wireways, building steel, grounding rods, etc.
- B. Where bond will be in an inaccessible location or as an alternate to ground clamps, provide exothermic weld, similar to Cadweld.

### **2.4 ACCESSORIES**

- A. Provide all necessary accessories of appropriate size and material for connection or termination of grounding conductors including:
  - 1. Straps.
  - 2. Clamps.
  - 3. Lugs.
  - 4. Bars and buses.
  - 5. Isolators (where applicable).
  - 6. Locknuts and bushings.

### **2.5 ACCEPTABLE MANUFACTURERS**

- A. Copperweld.
- B. Cadweld (for exothermic welds).
- C. O.Z. Gedney.
- D. Burndy.

## **PART 3 - EXECUTION**

### **3.1 SERVICE ENTRANCE/SWITCH**

- A. Coordinate all bonding and grounding requirements of the service entrance with the utility company.
- B. Provide ground lug in each switchboard, minimum 25% of phase bus, along entire length of switchboard.
- C. Separately connect each ground to existing grounding electrode. Test existing grounding electrode for proper resistance values and provide all necessary modifications required.

### **3.2 TRANSFORMERS**

- A. Bond each transformer secondary neutral to nearest building structural column or beam via transformer case grounding stud.
- B. Provide jumper between transformer case and all conduit bushings.
- C. Where a separate equipment-grounding conductor is provided the primary and/or secondary feeders; bond to transformer grounding stud.
- D. Where isolation shield is provided, bond to transformer grounding stud.
- E. Where a separate ground riser is provided in addition to or instead of building steel; bond transformer-grounding stud to the ground riser.

### **3.3 STRUCTURAL STEEL BUILDINGS**

- A. Select a column common to aligned electric closets as the bonding column for grounding of transformer neutrals, isolated grounds and separate equipment grounding conductors.
- B. All grounding conductors in each closet shall be bonded in close proximity to one another.
- C. Where a grounding conductor to be bonded is not in proximity to the common column, bond to the nearest column or structural beam.
- D. Provide bonding jumper strap across all structural expansion joints where the grounding integrity of the structural system is reduced

### **3.4 RACEWAYS**

- A. Grounding continuity is to be maintained for all metallic raceways. Provide necessary clamps, bushings, straps and locknuts to assure continuity.
- B. For non-metallic or flexible raceways, provide a separate equipment-grounding conductor bonded to both ends.
- C. Where indicated, an additional equipment-grounding conductor shall be provided in metallic raceway.
- D. Where indicated, an isolated ground conductor shall be provided in addition to the equipment-grounding conductor. Bond at each end to the isolated ground terminal identified.

### **3.5 EQUIPMENT**

- A. All equipment shall be grounded.
- B. Where isolated grounding is indicated, it shall be for the isolation of internal equipment components only. All metallic enclosures of such equipment shall be connected to the equipment ground system.

### **3.6 PANELBOARDS**

- A. All panelboards and distribution panels shall be provided with a ground bar bonded to the enclosure. Provide an isolated ground bar connected to the incoming feeder ground where indicated.

### **3.7 TESTING**

- A. Upon completion of the installation, confirm the grounding continuity of all raceways, conductors and equipment. Maximum allowable resistance is 25 ohms.

### **3.8 RECORD DRAWINGS**

- A. Submit record As-Built Drawings indicating the location of all points where grounding conductors are bonded to steel, rods, plates, etc.
- B. Indicate the location of all grounding buses not installed within distribution equipment.

**END OF SECTION**





**SECTION 26 0700**

**PANELBOARDS**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 WORK INCLUDED**

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the panelboards and to complete all work shown on the Drawings or specified herein.

**1.2 RELATED WORK**

- A. Grounding
- B. Overcurrent Protection

**1.3 SUBMITTALS**

- A. Submit shop drawings for equipment and component devices under provisions of Division 1.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Furnish two (2) sets of keys to Owner.

**1.4 REFERENCES**

- A. FS W-C-375 - Circuit breakers, molded case, branch circuit and service.
- B. FS W-P-115 - Power distribution panel.
- C. NEMA AB 1 - Molded case circuit breakers.
- D. NEMA KS 1 - Enclosed switches.
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instruction for safe installation, operation and maintenance of panelboard rated 600 volts or less.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS - PANELBOARD AND LOAD CENTERS**

- A. Siemens.
- B. Square "D".
- C. General Electric.
- D. Or approved equal.

## **2.2 BRANCH CIRCUIT PANELBOARDS**

- A. Lighting and appliance branch circuit panelboards: NEMA PB 1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1.
- C. Cabinet size: Approximately 6 inches deep; 20 inches wide for 240 volt and less panelboards. Verify field conditions and alter dimensions to suit at no additional cost.
- D. Provide surface cabinet front door-in-door with concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, rating as scheduled on Drawings. Provide copper ground bus in all panelboards and isolated ground bus in those as indicated on Drawings.
- F. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt rated for 125 amps or less, 22,000 amperes rms symmetrical for 240 volt rated greater than 125 amps to 225 amps and 30,000 amperes for emergency power panelboards (verify in field). If panelboard is noted as a main distribution panelboard, than panel shall be rated as a distribution panelboard. Contractor shall provide short circuit study to ensure adequacy.
- G. Molded case circuit breakers: Bolt-on type thermal magnetic trip handle for all poles. Provide circuit breakers UL listed as type SWD for lighting circuits. Breaker handle to indicate ampere rating.

## **2.3 DISTRIBUTION PANELBOARDS**

- A. Description: NEMA PB 1, circuit breaker type. The bus of all panels rated a minimum 400 amps shall be distribution type.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 240 volt panelboards; 65,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise noted on Drawings.
- D. Model Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR as specified on Drawings.
- E. Enclosure: NEMA PB 1, Type 1.
- F. Cabinet Front: Surface type, fastened with screws. Double hinged doors with flush lock, metal directory frame, finished in manufacturer's standard gray enamel. One hinged door to access breakers, the other to access wiring compartment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install panelboards flush or surface mounted as indicated on Drawings.
- B. Mounting height maximum 6 ft. (2 m) to top circuit breaker.
- C. Provide filler plates for unused spaces in panelboards.

- D. Provide type written circuit directory for each branch circuit panelboard. Indicate loads served and panel name by matching that shown on panel schedules on Drawings. Revise directory to reflect circuiting changes required to balance phase loads. Provide a second copy and turn over to Owner.
- E. Provide 3/4" thick plywood backboard for mounting of panels. Paint backboard with fire retardant paint.
- F. Provide nameplates as indicated in Section 26 0550.

### **3.2 FIELD QUALITY CONTROL**

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and mechanical inspection: Inspect for physical damage, proper alignment, anchorage and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches and fuses.
- C. Provide thermographic inspections in accordance with Section 26 0100.

### **3.3 TESTS**

- A. Submit certification that each panelboard has withstood, without breakdown, a factory dielectric (Hi-Pot) test consisting of a one minute application of a 60 cycle AC test voltage applied between phase legs and from each phase leg to enclosure.
- B. The applied test voltage shall have an RMS value of at least twice the line to line system voltage to which the panelboard is to be applied, plus one thousand volts (minimum 1500V).

### **3.4 RECORD DRAWINGS**

- A. Submit as-built Drawings indicating the location of all panelboards.

**END OF SECTION**



**SECTION 26 0725**

**SWITCHBOARD**

**PART 1 - GENERAL**

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 RELATED DOCUMENTS**

- A. The Contractor, Subcontractors, vendors and the like shall meet all Con Edison requirements.

**1.2 SUMMARY**

- A. Work of this section shall be governed by the contract documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this section as shown on the drawings, as specified herein and/or as required by job conditions.
- B. The work shall include, but not be limited to, indoor, low voltage switchboards of the circuit breaker, front accessible only, rear aligned, groove mounted type, as shown on the drawings and specified herein.

**1.3 REFERENCES**

- A. Related Work Specified Elsewhere
  - 1. General Conditions: Section 26 0100
  - 2. Overcurrent Protective Devices: Section 26 0320

**1.4 INTENT AND CODES**

- A. This specification describes the equipment required. It does not cover all phases of manufacture or assembly. Supplier shall assume the responsibility for providing well-integrated units of good quality.
- B. All codes, rules, regulations and ordinances governing this work, are as fully a part of this specification as if herein repeated or hereto attached. Where the requirements of this specification are more stringent than any applicable codes etc., the specification shall apply.

**1.5 MATERIAL AND WORKMANSHIP**

- A. Unless otherwise specified all materials shall be new. Supplier shall be responsible for defects in equipment and devices furnished but not manufactured by him. Exposed finishes and other features shall match in all respects. Supplier alone shall be responsible for all errors of fabrication and for correct fitting of all components that must be erected and joined in the field.

**1.6 SHOP DRAWINGS**

- A. Complete shop drawings showing size and arrangement of equipment, foundation and anchor bolt requirements, bill of materials, performance data and curves, wiring and elementary diagrams, methods of assembly, connections to other work and other pertinent data as called for in the various parts of this Specification shall be furnished by the Supplier for checking and approval.

### **1.7 MAINTENANCE AND OPERATING INSTRUCTIONS**

- A. In addition to submittal for approval, furnish to the Owner's Representative six (6) copies of the items listed below for all equipment and material furnished under this specification.
- B. Each approved shop drawing, including all final comments, shall be folded down so that it can be placed in a loose leaf binder of the size using standard 8-1/2" x 11" paper. The drawings shall be folded in a manner that they can be fully opened without removal from the binder.
- C. Complete detailed parts lists and/or assembly drawings.
- D. All governing agencies' and/or manufacturer's test certificates, permits and inspection reports, insurance inspection and all shop or field performance tests, when required.
- E. All operating and maintenance manuals as required by this specification. Such manuals shall be edited to identify equipment furnished.
- F. Approved catalog cuts and/or material lists as required by this specification.
- G. The Manufacturer's Specification, including tabulation of sizes and identifying numbers for all installed material and equipment. The applicable items in each brochure shall be clearly defined and marked.
- H. List of recommended spare parts.
- I. All of the above items shall be assembled in books identified for units covered, including all assemblies and components. Each book shall contain Table of Contents page. Forward all the above information except for field test and/or field inspection reports to the Owner's Representative promptly after approval of shop drawings for each item and before delivery of any equipment involved.

### **1.8 SHIPPING AND PROTECTION INSPECTION**

- A. All material, equipment and component parts shall be adequately protected to prevent damage, corrosion or entry of foreign matter during shipment, unheated storage or in a dusty atmosphere.
- B. Each packing crate and carton containing components shall be visibly stenciled, clearly identifying contents as to the type(s) of unit(s) contained therein and the related equipment assembly or assemblies.
- C. Each shipment shall contain packing slip listing all components.
- D. For handling during shipment, lifting irons, eye bolts, or other lifting aids shall be bolted to the housing and shall not be removed until the equipment is in final position. The shipping sections may consist of completely assembled structures or sections of one or more units, as required to suit the handling facilities and to facilitate installation. Wiring that extends between sections to be terminated at accessible terminal blocks with wiring harnesses to facilitate field interconnections. Clearly identify all conductors and terminals.

### **1.9 SERVICE CONDITIONS**

- A. The material covered by this specification shall be designed for operation under conditions where the altitude does not exceed 3300 feet and the temperature of the cooling air does not exceed 40 Degrees C. maximum, 30 Degrees C. average, unless otherwise specified.
- B. Construction shall conform to requirements for seismic restraints as specified in Section 26 0515.

## **1.10 GUARANTEE-WARRANTY**

- A. Guarantee that all equipment meets the design and performance requirements specified and alter and/or replace, at no costs to the Owner, any piece of equipment which fails to meet these requirements. This shall include any field work and factory trained supervision necessary.
- B. All material included herein shall be free from defects and warranted for a period of 18 months from date of shipment of material from factory or 12 months from date of installation. Any parts found defective due to manufacture shall be replaced and reinstalled at no expense to the owner.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Scope
  - 1. This part of the Specification covers the basic equipment and detailed construction requirements, and the required shop drawings to be submitted for the switchboard. All components, electric interconnections and accessories shall be designed and constructed in accordance with the latest applicable standards as recommended by the American National Standards Institute (ANSI), the National Electrical Manufacturers' Association (NEMA), the Institute of Electrical and Electronics Engineers (IEEE), the Underwriter's Laboratory (UL) as well as the construction details specified herein. In case of conflict between the aforementioned Standards and this Specification, the more stringent requirement shall apply.
  - 2. Applicable requirements of all Local Codes shall also be complied with.
  - 3. Switchboards shall conform to the following standards:
    - a. Underwriters Laboratories (UL) -  
UL 891 - "Dead Front Electrical Switchboards".  
Switchboards and its components shall be UL listed and labeled.
    - b. National Electrical Manufacturers Association  
NEMA-PB2 - "Dead Front Distribution Switchboards".  
NEMA-PB2.1 - General Instructions for proper handling, installation, operation, and maintenance of dead front distribution switchboards rated 600 volts or less.
  - 4. The general arrangements, limiting dimensions, type and/or ratings are shown on the drawings accompanying this Specification. The basic equipment and detailed construction requirements for the various components entering into individual switchboards, shall be in accordance with the applicable provisions of this part. Coordinate the requirements of the various Parts of this Specification with the drawings when ordering equipment or material in accordance with the applicable provisions of this Part.

### **2.2 REQUIRED SHOP DRAWINGS**

- A. Shop drawings shall be submitted as specified in Part 1 - General. As a minimum the following drawings shall be submitted for approval in accordance with the procedure indicated, falling into two categories.
- B. Drawings for Preliminary Approval to enable Supplier to proceed with equipment ordering and scheduling of fabrication:
  - 1. Front elevation, one line diagram showing main and branch circuit breaker ratings and types and any information required for complete identification and location of major equipment items, including dimension outline sizes, weights, shipping splits, and arrangement of all equipment.

2. Voltage, phase, frequency, horizontal and vertical bus capacities, short circuit ratings.
  3. Floor plan and top view showing materials, sizes, anchoring, location of power and control conduit, and ground cable entries above and below.
  4. Preliminary Bill of Material or switchboard summary showing all major components.
  5. Preliminary schematic diagrams of nonstandard circuits.
- C. Detailed Engineering Drawings supplied to Owner promptly after approval of preliminary drawings.
1. Wiring and schematic diagrams of all power circuits. Wiring diagrams shall be separate from schematic diagrams and shall show equipment arrangement, terminal numbers and point-to-point wiring of each piece of equipment and terminal block. Interconnection wiring diagram shall be furnished, showing general physical arrangement of all units and terminal blocks used in wiring between such units. The separate schematic diagrams shall include complete three line diagrams for buses, low-voltage switch and fuse units and any other devices in this Switchboard.
  2. Complete Bill of Material, or switchboard summary showing all components and materials, clearly describing same and providing numbers and data for checking.
  3. Detailed sections through all frames showing equipment, buswork, bus phasing connections and ground stud assembly on bus.
  4. Detailed drawings showing provision for main and feeder bus extension and bus risers and indication of short circuit bracing.
  5. Handling, installation and assembly drawing.
  6. Final dimensioned outline drawings and accessories, phasing, location of jacking points, etc.
  7. Device connection diagrams.
  8. Nameplate data sheets.
  9. Cable lug type, quantities and sizes.
  10. Operating and maintenance instruction manuals for all types of equipment.

### **2.3 LIMITING DIMENSIONS**

- A. The dimensions indicated on the drawings are limiting and the orientation of the equipment shall be maintained. If a particular manufacturer's equipment exceeds any of the dimensions shown, it should be clearly stated in his proposal. The Owner will evaluate the cost of accommodating this equipment in the building design when reviewing his bid.

### **2.4 600 CLASS METAL-ENCLOSED SWITCHBOARD**

- A. General
1. Switchboard shall be indoor, free-standing, bolt-on circuit breaker type, group mounted, front accessible only, front and rear aligned and suitable for mounting against a wall, complete with all disconnects and accessories as shown on the drawings and specified herein.
  2. Switchboards and buswork shall be fabricated to permit future expansion.



3. Where spaces for future circuit breaker units are shown, provide all current carrying components and covers, ready to receive the future units.
  4. Provide nameplates for all units.
- B. Enclosure
1. The entire assembly shall be totally metal enclosed, of indoor construction unless otherwise noted. Enclosures shall be fabricated of code gauge steel, formed and framed for rigidity. Fixed panels and framework shall be of bolted construction. Assembly shall be 90 inches high unless conditions require otherwise.
  2. Cable compartments shall have adequate space for cables as required. Provide cable supports for each vertical section.
  3. Housing shall be thoroughly cleaned and degreased after fabrication, bonderized and primed with zinc chromate. Finish shall be two coats of gray enamel, ANSI #61.
- C. Buswork
1. Buswork shall be 3-phase, 4-wire fabricated of copper, tin or silver plated throughout extending the entire length of the assembly, ampere rating as shown on the drawings.
  2. Main buswork shall have full capacity throughout the entire length of the switchboard. Vertical buswork shall be equal in size to the sum of the switch sizes in the vertical section including spares and spaces with a maximum size equal to that of the main bus. Bus extensions to feeder switches and from the load side of the switches to the cable compartment shall be equal to the size of the switch. The continuous current ratings of the busses shall be determined by temperature rise as limited by ANSI standards and the National Electrical Code. Neutral bus shall be full sized, rating scale as the phase busses.
  3. Provide an A-B-C bus arrangement, left to right, top to bottom, front to back, throughout as viewed from the front of the switchboard.
  4. Buswork shall be braced and supported to safely withstand short circuit stresses equal to the full available fault currents at the switchboard, minimum 100,000 AIC ampere RMS symmetrical.
  5. Provide two-hole long barrel compression cable connectors for cable as indicated per phase, neutral and ground on all incoming conductors.
  6. Provide bus tap lugs for connection of transient voltage surge suppressors as close to incoming conductors as possible.
  7. Ground bus shall be rated 25 percent of the phase busses with minimum size of 3 inches by 1/4 inch and be continuous for the entire length of the switchboard. Ground bus shall be accessible from the front of the switchboard. Ground bus shall be copper.
- D. Circuit Breaker - Provide thermal magnetic circuit breakers with interrupting capacity as shown on the Drawing. Where indicated on distribution schedule on drawing, provide circuit breakers with electronic trip units.

E. Accessories

1. The following accessories shall be furnished with each switchboard.
  - a. One (1) quart of touchup paint.
  - b. One set of special wrenches, removable hand cranks, tools as required to maintain and disassemble parts of the switchgear for field maintenance.

F. Approved Manufactures

1. The 600 volt class metal-enclosed switchboard shall be the product of one of the following approved manufactures:
  - a. General Electric Company - AV5
  - b. Square D I-line Switchboard
  - c. Eaton/Cutler Hammer Electric Corporation - POW-R-Line C, or equal.

**PART 3 - EXECUTION**

**3.1 SHIPMENT**

- A. Prior to shipment, all equipment shall be cleaned. All openings shall be covered to prevent entrance of foreign material. Where necessary, desiccant bags shall be located within cabinets to provide a minimum of 3 months protection.
- B. Equipment shall be shipped in sections to facilitate installation, complete with all accessories required for assembly. All wiring that extends between sections shall terminate on terminal blocks at the interface points, with a wiring harness (with framing strips) that will be field installed between adjacent sections. All terminal and wires shall be clearly marked with wire numbers.

**3.2 INSTALLATION**

- A. General: Install and connect switchboard equipment in accordance with approved manufacturer's shop drawings including supplemental devices required to make each unit a complete installation.
- B. Switchboards shall be anchored to two (2) 3-inch channel sills set flush with the concrete housekeeping pad. Provide all required shims, etc., to achieve a level installation.
- C. Mechanical Connections
  1. Make all required connections including split line connections.
  2. Remove shipping irons after equipment is set in place.
- D. Electrical Connections
  1. Bus connections: Use manufacturer's recommended torque.
  2. Install control wiring connections at shipping splits and coordinate with SCADA requirements for Emergency Switchboards.
  3. Provide holes in plates to allow for required conduit connections.
  4. Terminate low voltage cables.

5. Ground conduits and cables as specified in Section 26 0200 and 26 0300.
6. Insulating Tape: When main buses are insulated or enclosed by barriers, insulate with tape wrappings all cable connections for voltage level involved so no current carrying parts are exposed.
7. Cable Blocks: support all outgoing secondary cables from cable blocks.

### **3.3 FIELD QUALITY CONTROL**

#### **A. Phase Sequence**

1. Coordinate with the system supply for proper phase sequence throughout.
2. Provide phase sequence indicator on jobsite to verify all secondary outgoing feeder rotation.

#### **B. Test all circuit breakers or fuses and switches for proper operation.**

#### **C. Bus Bar Connections**

1. Check for proper resistance values using “Ducter” low resistance ohmmeter. Make adjustments where values exceed manufacturer’s recommendations.
2. “Megger” phase bus bars to assure that no grounds or shorts are present. Disconnect potential and control transformers, instrument fuses and other equipment which may cause false readings.

#### **D. Start-Up and Acceptance**

1. Coordinate with equipment supplier and Owner for preparatory work required prior to energizing and acceptance and in accordance with Owner’s start-up procedures.

#### **E. Contractor shall leave the entire installation in perfect working order.**

**END OF SECTION**



## SECTION 26 0770

### SURGE PROTECTION DEVICES

#### PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### 1.1 WORK INCLUDED

- A. This specification describes the mechanical and electrical requirements for a Surge Protection Device herein known and shown on all drawings as SPD. The SPD shall be suitable for application in category C High environments as described in ANSI/IEEE C62.41. The SPD shall be parallel in design and provide protection for the following modes: {Line to Neutral, Line to Ground, Line to Line, Neutral to Ground} for electrical distribution systems. "Series" type SPD units will be deemed unacceptable

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Product Certificates: For surge protection devices, signed by product manufacturer certifying compliance with the following standards:
  - 1. UL 1283
  - 2. UL 1449 3<sup>rd</sup> Edition

#### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer
- B. Product Options: Drawings shall indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices"
- E. Codes and Standards
  - 1. UL compliance and Labeling: Listed per UL 1449 3<sup>rd</sup> Edition
  - 2. UL 1283 "Electromagnetic Interference Filters"
  - 3. Comply with ANSI/IEEE C62.1, C62.41, and C62.45
  - 4. NEC compliance: Comply with NEC as applicable to construction and Article 280 for installation.

#### 1.4 MANUFACTURERS QUALIFICATIONS

- A. Only pre-approved SPD products shall be accepted
- B. Manufacturer Qualifications: All SPD units shall be manufacturer by a firm that strictly manufactures SPD products only, for at least 10 years. Firms must also regularly engage in the manufacturing of SPD products for Categories B (ANSI/IEEE 62.41) and C High.
- C. The SPD shall be warranted for no less than 15 years and shall include free replacement in whole or in part during those 15 years for any reason of failure.

**PART 2 - PRODUCTS**

**2.1 SERVICE ENTRANCE SUPPRESSORS**

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL	VPR UL	CAT B	CAT C High
	1449 2 <sup>nd</sup>	1449 3 <sup>rd</sup>	6kV/3kA	20kV/10kA
480Y/277	800V	1200V	776V	904V
208Y/120	400V	700V	416V	528V

C. SPD specifics

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:

- a. Fabrication using bolted compression lugs for internal wiring
- b. Replaceable bolt down modules per phase. The use of single "Brick" Module and/or "Plug In" type module designs will not be accepted.
- c. Arrangement with wire connections to phase buses, neutral bus, and ground bus
- d. A 200,000 AIC Fused Rotary Disconnect
- e. Remote Audio/ Visual Alarm Panel
- f. UL Listed 1283 Extended Power Range Filter
- g. Green/Red LED Indicator lights for power and protection status.  
Green = Power On / Protection Present    Red = Failure
- h. Normally Open / Normally Closed Form C Dry Contacts
- i. Surge Event Counter

3. Peak Single-Impulse Surge Current Rating shall be 240kA per phase.

4. Standard unit housings shall be 16 gauge painted steel and match the NEMA rating of the panel board.

5. Standard unit warranty must be for at least 15 years and be stated in the manufacturer's literature.

D. Approved Manufacturers

1. Atlantic Scientific – ZoneMaster PRO Series or Equal. (contact Andy Topinka @ 862-210-8126)

**2.2 DISTRIBUTION PANEL SUPPRESSORS**

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL	VPR UL	CAT B	CAT C High
	1449 2 <sup>nd</sup>	1449 3 <sup>rd</sup>	6kV/3kA	20kV/10kA
480Y/277	700V	1000V	825V	950V
208Y/120	330V	600V	456V	550V

C. SPD specifics

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.
2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:
  - a. Fabrication using bolted compression lugs for internal wiring
  - b. Replaceable bolt down modules per phase. The use of single “Brick” Module and/or “Plug In” type module designs will not be accepted.
  - c. Arrangement with wire connections to phase buses, neutral bus, and ground bus
  - d. UL Listed 1283 Extended Power Range Filter
  - e. Green/Red LED Indicator lights for power and protection status.  
Green = Power On / Protection Present    Red = Failure
  - f. Normally Open / Normally Closed Form C Dry Contacts
3. Peak Single-Impulse Surge Current Rating shall be 100kA per phase
4. Standard unit housings shall have a transparent front cover for complete visual inspection and monitoring the status of protection for each module, any onboard diagnostics, module configuration, and wiring configuration.
5. Standard unit housings shall be non-metallic and meet NEMA 1, 2, 3, 3S, 4, 4X, 12 and 13 classifications
6. Standard unit warranty must be for at least 15 years and be stated in the manufacturer’s literature.

D. Approved Manufacturers

1. Atlantic Scientific Corporation – ZoneSentinel 100 Series or equal.  
(contact Andy Topinka @ 862-210-8126)

**2.3 BRANCH PANEL SUPPRESSORS**

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient overvoltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing metal oxide varistors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL	VPR UL	CAT B	CAT C High
	1449 2 <sup>nd</sup>	1449 3 <sup>rd</sup>	6kV/3kA	20kV/10kA
480Y/277	800V	1000V	890V	1200V
208Y/120	400V	500V	435V	730V

C. Surge Protection Devices details:

1. The surge protection device shall be permanently wired through an overcurrent device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads trimmed as short as possible and not to exceed 18 inches.
2. Surge Protection Device Description - Non-Modular Design with the following features and accessories:
  - a. 200,000 AIC Fused
  - b. Built in Audible Alarm
  - c. UL Listed 1283 Extended Power Range Filter
  - d. Green/Red LED Indicator lights for power and protection status.  
Green = Power On / Protection Present    Red = Failure
  - e. Normally Open / Normally Closed Form C Dry Contacts
2. Peak Single-Impulse Surge Current Rating shall be 80kA per phase.
3. Standard unit housings shall be metallic in construction and meet NEMA 1,2,3,3S,4,4X,12, and 13 classifications.
5. Standard unit warranty must be for at least 10 years and be stated in the manufacturer's literature.

B. Approved Manufacturers

1. Atlantic Scientific Corporation – ZoneDefender PRO Series or equal.  
(contact Andy Topinka @ 862-210-8126)



### **PART 3 - EXECUTION**

#### **3.1 APPLICATION OF SPD**

##### **A. General**

1. Apply SPD on the load side of the first main disconnect at the electrical service entrance switchboard and on the load side of the main overcurrent device at the electrical distribution panelboard.
2. Coordinate system voltage, wiring configuration, and location as shown on project drawings.

#### **3.2 INSTALLATION OF SPD**

- A. Service Entrance: Connect the SPD to a 60A Breaker with #6 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Service Entrances panel being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.
- B. Distribution Panels: Connect the SPD to a 60A or 30A (whichever is specified by the manufacturer for that model) with #8 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Distribution panels being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.
- C. Branch Panels: Install the SPD to with #10 AWG provided from the manufacturer to the Branch panels being protected. The conductors are to be kept as short and straight as practically possible and shall not exceed 18 inches in length that is provided. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

**END OF SECTION**



**SECTION 26 0775**

**PACKAGED ENGINE GENERATOR SYSTEM – DIESEL OUTDOOR**

**PART 1 - GENERAL**

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

**1.1 CODES AND STANDARDS**

- A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards:
1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.
  2. IEEE446 B Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
  3. NFPA37 B
  4. NFPA70 B National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
  5. NFPA99 B Essential Electrical Systems for Health Care Facilities.
  6. NFPA110 B Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
- B. The generator set and supplied accessories shall meet the requirements of the following standards:
1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
  2. UL142 B Sub-base Tanks.
  3. UL1236 B Battery Chargers.
  4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
- C. The control system for the generator set shall comply with the following requirements.
1. CSA C22.2, No. 14 B M91 Industrial Control Equipment.
  2. EN50082-2, Electromagnetic Compatibility B Generic Immunity Requirements, Part 2: Industrial.
  3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
  4. FCC Part 15, Subpart B.
  5. IEC8528 part 4. Control Systems for Generator Sets.
  6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
  7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
  8. UL1236 B Battery Chargers.
- D. The diesel fuel day tank shall meet the requirement of regulatory agencies: Comply with applicable provisions of regulatory agencies below and others having jurisdiction:
1. Underwriters' Laboratories, Inc. UL - 142, UL - 2085 for Insulated Secondly Contained.
  2. National Fire Protection Association 30, 30A, and 31
  3. United States Environmental Protection Agency
  4. Local and State Building Codes and Ordinances
- a. The New York State Uniform Fire Prevention and Building Code.

- b. State of New York local codes and ordinances Department of Environmental Protection Division.
  - c. The New York State Department of Health Requirements.
5. Permits and Registrations: Contractor shall obtain and pay for all required permits/registrations, fees and inspections.
- E. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

## 1.2 SUBMITTALS

- A. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- B. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, microprocessor control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, trailer and radiator.
- C. Prototype Test Reports: Submittals will not be received without submission of prototype test report as specified herein.
- D. Manufacturers Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- E. Manufacturers Certificate: Certify that Products meet or exceed specified requirements.
- F. Alternator data indicating sub transient reactance and temperature rise rating to meet requirements specified herein.

## 1.3 OPERATION AND MAINTENANCE

- G. Manuals: Furnish four (4) Operation and Maintenance manuals.
- H. Operation & Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

## 1.4 QUALITY ASSURANCE

- I. To provide proven reliability of the Generator set, three series of tests shall be performed, no exceptions taken:
  - 1. Prototype model tests
  - 2. Fully assembled factory production model tests
  - 3. Field acceptance tests
- J. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and Factory Production tested as described herein shall not be acceptable.
- K. Generator set Prototype Tests: These tests and evaluations must have been performed on a prototype generator set representative of the model specified. A summary of the generator set testing results shall be

submittal for review. The manufacturer=s standard series of components development tests on the generator system, engine and other major components shall be performed and available for review, but shall not be acceptable as a substitute for a prototype testing on the complete representative generator set prototype.

- L. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.
- M. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.
- N. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.
- O. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer=s standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.
- P. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two (2) minutes.
- Q. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer=s acceptable criteria.
- R. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122 °F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge shall be verified by this test.
- S. Maximum Motor Starting KVA Test: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent on no load voltage with the specified load KVA at near zero power factor applied to the generator set.
- T. Transient Response, Steady State Speed Control and Voltage Regulation Test: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.
- U. Witness-Generator Set Factory Production Tests: On the equipment to be shipped, a two (2) hour test shall be performed at rated load and 0.8 PF. These tests shall include certified data to document the following: run at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup and safety shutdowns. Provide a factory test record of the production testing. The equipment supplier at their expense shall coordinate and provide all transportation and lodging for the owner and Owner’s engineering representatives, minimum of four to witness the above stated factory test. Tests performed at facilities other than the manufacturer’s factory shall not be acceptable.

- V. Factory Test: The unit shall completely assembled and all preliminary adjustments made before the test is initiated. 125 KW genset shall be tested with the complete radiator and fan assembly to be shipped. Outside radiator, heat exchanger attachments shall not be acceptable.
- W. Testing Procedure:
1. Test diesel-alternator unit at 0.8 PF in the following sequence:
  2. 0.5 hour at 1/4 load.
  3. 0.5 hours at 1/2 load.
  4. 0.5 hours at 3/4 load.
  5. 0.5 hours at full load.
- X. Above testing shall be strip chart recorded and certified. During this test, the following measurements shall be taken and recorded on a certified report format:
1. Barometric Pressure.
  2. Intake Air Pressure.
  3. RPM.
  4. Output voltage per phase.
  5. Output amperes per phase.
  6. Power Factor.
  7. KW.
  8. Winding temperature.
  9. Transient response testing sequence:
  10. 0-25%, 25%-0.
  11. 0-50%, 50%-0.
  12. 0-75%, 75%-0.
  13. 0-100%, 100%-0.
- Y. Above testing shall be strip chart recorded. Provide necessary equipment and instruments to measure voltage dips and frequency dips. Comparison shall be made to the herein specified alternator performance characteristics prior to acceptance.
- Z. Field Acceptance Tests: Generator supplier shall provide and conduct a four (4) hour load bank test at unity power factor for the generator set. Contractor must provide portable load bank for testing generator set at 100% load. Load bank test shall test each generator at full nameplate KW ratings. Generator manufacturer's representative shall record test data, as described below. Test data shall be tabulated and typed for submission and approval by the engineer for final acceptance. No handwritten field notes will be allowed.
- AA. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment. Contractor responsible for protection of testing equipment and any additional cable, etc., required if equipment cannot be located internally during testing.
- BB. Test data shall be collected and recorded on the following: Time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.

## 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience, and with an authorized distributor offering 24 hour parts and service availability within 50 miles of the project. Proposed engine/generator combination shall have been in production a minimum of five (5) years.

- B. Supplier: Authorized distributor of specified manufacturer with minimum five (5) years documented experience with specified products and factory-trained service technicians.

#### **1.6 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.
- B. Furnish Products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

#### **1.7 PRE-INSTALLATION CONFERENCE**

- A. Convene one (1) week prior to commencing work of this Section.

#### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect and handle products to site.
- B. Accept unit on site mounted on trailer. Inspect for damage. Provide written verification that Genset tested and Genset received are one and the same.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic during construction.

#### **1.9 EXTRA MATERIALS**

- A. Provide two (2) of each fuel, oil and air filter element, engine belts and hoses.

#### **1.10 WARRANTY**

- A. A no deductible comprehensive warranty shall be provided for all products against defects in materials and workmanship for a five-year or 1500 hour period from the start-up date. Warranty shall cover all costs of covered repairs, including travel expenses.

#### **1.11 SERVICE AGREEMENT**

- A. Manufacturer shall provide Owner with a One (1) year service agreement that includes changing all fluids and filters once a year and a minor inspection six (6) months after each change.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Approved manufacturer:
  - 1. Cummins Power Generation, model C125D6D rated for STANDBY POWER with BB87 Frame Alternator as distributed by Cummins Sales & Service. 890 Zerega Avenue, Bronx, NY 10473. Contact Ed Cheung: 718-892-2400, ext. 217.
  - 2. Approved substitute, meeting specifications: Caterpillar model C7.1
- B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

## 2.2 DIESEL ENGINE-GENERATOR SET

### A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of: 208 Volts AC, 3-phase, 4-wire, 60 hertz.
2. The generator set shall be rated at 125 kW, 188 kVA at 0.8 PF, standby rating, based on site conditions of: Altitude 1,000 ft., ambient temperatures up to 122 degrees F (50 degrees C).

### B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
3. The diesel engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Motor starting capability shall be a minimum of 791 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3<sup>rd</sup> order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

### C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

### D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, [with required protection located at a wall-mounted common distribution panel] If walk-in enclosure.
3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

## 2.3 ENGINE AND ENGINE EQUIPMENT

- A. The engine shall be diesel, minimum EPA TIER 3, 4 cycle, radiator and fan cooled. Minimum displacement shall be 408 cubic inches. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.



- B. A digital electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
- C. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H<sub>2</sub>O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental Electric starter(s) capable of three complete cranking cycles without overheating.

## 2.4 ENGINE ACCESSORY EQUIPMENT

- A. The engine for the generator shall include the following accessories:
  - 1. Positive displacement, contact.
  - 2. Mechanical, full pressure, lubrication oil pump.
  - 3. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
  - 4. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
  - 5. Replaceable dry element air cleaner with restriction indicator.
  - 6. Flexible supply and return fuel lines.
  - 7. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
- B. Coolant Heater
  - 1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
  - 2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
  - 3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
  - 4. The coolant heater(s) shall be 240V, 4500 watts and sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

- C. Provide vibration isolators, internal pad type, quantity as recommended by the generator set manufacturer.
- D. Starting and Control Batteries shall be calcium/lead antimony type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.
- E. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade installed inside enclosure.
- F. A UL listed/CSA certified 6 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be located inside the automatic transfer switch. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings.

## **2.5 AC ALTERNATOR**

- A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 80 degrees Centigrade.
- B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- C. The subtransient reactance of the alternator shall not exceed 10 percent, based on the 80 C rise rating.
- D. Alternator shall be rated for a minimum of 150 KW at a 80C, 120/208 VAC standby.

## **2.6 ENGINE GENERATOR SET CONTROL**

- A. Generator set Control. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
- C. Control Switches
  - 1. MODE SELECT Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP Switch: Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

3. RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  4. PANEL LAMP Switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- D. Generator Set AC Output Metering - The generator set shall be provided with a metering set including the following features and functions:
1. Digital metering set, .5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
  2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.
  3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.
  4. The control system shall log total number of operating hours, total kWh, and total control on hours, as well as total values since reset.
- E. Generator Set Alarm and Status Display
1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
    - a. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
    - b. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    - c. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
    - d. The control shall include an amber common warning indication lamp.
  2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
    - a. low oil pressure (warning)
    - b. low oil pressure (shutdown)
    - c. oil pressure sender failure (warning)
    - d. low coolant temperature (warning)
    - e. high coolant temperature (warning)
    - f. high coolant temperature (shutdown)
    - g. high oil temperature (warning)

- h. engine temperature sender failure (warning)
  - i. low coolant level (warning)
  - j. fail to crank (shutdown)
  - k. fail to start/overcrank (shutdown)
  - l. overspeed (shutdown)
  - m. low DC voltage (warning)
  - n. high DC voltage (warning)
  - o. weak battery (warning)
  - p. low fuel-daytank (warning)
  - q. high AC voltage (shutdown)
  - r. low AC voltage (shutdown)
  - s. under frequency (shutdown)
  - t. over current (warning)
  - u. over current (shutdown)
  - v. short circuit (shutdown)
  - w. ground fault (warning) (optional--when required by code or specified)
  - x. over load (warning)
  - y. emergency stop (shutdown)
  - z. (4) configurable conditions
3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

F. Engine Status Monitoring

1. The following information shall be available from a digital status panel on the generator set control
- a. engine oil pressure (psi or kPA)
  - b. engine coolant temperature (degrees F or C)
  - c. engine oil temperature (degrees F or C)
  - d. engine speed (rpm)
  - e. number of hours of operation (hours)
  - f. number of start attempts
  - g. battery voltage (DC volts)
2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
3. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the Drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

4. The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

<u>Condition</u>	<u>Lamp Color</u>	<u>Audible Alarm</u>
Genset Supplying Load	Amber	No
Charger AC Failure	Amber	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Red	Yes
Check Genset	Amber	No
Not In Auto	Red	Yes
Genset Running	Amber	No
High Battery Voltage	Amber	Yes
Low Battery Voltage	Red	Yes
Weak Battery	Red	Yes
Fail to Start	Red	Yes
Low Coolant Temperature	Red	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Red	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
(4) Spares	Configurable	Configurable

**2.7 ENGINE CONTROL FUNCTIONS**

- A. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
- B. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled. Total duration of operating time in the idle mode shall be controlled by the system, to prevent degradation of the engine capabilities due to excess operating time at idle.
- C. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
- D. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- E. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

**2.8 ALTERNATOR CONTROL FUNCTIONS**

- A. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase

line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

- B. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
- C. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
- D. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- E. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

## **2.9 OTHER CONTROL FUNCTIONS**

- A. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

## **2.10 GENERATOR MAIN LINE CIRCUIT BREAKERS & ADDITIONAL PROTECTION**

- A. The generator set shall be provided with genset mounted, 30, 175 & 400 amp main line circuit breakers. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.
- B. The generator set shall be provided with a utility grade protective relay, designed to provide thermal overload protection for the alternator, and performance certified for that purpose by a 3<sup>rd</sup> party testing organization. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided. Relay shall be installed to allow shutdown of the generator excitation system on an alternator overload condition, with the engine operating for a cool-down period before shutdown. The relay shall not include an instantaneous trip function

## **2.11 SUBBASE FUEL TANK (72 hours @ 100% load)**

- A. Provide a sub-base nominal 737 gallons fuel tank for the generator set. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA 37. The fuel tank shall be a double-walled, steel construction and include the following features:
1. Emergency tank and basin vents.
  2. Mechanical level gauge.
  3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
  4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
  5. Low level float switches to indicate fuel level set to 40%. Wire switches to generator control for local and remote indication of fuel level.
  6. Basin drain.
  7. Integral lifting provisions.
  8. Provide Over fill prevention valve to stop fuel flow at 95% of tank capacity.
  9. Provide fuel fill with spill containment.
  10. Provide high level visual and audible alarm panel when tank level is at 90% capacity.

## **2.12 OUTDOOR SOUND ENCLOSURE**

- A. Construction:
1. Aluminum - UL2200 listed Sound Attenuated, Weatherproof Genset Enclosure
    - a. Package shall comply with the requirements of the NEC for all wiring materials and components.
    - b. Sound attenuation rating of 72 dBA @ 7m.
    - c. The enclosure shall be designed in which allows generator set to operate at full rated load in an ambient temperature of up to 122 F.
- B. The enclosure will consist of a cambered roof, two sidewalls, two end walls, and a nominal 737 Gallon fuel tank base, incorporating prepainted steel construction and application-specific non-hydroscopic acoustic insulation, air handling equipment designed to provide the specified level of sound attenuation.
- C. Exhaust silencer shall be installed inside enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with rain cap.
- D. The enclosure shall include flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure with internal drain valves.
- E. External radiator fill provision must be provided.
- F. Doors shall be recessed, lockable with retainers to hold doors open for easy access.

## **2.13 OUTDOOR PERMANENT FREE STANDING LOADBANK**

- A. Loadbank shall be manufactured by ASCO, model 4100. Rated 50 kw, 208 VAC. Control panel shall be locally mounted on loadbank with NEMA4 rated enclosure. Control power shall be drawn from internal mounted CTs. Loadbank shall be automatic load regulating type. Provide CT for contractor to install and wire on PHASE A of 400 amp main CB.

**PART 3 - EXECUTION**

**3.1 ACCEPTANCE**

- A. Equipment shall be initially started and operated by representatives of the manufacturer.
- B. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

**3.2 TRAINING**

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than two (2) four (4) hours sessions in duration and the class size shall be limited to five (5) persons. Training date shall be coordinated with the facility owner.

**3.3 DEMONSTRATION**

- A. Provide systems demonstration. Electric Contractor shall provide fuel for testing and shall fill tank complete after all testing is done and before turning over to Owner.
- B. Describe loads connected to standby system and restrictions for future load additions.
- C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide standby power.

**END OF SECTION**



## SECTION 26 0785

### AUTOMATIC TRANSFER SWITCH

#### PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

#### 1.1 SCOPE

- A. Provide complete factory assembled power transfer equipment with digital electronic controls designed for surge voltage isolation, and including voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts.
- B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches.

#### 1.2 CODES AND STANDARDS

- A. The automatic transfer switch shall conform to the requirements of the following codes and standards:

UL1008.	The transfer switch shall be UL listed and labeled.
CSA C22.2, No. 14 – M91	Industrial Control Equipment.
CSA 282,	Emergency Electrical Power Supply for Buildings
EN55011,	Class B Radiated Emissions
EN55011,	Class B Conducted Emissions
IEC 1000-4-5	(EN 61000-4-5); AC Surge Immunity. Similar waveforms are described in ANSI/IEEE 62.41-1991
IEC 1000-4-4	(EN 61000-4-4) Fast Transients Immunity
IEC 1000-4-2	(EN 61000-4-2) Electrostatic Discharge Immunity
IEC 1000-4-3	(EN 61000-4-3) Radiated Field Immunity
IEC 1000-4-6	Conducted Field Immunity
IEC 1000-4-11	Voltage Dip Immunity
NFPA20 –	Fire Pumps. Transfer switches serving fire pumps shall be specifically listed and labeled for that application.
NFPA70 –	National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
NFPA99 –	Essential Electrical Systems for Health Care Facilities
NFPA110 –	Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
IEEE446 –	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
NEMA ICS10-1993 –	AC Automatic Transfer Switches.

#### 1.3 ACCEPTABLE MANUFACTURERS

- A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based transfer switches manufactured by Cummins as distributed by Cummins Power Systems LLC. Basis of Design: Cummins model OTPC/ASCO 7000 series.

#### **1.4 POWER TRANSFER SWITCH**

- A. Rating: As noted in contract drawings.
- B. Main contacts shall be rated for 600 Volts AC minimum.
- C. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).
- D. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

#### **1.5 CONSTRUCTION**

- A. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
- B. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.
- C. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
- D. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
- E. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with line voltage components.
- F. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

#### **1.6 CONNECTIONS**

- A. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- B. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the generator set.

#### **1.7 TRANSFER SWITCH CONTROL**

- A. Operator Panel: Transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

- B. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
- C. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
- D. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
- E. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
- F. “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
- G. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via the service tool or an operator display panel.
- H. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
- I. Display source status, to indicate source is connected or not connected.
- J. Display load data, including 3-phase AC voltage, 3-phase AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
- K. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
  - 1. Set nominal voltage and frequency for the transfer switch.
  - 2. Adjust voltage and frequency sensor operation set points.
  - 3. Set up time clock functions.
  - 4. Set up load sequence functions.
  - 5. Enable or disable control functions in the transfer switch, including program transition.
  - 6. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
- L. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall be “Year 2000” compliant and incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
- M. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
- N. Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.
- O. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

## **1.8 INTERNAL CONTROLS**

- A. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions are not acceptable.
- B. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
- C. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
- D. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
- E. All transfer switch sensing shall be configurable from a Windows 95 or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
- F. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
- G. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).
- H. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the following voltage and RFI/EMI standards.
- I. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

## **1.9 CONTROL INTERFACE**

- A. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
- B. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

## **1.10 ENCLOSURE**

- A. Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking.

- B. Transfer switches shall be mounted in enclosures of the type NEMA 1.
- C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

**END OF SECTION**



**SECTION 26 0800**

**FIRE ALARM SYSTEM**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 FIRE ALARM SYSTEM**

- A. The existing fire alarm system is an addressable system. The fire alarm control panel is located in the boiler room.
- B. Add and modify as required to the existing system, as specified/shown on the drawings and as per field requirements. All devices shall be suitable for operation and compatible with existing system. Provide relays modules, cards, power supplies, etc. as required.
- C. Provide sufficient quantity of relays for fan shutdown as specified/shown on Drawings.
- D. Connect, test and leave the system in first class operating condition.
- E. The system shall maintain all applicable Local, State and National Codes including the National Electrical Code, NFPA-72, NFPA-101, ADA 1971 and NEC. The system shall be listed by Underwriter's Laboratories, Inc.
- F. The Electrical Contractor shall provide a manufacturers certified technician to supervise installation, adjustments, final connection and system testing.
- G. Fire alarm wiring and cable shall be per manufacturer's requirements.
- H. Fire alarm system test shall be in accordance with NFPA-72 and local fire department requirements.

**END OF SECTION**





**SECTION 26 0825**

**PUBLIC ADDRESS SYSTEM**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

**1.1 GENERAL REQUIREMENTS**

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the General Requirements are hereby made a part of this Section.
- B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of the Bogen Nyquist E7000 Series IP-Based Communications System and the specifying authority must approve any alternative system.
- C. Contractors who wish to submit alternative equipment shall provide the specifying authority with the appropriate documentation at least 10 business days prior to bid opening. The submitted documentation must provide a feature by feature comparison identifying how the proposed equipment meets the operation and functionality of the system described in this specification. Prior to bid date, the contractor shall provide adequate and complete submittal information, which shall include but not be limited to specification sheets, working drawings, shop drawings, and system demonstration. The alternative supplier-contractor must also provide a list to include six installations identical to the proposed system.
- D. The contractor shall provide the FCC registration number of the proposed system, where applicable.
- E. Final approval of the alternative system shall be determined at the time of job completion. Failure to provide the "precise functional equivalent" shall result in the removal of the alternative system at the contractor's expense.
- F. The contractor for this work shall have read all the bidding requirements, the general requirements of division 1, and the contract proposal forms, and shall be held to the execution of this work. The contractor shall be bound by all the conditions and requirements therein.
- G. The contractor shall be responsible for providing a complete functional system, including all necessary components whether included in this specification or not.
- H. In preparing the bid, the contractor should consider that no claim will be made against the owner for any costs incurred by the contractor for any equipment demonstrations requested by the owner.

**1.2 SCOPE OF WORK**

- A. The conditions of the General Contract (General, Supplementary, and other Conditions) and the General Requirements are hereby made a part of this Section.
- B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are that of the Bogen Nyquist E7000 Series IP-Based Communications System and the specifying authority must approve any alternative system.

- C. Contractors who wish to submit alternative equipment shall provide the specifying authority with the appropriate documentation at least 10 business days prior to bid opening. The submitted documentation must provide a feature by feature comparison identifying how the proposed equipment meets the operation and functionality of the system described in this specification. Prior to bid date, the contractor shall provide adequate and complete submittal information, which shall include but not be limited to specification sheets, working drawings, shop drawings, and system demonstration. The alternative supplier-contractor must also provide a list to include six installations identical to the proposed system.
- D. The contractor shall provide the FCC registration number of the proposed system, where applicable.
- E. Final approval of the alternative system shall be determined at the time of job completion. Failure to provide the "precise functional equivalent" shall result in the removal of the alternative system at the contractor's expense.
- F. The contractor for this work shall have read all the bidding requirements, the general requirements of Division 1, and the contract proposal forms, and shall be held to the execution of this work. The contractor shall be bound by all the conditions and requirements therein.
- G. The contractor shall be responsible for providing a complete functional system, including all necessary components whether included in this specification or not.
- H. In preparing the bid, the contractor should consider that no claim will be made against the owner for any costs incurred by the contractor for any equipment demonstrations requested by the owner.

### **1.3 SUBMITTALS**

- A. Specification sheets on all items including cable types
- B. Outline drawing of system control cabinet showing relative position of all major components
- C. Shop drawings, detailing integrated electronic communications network system including, but not limited to, the following:
  - 1. Station wiring arrangement.
  - 2. Equipment cabinet detail drawing.
- D. Wiring diagrams showing typical connections for all equipment.
- E. Numbered Certificate of Completion for installation, programming, and service training, which identifies the installing technician(s) as having successfully completed the Nyquist E7000 technical training course provided by the Bogen Communications, Inc.

### **1.4 QUALITY ASSURANCE**

- A. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- B. The contractor shall be an established communications and electronics contractor that maintains a locally run and operated business and has done so for at least 10 years. The contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
- C. The contractor shall show satisfactory evidence, upon request, that he or she maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The contractor shall maintain at his or her facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

### **1.5 SINGLE SOURCE RESPONSIBILITY**

- A. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and a minimum of 30 years of experience in the industry. The supplying contractor shall have attended the manufacturer's installation and service training classes. A certificate of this training shall be provided with the contractor's submittal.

### **1.6 SAFETY / COMPLIANCE TESTING**

- A. The communications system and its components shall, where applicable, bear the label of a Nationally Recognized Testing Laboratory (NRTL), such as Environmental Technology Laboratory (ETL), and shall be listed by their re-examination service. All work must be completed in strict accordance with all applicable electrical codes, under direction of a qualified and factory-approved contractor, and to the approval of the owner.
- B. Bogen's Nyquist E7000 solution is consistent with those NEMA SB 40-2015 requirements that specifically apply to school paging and intercom systems only as outlined within the ANSI/NEMA SB 40-2015 standards publication.

### **1.7 IN-SERVICE TRAINING**

- A. The contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system including Admin Web UI Dashboard operation, Scheduling, and Audio Distribution as a minimum. Operation manuals shall be provided at the time of this training.

### **1.8 WIRING**

- A. System wiring and equipment installation shall be in accordance with generally accepted engineering best practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall be tested to be free from grounds and shorts.
- B. All system wiring shall be labeled at both ends of the cable. All labeling shall be based on the room numbers as indicated in the architectural graphics package.
- C. Wiring shall be done per manufacturer's recommendation (Cat 5 or West Penn #357) depending on speaker type. All terminal connections are to be on barrier strips.

### **1.9 PROTECTION**

- A. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- B. The contractor shall note in his system drawings, the type and location of these protection devices as well as all wiring information. Such devices are not to be installed above the ceiling.

### **1.10 SERVICE AND MAINTENANCE**

- A. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of this system after the initial hardware and software warranty periods.

- B. System shall include software maintenance that includes bug fixes and new feature releases for a period of five years. In addition, the contractor shall provide at the owner's request additional maintenance contracts that are available as one-year, three-year, and five-year extensions. The contractor shall provide a 24-hour response time from call by customer.
- C. The system manufacturer shall maintain engineering and service departments capable of rendering advice regarding installation and final adjustment of the system.

#### **1.11 WARRANTY**

- A. The Bogen Nyquist hardware products identified in this specification shall be warranted to be free from defects in materials and workmanship for five (5) years from the date of sale to the original purchaser; except for the NQ-SYSCTRL, NQ-T1100 and NQ-T1000 which each carry a two (2) year warranty. The Bogen Nyquist software products identified on this specification are warranted to be free from defects in material and workmanship for ninety (90) days from the date of sale to the original purchaser.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers, subject to compliance with requirements specifications, provide the following system:
  - 1. Bogen Nyquist E7000 IP-based paging and intercom solution manufactured by Bogen Communications, Inc.
- B. The specifying authority must approve any alternative system 10 days prior to bid day.
- C. The intent is to establish a standard of quality, function, and features. It is the responsibility of the contractor to ensure that the proposed product meets or exceeds every standard set forth in these specifications.
- D. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

#### **2.2 EQUIPMENT**

- A. Nyquist NQ-SYSCTRL System Controller
  - 1. Configuration and management via a Web-based Graphical User Interface (GUI)
  - 2. Wizard based setup for quick installation
  - 3. Remote access from virtually any PC/MAC, tablet, or mobile device
  - 4. Continuous monitoring of stations and appliances to ensure system operation
  - 5. Dual network adapters to allow the System Controller to operate on two separate networks
  - 6. Music automatically added to music library and playlist from USB port
  - 7. Network-based audio that can be sourced (input) from any number of Nyquist appliances (NQ-P0100, NQ-A2xxx, NQ-A4xxx, etc.)
  - 8. Ample storage for music files, recorded announcements, and call recordings
  - 9. G722 and OPUS audio codec support to deliver superior HD audio quality
  - 10. Convection air cooled; fan-less design for quiet, maintenance-free operation
  - 11. Wall, rack, or shelf mountable

- B. Nyquist NQ-P0100 Matrix Mixer Pre-Amplifier (MMPA)
1. No less than four Mic/Line inputs used for analog audio input like AM/FM Tuner or CD Player
  2. Channel 4 configurable for Push-to-Talk MIC application
  3. Line Level output to drive external amplifier
  4. Software programmable configuration and operation
    - a. Push-to-Talk Channel
    - b. Push-to-Talk Type
    - c. Push-to-Talk Zone
    - d. Mixer Channels
  5. Configurable built-in DSP
    - a. Noise Gate
    - b. Compressor/Limiter functions, etc.
    - c. Tone Controls: Low Shelving, Mid Bandpass and Hi Shelving
    - d. Multi-band Parametric EQ
    - e. Variable Low-Cut/High-Pass filters
    - f. CH1 can be configured as a digital AES/EBU (AES3) input
  6. USB 2.0 host port, Type-A connector (future use)
  7. Powered by 100V – 240V Universal AC Mains
  8. Wall, rack, or shelf mountable
- C. The Nyquist two and four channel amplifiers available in the following number of channels and watts
1. NQ-A2060 two channel with 60 watts per channel
  2. These amplifiers shall include GUI based DSP controls; 16-band Graphic Equalizer; Signal Present and Clip Monitor; Adjustable High Pass, Low Pass, and Bandpass Filters; Noise Gate; Compressor/Limiter; and 7-band Parametric Equalizer. Outputs shall be provided for 4-, 8-ohm, 25V, and 70V distributed systems.
  3. Bridged or Mono Mode
  4. Integrated Digital Signal Processor
    - a. Noise Gate
    - b. Compressor/Limiter functions, etc.
    - c. Tone Controls: Low Shelving, Mid Bandpass and Hi Shelving
    - d. Multi-band Parametric EQ
    - e. Variable Low-Cut/High-Pass filters
  5. One Line-Level Input on two channel amplifiers
  6. Two Line-Level Inputs on the four channel amplifiers
  7. 100/1000 GB ethernet connection
  8. USB 2.0 host port, Type-A connector (future use)
  9. 100V – 240V Universal AC Mains
  10. Wall, rack, or shelf mountable
  11. The amplifiers shall carry the necessary safety agency listings for both the US and Canada. The amplifier shall employ convection air cooling. Amplifiers that require fans for cooling shall not be considered equal.
- D. Nyquist NQ-E7010 Input/Output Controller
1. Power over Ethernet 802.3af compliant
  2. 8 x Dry Contact Closure Inputs
  3. 8 x Relay Driver Outputs (Open-Collector)
  4. USB 2.0 host port, Type-A connector (future use)
  5. Software programmable configuration and operation including; Contact Type, Extension, Name, Close Interval, Actions (911, Audio, Alarm, Announcement, All-Call, Multi-Site-Emergency-All-Call, Emergency-Call, Emergency-All-Call, Hourly, Audio-Disabled, No Action, Page, Tone, Enable-Audio and Manual), Action ID, Zones, Close Extension, Dashboard Type, Dashboard Title, Dashboard Scope, Dashboard Text, Dashboard Style, Email and Routines
  6. Wall, rack, or shelf mountable

- E. Nyquist NQ-S1810WT-G2 Classroom VoIP Wall Baffle Speaker(s) GEN-2
1. Adjustable volume in 3db increments 1/8, 1/4, 1/2, 1, 2, 4, and 8 Watts via web browser
  2. Built-in 10W amplifier
  3. MEMS digital microphone for talkback
  4. Audio Active Control SPDT Relay Output Rated at 2A
  5. Power over Ethernet 802.3af compliant
  6. CAN Bus 2.0 Interface connects to Nyquist Digital Call Switches (NQ-E7020)
  7. Capable of four (4) different wall mounting options:
    - a. 2X2 Wall Mount
    - b. Box Mount
    - c. Corner Mount
    - d. Tilted Mount
- F. Nyquist NQ-S1810CT-G2 Classroom VoIP Ceiling Speaker(s) GEN-2
1. Adjustable volume in 3db increments 1/8, 1/4, 1/2, 1, 2, 4, and 8 Watts via web browser
  2. Built-in 10W amplifier
  3. MEMS digital microphone for talkback
  4. Audio Active Control SPDT Relay Output Rated at 2A
  5. Power over Ethernet 802.3af compliant
  6. CAN Bus 2.0 Interface connects to Nyquist Digital Call Switches (NQ-E7020)
  7. Optional hardware available:
    - a. RE84 Recessed Enclosure (Back box)
    - b. TB8 Time Bridge
    - c. MR8 Mounting Ring (for installation where RE84 is not used)
- G. NQ-T1100 VoIP Admin Phone Color Touch Display (aka Admin Station)
1. 7" 800 x 480-pixel color display with backlight
  2. Touch screen display for one touch operation
  3. Full-duplex hands-free speakerphone with AEC
  4. Call hold
  5. Mute
  6. Redial, call return, auto answer
  7. PoE (802.3af) Class-3 support
  8. Headset with EHS support
  9. Dual Gigabit Ethernet ports
  10. Desk Mountable
  11. Optional Wall mount available
- H. NQ-T1000 VoIP Staff Phone LCD Display (aka Staff Station)
1. 132 x 64-pixel graphical LCD with backlight
  2. Two-port 10/100M Ethernet Switch
  3. Full-duplex hands-free speakerphone with AEC
  4. Call hold
  5. Mute
  6. Redial, call return, auto answer
  7. PoE (802.3af) Class-3 support
  8. Dual-color (red or green) illuminated LEDs for line status information
  9. Two 10/100M Ethernet ports
  10. Wall or desk mountable

I. E7000 Server Requirements

1. Provide P.D.E switches, patch panels, wall mounted rack, punch cords and all required provisions and necessary accessories for a complete installation.
2. Contractor is responsible to furnish and install a complete stand-alone Public Address system as turn-key to Owner. Coordinate with IT department before purchase and installation of PA server (see I. 1).

**2.3 COMPONENTS AND DESCRIPTIONS**

A. The Nyquist E7000 Series Educational System is a software-based VoIP paging and intercom system.

B. The System must be capable of supporting existing Bogen Multicom 2000 and Bogen Quantum Multicom IP wiring, 25-Volt speakers and analog call-switches, and equivalent competitive systems utilizing the existing architectural numbering scheme. The VoIP capabilities of the Nyquist system will enable the support of the features across the Nyquist appliances within the facility. The following sections define how the system handles each of the features in the system. Systems that do not allow the reuse of existing wiring or numbering scheme shall not be deemed acceptable. Systems that do not allow appliances to be seamlessly integrated via the existing customers LAN are not considered equal.

C. Nyquist E7000 Software

1. The Nyquist E7000 software is pre-installed on a Nyquist NQ-SYSCTRL System Controller or can be optionally installed on a dedicated dealer or customer supplied server. An unlimited number of facilities can be networked into a Nyquist-based District.
2. If the Nyquist Software is not a Nyquist NQ-SYSCTRL System Controller than the Minimum Server Requirements apply to dealer or customer supplied Server.
  - a. Debian Linux OS (AMD 64-bit version) release 8.4.x – 8.11.0
  - b. Quad-core Intel-based processor running at 3.0 GHz or higher
  - c. 8 GB RAM
  - d. One 250 GB disk drive or larger
3. Redundant Array of Independent Disks (RAID) is recommended for redundancy and high availability.
4. Consider using a larger drive if large amounts of audio (for example, voice mail, announcements, recordings, and music) are being stored on the system. Other factors that should be considered are:
  - a. How often will backups be performed?
  - b. Will the system be backed up locally or remotely on a detachable drive, SAN/NAS, or NFS?
  - c. How many users will have voicemail ability?
  - d. How long will voicemail messages be stored?
  - e. Will voicemail messages be part of the local system backups?
  - f. NIC 10/100/1000 MB Ethernet port.
  - g. One or more PCI/PCI Express (PCIe) slots if telephony network connectivity other than, or in addition to, SIP trunking.
  - h. One or more PCI/PCIe type third-party telephony interface cards (for example, FXO, FXS, etc.) if telephony network connectivity other than, or in addition to, SIP trunking.
5. Audio shall be transmitted between the System Controller and the Nyquist appliances using the customer supplied LAN/WAN using both G.722 and Opus 48k audio encoding and streaming technology to deliver High Definition DVD quality audio. Systems that do not use G.722 and Opus for audio encoding and streaming shall not be deemed equivalent.

6. Installers have the ability to verify that the Nyquist System Controller can access Internet-based URLs required for the system to run properly by clicking on the "Check Internet Site Access" on the license activation wizard. If the installer made mistakes in configuring the network the install has the ability to go back and make changes to the network by clicking on the "Network Wizard" button.
7. The Nyquist software and Nyquist appliances firmware shall be upgradeable via the Nyquist Web UI System Update page that contains a list of available Nyquist software updates. When automatic software check and download are enabled, new software updates will automatically be downloaded and appear in the System Update list, and a dashboard message will be displayed to announce newly available software. Release notes can be viewed for each available update. System updates can be started via the System Update list. The System Update page includes a "Check for System Updates" button that can be used to manually check for and download available Nyquist software updates.
8. Prior to performing Nyquist updates the technician shall have the ability to verify if the default gateway, Network Time Protocol, and Domain Name Servers are configured and available, to obtain network interface and routing tables status, and to display the Nyquist E7000's public IP address. See "Check Internet Site Access" under "System Parameters". The E7000 system can be setup to automatic check for new Nyquist System software and automatic download of new Nyquist System Software.
9. It shall be possible for a Nyquist facility to make "station-to-station" calls and "remote facility" All-Call pages to a single facility or to all Nyquist facilities in a district via the Nyquist Web UI or an Admin Station. Systems that require remote viewing software or other application software to be installed/loaded on to additional servers or PCs to make station-to-station calls and remote facility All-Call or district paging shall not be considered equivalent.
10. The Nyquist software is designed to handle all facility and district-wide communications, including but not limited to, inter-facility intercom calling and paging, district-wide Emergency All-Call and local facility point-to-point calls. Via the Nyquist Web UI, every facility shall be configured with the IP addresses of all the other remote facilities within the district. To ensure that these communications are operating correctly at all times the Nyquist appliances are supervised and remote facilities are monitored, if a device or facility has a fault the system can send and/or email and also display a message if a device changes state. System that does not provide Station Supervision and remote Facility Monitoring shall not be considered.
11. Nyquist can support an unlimited number of facilities; however, the maximum number of simultaneous remote facility intercom calls supported is based on the actual performance of the WAN and the Nyquist System Controller CPU load.
12. The voice quality of the facility calls may vary based on the WAN conditions. The maximum network bandwidth that All-Call and Zone Paging uses is average of 0.086 Mbps (Multicast G.722), and intercom calls average of 0.171 Mbps (unicast, G.722).
13. The system shall facilitate the repetitive playing of Normal or Emergency audio tones or announcements directed to an All-Call or a Paging Zone until stopped by the Nyquist user via the Web UI, an Admin Station, or a dry contact closure connected to the Nyquist I/O Controller NQ-E7010.
14. Through the use of Routines, a trained individual can create a routine that can perform a sequence of events that can include the repetitive playing of normal or emergency audio files, make or break contact closure(s), display different messages in different areas, send email(s), and place a phone call (if equipped) offsite and play a pre-recorded message. Routines can be triggered/started by Application Programming Interface (API) or the playing of normal or emergency audio files, make or break contact closure(s) or almost any feature or function in the E7000 system. The system must also be capable of executing multi-site Routines (e.g., supports District-wide lockdown). System that does not provide Routines are not equal.



15. A built-in Master Clock shall be included to automatically control class change bells or other time-based events. The Master Clock shall have an unlimited number of Events that may be programmed into any of the unlimited number of Facilities, unlimited number of Schedules, and unlimited number of Holiday events. The schedules shall be nameable for easy selection when assigning schedules to days or overriding a schedule. Schedules can be overridden via the Admin Web UI or Admin phone.
  16. Network Time Synchronization. The system shall be capable of periodically updating/synchronizing the processor's time with a Network Time Server running Network Time Protocol (NTP) via the school's LAN network. Systems that do not provide Network Time Synchronization will not be deemed equivalent. The Nyquist server can be the NTP server for other devices on the LAN such as IP clocks and other IP devices.
- D. Nyquist E7000 System Software Application
1. The Nyquist software is pre-installed on the Nyquist System Controller, and upon boot-up, users can log in to the Nyquist application via a web browser that supports WebRTC. Systems that require Com Port redirect software, client PC application, software or serial-to-Ethernet adapters for user access are not deemed equal. Communications between the System Controller and the Web UI(s) shall be via secure Hyper Text Transfer Protocol (HTTPS) connections (i.e., https://).
  2. The Nyquist Web UI shall be configured with four different default user access levels, based on four unique user roles. Systems that do not provide unlimited access levels and unlimited number of user roles are not considered equal.
  3. The four default roles shall be: admin, optech, operator, and user. These roles provide a starting point/example for administrators to create additional roles
  4. Only a user assigned the admin role shall be able to provide access to users, giving them the ability to create, delete, edit, and view system parameters.
  5. Only an Administrator shall have the ability to adjust roles and Class of Service (CoS) of users. The roles determine if users can view the definable data objects that can include configuration, alarms, and performance data and if users can perform certain operations based on the user's role and station's CoS. All changes to roles and CoS are effective immediately, without the need to restart the browser or reboot the System controller or server.
  6. The Nyquist Web UI Dashboard shall provide full administrative capabilities to manage/operate the following system features:
    - a. Calling/Paging – Used to access directory, dial pad, Page Exclusion, Call Forwarding, Zone Page, Record Page, Prepending Page, All-Call, Emergency All-Call, Manage Check-in and operate Routines.
    - b. Multi-Site Calling/Paging – Used for Facility Page, Multi-Site All Call, and Multi-Site Emergency All Call.
    - c. Tones/Announcements – Used for Tones, Announcements, Alarms, Stop Announcement, Display Message, and Remove Message.
    - d. View Weekly Schedule – Used to show the current active Bell Schedules.
    - e. Audio Distribution – Used to distribute audio sources to Stations, Audio Zones or entire facility. Operators can create an unlimited number Audio Distributions as needed by the facility.
    - f. Enable or Disable Audio – Used to place the Nyquist system into Page Exclusion mode (i.e., “mute” the system) when a contact closure is supplied from the fire alarm panel. Systems that do not provide this capability are deemed not equal.
  7. Systems that require application software to be installed on a PC to manage the above features shall not be considered.

8. To facilitate installation and configuration of the system, additional Web UI menus are required. The menus shall only be visible to users with the correct roles and CoS. The navigation menus found on the Web UI shall be as follows:
- a. System Parameters – Allow installers to adjust core system parameters including Product License, Restart Server, Station Supervision, Email Configuration, System Update, Shut Down Server, Check Internet Site Access, Check Server Status, Edit system tools and adjust all the System Parameters.
  - b. Zones and Queues – Allow installers to create and modify Paging, Time, and Audio Zones. Installers can also setup Queues that can be used to eliminate feedback.
  - c. Schedules – Allow installers and administrators to create bell schedules for multiple Schools, predefine alternative schedules to run, prevent the bells from ringing on a holiday, and schedule an announcement to play. The system shall allow an unlimited number of schedules to operate simultaneously within a facility.
  - d. CoS Configuration – Allow the installer to create, modify, and delete CoS groups that control station access to the following features: Call-in Level, Zone Paging, All-Call Paging, Emergency All-Call, Inter-Facility Call/Page, Audio Distribution, Remote Pickup, Join Conversation, Call Forwarding, Walking Class of Service, External Call Routing, Call Transfer/3-way Calling, Manually Activate Tone Signals, Call Any Station, Manage Recording, Monitor Calls, Monitor Locations, Conference Admin, Conference User, Voicemail, Record Calls, Activate Alarm Signals, Disable Audio, Enable Audio, Allow Callee Auto-answer, District Paging, Inter-Facility Features, Manage Output Contacts, and Execute Routines.
  - e. Admin Groups – Allow the installer to create, modify, and delete software groupings of admin phones, staff phones, and Admin Web UIs that can ring when a station calls in with a call switch.
  - f. Stations – Allow the installer to set up, modify, and delete stations; set up Page Exclusion; view Station Status; and add New Stations.
  - g. Bridge Devices – Allow the installer to configure the Nyquist ASBs.
  - h. Amplifier Devices – Allow the installer to configure Nyquist Two and Four and PA Amplifiers
  - i. Audio – Allow the installer to upload and manage Announcements, Playlists, Recordings, Songs, Tones, and Internet Radio Services. The system must support the uploading of both MP3 and WAV files and make Audio file management simple for users. Systems that limit the size of Audio files shall not be considered equal.
  - j. Users – Allow the installer to manage users by giving them the proper roles and assign extensions if needed.
  - k. Roles – Allow the installer to grant users rights to Create, Delete, Edit, Restart System, Sort Menu, Systems Update, Manage, Import/Export, Restore, Settings, or View.
  - l. Facilities – Allow the installer to set up the district wide facilities for remote paging and calling.
  - m. Outside Lines – Allow the installer to set up FXS and FXO ports for inbound and outbound system calling.
  - n. SIP Trunks – Allow the installer to set up SIP trunks into the facility for inbound or outbound calling.
  - o. Call Details – Allow the installer to review the historical system activities that can be used for incident investigation or system troubleshooting.
  - p. System Backup/Restore – Allow the installer to preform system backups or restores and allow the backups to be scheduled to run automatically.
  - q. System Logs – Allow the installer to view and export log files, Nyquist-Intercom, and Web Server logs that can be used for troubleshooting and technical assistance.
  - r. Paging Exclusions – Allow the installer to view and edit stations that are excluded from paging.
  - s. Firmware – Update firmware for Nyquist speakers and appliances.

- t. Routines – Allow installers to create routines that are a sequence of actions, that the Nyquist system executes as a result of an input trigger. Routines can support crisis plans for situations such as school lockdowns, weather events, or emergency evacuations.
- u. Alert Filters – Allow installers to select the National Weather Alerts that the facility needs to monitor for such as weather events, earthquakes, tsunami, volcanoes, public health, power outages, and many other emergencies.
- v. Systems that do not provide these options as a minimum shall not be considered equal.

E. Nyquist NQ-P0100 Matrix Mixer Pre-Amplifier (MMPA)

1. The Nyquist NQ-P0100 MMPA is designed to bring external audio into the Nyquist system. The MMPA interfaces with a local sound system by accepting one or more analog audio sources, mixing them, and outputting them to either, a) the network for Audio Distribution, or b) the MMPA's line level output that can then be inserted into an external amplifier to drive local sound system in gyms, cafeterias, auditoriums, etc. The MMPA supports the following:
  - a. Four software selectable Line/MIC Input channels via three XLR connectors and four sets of screw-terminals. Input channel four (4) shall be capable of being configured to support a Push-to-Talk microphone Bogen model DDU-250. Channel-1 can be configured as a digital AES/EBU (AES3) input. Line/Monitor output – The MMPA becomes a station on the Nyquist system, allowing users to call it directly or to include it in any of the Page, Time, or Audio Zones and can be direct one-way page by calling it extension.
  - b. The MMPA shall support the following features: Line-Level output to drive input on a local amplifier or self-amplified speaker; One USB 2.0 host port (Type-A connector) for future use; two (2) x RGB full spectrum LED status indicators.
  - c. Configurable built-in Digital Signal Processing for Noise Gate, Compressor/Limiter functions, etc., Tone Controls: Low Shelving, Mid Bandpass and Hi Shelving, Multi-band Parametric EQ, and Variable Low-Cut/High-Pass filters.
  - d. The MMPA is powered by Universal mains supply (100VAC – 240VAC).
  - e. The MMPA shall be wall or shelf mountable and shall include the required mounting bracket hardware.
2. The system shall be equipped a minimum of one (1) Nyquist MMPA that allows for up to four user-configurable audio inputs. The MMPA shall support Line, MIC, and digital AES/EBU (AES3) input sources. The system supports an unlimited number of MMPAs.

F. Nyquist NQ-E7010 Input/Output Controller

1. The Nyquist NQ-E7010 I/O Controller is designed to accept contact closure inputs and activate open-collector outputs to drive relay coils. These inputs and outputs are used to trigger events or to be triggered by an event or Routine within the Nyquist system.
  - a. PoE Class-1; IEEE 802.3af compliant with Optional 48VDC 15W power supply
  - b. Eight Dry Contact Closure Inputs that can be used with Fire Alarm Override Relays, external event triggers (for example, Lockdown Buttons, etc.)
  - c. Eight Relay Driver Outputs (Open-Collector) for use with Clock Correction (Sync Pulse), response to contact closure inputs, etc.
  - d. USB 2.0 host port, Type-A connector (future use)
  - e. Two (2) x RGB full spectrum LED Power and Status indicators
2. The Nyquist NQ-E7010 I/O Controller shall support wall or shelf-mounting options and shall include the required mounting bracket hardware.
3. The Nyquist NQ-E7010 I/O Controller shall be designed for wall or shelf mounting.

G. Nyquist NQ-S1810CT-G2 VoIP Ceiling Speaker with Talkback and NQ-S1810WT-G2 VoIP Wall Baffle Speaker with Talkback

1. The VoIP speakers shall not require traditional intercom wiring or transformer taps to manually set or adjust volume. Simply connecting them via Cat 5 or better to a PoE Switch or PoE Injector on the system's network should allow them to be ready to program into the system. Volume is controlled via the Nyquist Web UI. All Nyquist audio appliances shall use a wideband Opus codec for DVD quality Audio Distribution. Use of the Opus codec, along with G.722, allows for High Definition (HD) audio. Nyquist VoIP speakers shall be equipped with a digital MEMS microphone to achieve superior talkback audio. VoIP Speakers that utilize the speaker as the microphone shall not be considered equal.
2. Software adjustable volume in 3db increments 1/8, 1/4, 1/2, 1, 2, 4, and 8 Watts via web browser allow the operators to adjust the Built-in 10W amplifier.
3. The MEMS digital microphone provide unprecedented talkback from the classroom allowing staff to hear the slightest inflection in anyone's voice.
4. Audio Activated Control Relay Output designed to override local classroom sound systems
5. The Nyquist VoIP speaker are equipped with an audio activated control Relay Output that is normally open or closed and changes state when audio is active. This relay can be used to override a local sound system in the classroom.
6. The VoIP Speakers shall be PoE IEEE 802.3af compliant allowing staff to effortlessly add additional speakers as needed on available PoE Ports throughout the campus. Making them easy to add move or change as the needs of the facility changes over time.
7. Connection to optional Digital Call Switch Nyquist NQ-E7020, which can place Normal, Urgent, or Emergency priority calls and can provide station status and the ability for the user to enable and disable Privacy Mode
8. The NQ-S1810WT VoIP Wall Baffle Speaker with Talkback design facilitates mounting the speaker up to four different ways:
  - a. 2x2 Wall Mount
  - b. Box Mount
  - c. Corner Mount
  - d. Tilted Mount
9. The NQ-S1810CT VoIP Ceiling Speaker is designed to work with the same Bogen hardware used with our analog ceiling speakers to make the installation process easy for installers that have installed ceiling speaker in the past available accessories:
  - a. RE84 Recessed Enclosure (Back box)
  - b. TB8 Time Bridge
  - c. MR8 Mounting Ring (for installation where RE84 is not used)
10. Like all Nyquist Appliances we support the most common network features to rapidly deploy Nyquist Appliances on the network such as DHCP with Option 66 and VLAN support to aid in this effort.
11. The VoIP Speakers come pre-assembled for faster installation

H. Nyquist NQ-E7020 Digital Call Switch

1. The Nyquist DCS has been exclusively designed for use with Nyquist appliances equipped with a CAN Bus 2.0 Interface. The CAN Bus 2.0 interface provides power and signal, and multiple DCSs can connect to each CAN Bus 2.0 interface. The DCS fits into a Single Gang/ Low Voltage installation using standard 'decora-plate' covers (supplied).
2. The DCS is a capacitive touch button design, so it does not have any moving parts to wear out. The behavior of this switch is software definable. Systems that require membrane or mechanical rocker style call switches that can wear out over time shall not be acceptable.
3. Normal call initiation involves touching the DCS one time. When a user touches the button on the DCS once, one of the three LED segments will light up green, a normal call will be placed, and the light will start blinking green. This is the indication that the Normal call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones and that the phone or phones are ringing.
4. Urgent call initiation involves touching the DCS one time. When a user touches the button on the DCS once, one of the three LED segments will light up yellow, an Urgent call will be placed, and the light will start blinking yellow. This is the indication that the Urgent call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
5. Emergency call initiation involves touching the DCS one or three times depending on station programming. When a user touches the button on the DCS once or three times within three seconds, all three LED segments will light up red, an Emergency call will be placed, and the light will start blinking red. This is the indication that the Emergency call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
6. Single Press Emergency Call, if programmed, involves touching the DCS one time. When a user touches the button once, all three LED segments will light up red on the DCS, an Emergency call will be placed, and the light will start blinking red. This is the indication that the Emergency call has been placed to the VoIP Admin Phone or to a group of VoIP Admin Phones.
7. Normal and Urgent calls can easily be upgraded to an Emergency call after the DCS is flashing by touching the button on the DCS one time. The Normal or Urgent call will be replaced by an Emergency call. Systems that don't allow the staff to upgrade the priority of a call shall not be considered equivalent.
8. Privacy Mode – Pressing and holding the button on the DCS for four seconds will place the speaker into Privacy Mode. As the user continually touches the DCS button, all LED segments will turn purple; when all three LED segments are lit purple, the speaker is in Privacy Mode. If a call comes into the classroom when the station is in Privacy Mode, the microphone will be disabled; the user in the classroom can touch the DCS once and it will allow talkback. Once the call ends, the classroom will need to manually return the speaker into Privacy Mode, if desired. The user can disable Privacy Mode without placing a call by pressing and holding the button on the DCS for four seconds. As the user continually touches the DCS, all LED segments will turn blue. When all three LED segments are lit blue, the speaker is no longer in Privacy Mode. Systems that require mechanical or membrane switches to achieve Privacy Mode shall not be considered equal.
9. The colors specified above are created by three RGB full spectrum LED segments to provide installers and users with visual status and feedback when installing and using the DCS. When the DCS is being installed and the power is connected before the signal, the LED will light red. It will also light red if the speaker in the classroom stops communicating with the Nyquist System Controller, indicating a problem with the station.

10. In addition to providing visual call status indications, a call confirmation audio file shall be played on the associated loudspeaker when a call is placed via a DCS. The three call-in levels shall have distinct audio confirmation messages:
  - a. Call Placed
  - b. Urgent Call Placed
  - c. Emergency Call Placed
  
11. Emergency Link Transfer – If an Emergency call is unanswered by the VoIP Admin Phone and the Emergency Link Transfer is active, the Emergency call will be forwarded to the loudspeaker associated with the Emergency Link Station. Any station equipped with a loudspeaker can be programmed as the Emergency Link Station. Systems that do not provide Emergency Link Transfer shall not be considered equal.
  
- I. The Nyquist based two channel amplifier shall be model NQ-A2060/2x60 watts, with switch selectable 2-Channel or 1-Channel bridged operation. The amplifier shall have one dedicated Balanced Line Input. The amplifier shall provide a frequency response from 20-20 kHz +/- 0.25 dB at rated power. Distortion shall be less than 0.03%. The amplifier shall include GUI based DSP controls; 16-band Graphic Equalize; Signal Present and Clip Monitor; Adjustable High Pass, Low Pass, and Bandpass Filters; Noise Gate; Compressor/Limiter; and 7-band Parametric Equalizer. Outputs shall be provided for 4-, 8-ohm, 25V, and 70V distributed systems. The amplifier shall be rack mountable 1/2 Rack Width - Wall, Rack, or Shelf mountable 1RU and 2RU packages or by using a 19" Rack Mount Kit (NQ-RMK03; sold separately). It shall carry the necessary safety agency listings for both the US and Canada. The amplifier shall employ convection air cooling. Amplifiers that require fans for cooling shall not be considered equal.
  
- J. The Nyquist based four channel amplifier shall be model NQ-A4060/4x60 watts with switch selectable 4-Channel or 2-Channel bridged operation. The amplifier shall have two dedicated Balanced Line Inputs with both Phoenix plug and XLR connections for each input. The amplifier shall provide a frequency response from 20-20 kHz +/- 0.25 dB at rated power. Distortion shall be less than 0.03%. The amplifier shall include GUI based DSP controls; 16-band Graphic Equalizer; Signal Present and Clip Monitor; Adjustable High Pass, Low Pass, and Bandpass Filters; Noise Gate; Compressor/Limiter; and 7-band
  
- K. Nyquist NQ-T1100 VoIP Admin Phone – Color Touch Display (Admin Station)
  1. The Nyquist Admin Station shall have the following features:
    - a. 7" 800 x 480-pixel color display with backlight
    - b. Touch screen display for one touch operation
    - c. Full-duplex hands-free speakerphone with AEC
    - d. Call hold
    - e. Mute
    - f. Redial, call return, auto answer
    - g. PoE (802.3af) Class-3 support
    - h. Headset with EHS support
    - i. Dual Gigabit Ethernet ports
    - j. Desk Mountable
    - k. Optional Wall mount capable
  
  2. The Nyquist Admin Station display panel shall show the time of day and day of week, the current bell schedule(s), and the station numbers and call-in priority of staff stations that are calling in. Depending upon the system programming, an Admin Station shall display menus to activate Zone Paging, All-Call Paging, Emergency All-Call Paging, District All-Call paging, alarm signals, and external functions.
  
  3. The Admin Station shall be capable of calling either the loudspeaker or Staff Station at each classroom location.

4. The Admin Station shall display the classroom number of any station that calls 911. This allows front-office administrators to direct emergency personnel to the correct physical location in the building when they arrive. If a system is not connected to outside phone lines, then 911 calls can be routed to a designated station within the facility. The system shall automatically record all 911 calls made from any station. The 911 call recording shall begin as soon as 911 is dialed and continue until the call is terminated. Recorded calls shall be maintained on the system for later playback review and/or retrieval by authorized personnel and/or authorities. Systems that do not provide this feature will not be deemed equal.
- L. Nyquist NQ-T1000 Staff VoIP Phone – LCD Display (Staff Station)
1. Nyquist Staff Station shall have the following features:
    - a. 132 x 64-pixel graphical LCD with backlight
    - b. Two-port 10/100M Ethernet Switch
    - c. Full-duplex hands-free speakerphone with AEC
    - d. Call hold
    - e. Mute
    - f. Redial, call return, auto answer
    - g. PoE (802.3af) Class-3 support
    - h. Dual-color (red or green) illuminated LEDs for line status information
    - i. Two 10/100M Ethernet ports
    - j. Wall or desk mountable
  2. The classroom Staff Station shall be capable of the following features depending on how the station CoS is configured:
    - a. Emergency intercom call – Staff Stations shall be capable of making an Emergency intercom call, which is then routed to the assigned Admin Station. This requires the display of the architectural number and call in level on the Admin Station. Systems that do not provide this feature are not equivalent.
    - b. Speed dial
    - c. Toggle audio distribution on and off
    - d. Call Forward activation and deactivation for All-Calls/Busy/No Answer/Busy or No Answer
    - e. Conference Calling
    - f. Transfer Call
    - g. Dial Administrative station – Staff Stations can allow the user to dial the station number to call to the Admin phone or its associated speaker. The call shall be routed to the Admin Station showing the architectural number that is calling.
    - h. Emergency All-Call – An emergency page shall be broadcasted to all the stations in the facility.
    - i. Place Outside Call
    - j. Remote Answer
    - k. Single-Zone/All-Station Page
    - l. Call Waiting Tone for Outside Calls – It shall be possible to feed the call waiting tone to the Administrative Phone during a conversation.
    - m. Transfer call from VoIP speaker in classroom down to an associated Staff Station
    - n. Transfer call from analog speaker in classroom down to an associated Staff Station
    - o. Transfer call from VoIP Staff Station in classroom up to an associated VoIP speaker
    - p. Transfer call from Staff Station in classroom up to an associated analog speaker

## 2.4 SYSTEM CAPABILITIES

- A. The communication system shall be a Bogen Nyquist E7000 Series Educational System and shall provide a comprehensive communications network between administrative areas and staff locations throughout the facility.
- B. The system shall provide no less than the following features and functions:
1. Software-based, state-of-the-art, Voice over IP (VoIP) paging and intercom solution.
  2. The system shall provide a Web User Interface (Web UI) shall allow users to configure and control the system, in accordance with their assigned User Role, from any Web browser enabled PC, Mac, Android or iOS tablet or mobile device.
  3. Amplified-voice communication with analog loudspeakers shall use a shielded audio pair when connected to an ASB.
  4. The system shall support any combination of the following VoIP phone station types: NQ-T1100 Administrative VoIP Phone – Color Touch Display (Admin Station) or NQ-T1000 Staff VoIP Phone – LCD Display (Staff Station).
    - a. All VoIP phone station types shall utilize the same type of field wiring.
    - b. There shall be no limit to the number of Admin Stations that can be connected to a facility. Systems that require different head-end equipment to make Admin Stations function, or systems that limit the number of Admin or Staff Stations shall not be deemed acceptable.
  5. Future station alterations shall only require the Station Type to be changed in system programming. Alterations shall not require field wiring or system head-end alterations, unless an analog station device is being replaced by a VoIP station device or vice-versa.
  6. The system shall be a global non-blocking system. The system shall be capable of unlimited amplified intercom paths per facility. Two amplified intercom paths shall be provided with each ASB for its complement of 24 stations. All hardware, etc., required to achieve the necessary number of amplified-voice intercom channels for this system shall be included in this submittal. ASB amplified-voice intercom channels shall provide voice-activated switching. Systems requiring the use of a push-to-talk switch on administrative telephones shall not be acceptable. There shall be an automatic level control for return speech during amplified-voice communications. The intercom amplifier shall also provide control over the voice switching sensitivity and delay times of the VOX circuitry on the ASB.
  7. The system shall provide 911 Dial-Through via outside FXO/FXS lines or SIP trunks to ensure that one or more lines are always available for 911 calls. The 911 Dial-Through is available to any properly configured station (via CoS). When a station dials 911, the 911 call is processed as follows:
    - a. Call routes to an Emergency Group where the call can be answered.
    - b. The 911 CO lines can be pre-configured and reserved. If the 911 reserved lines are busy, the normal CO lines will be connected to route the 911 calls. If all the normal CO lines are busy, then one of the ongoing calls shall be disconnected and the 911 call shall be placed.
    - c. When 911 is dialed from any station, its designated Admin Station or Admin Group will receive a message that the station has dialed 911.
    - d. The system shall automatically record all 911 calls made from any station. The 911 call recording shall begin as soon as 911 is dialed and shall continue until the call is terminated. Recorded calls shall be maintained on the system for later playback review and/or retrieval by authorized personnel and/or authorities.



8. It is of highest importance that Emergency calls from stations receive prompt attention. Therefore, it is important that there be an alternative destination in case the Emergency call does not get answered at the primary location. Details are as follows:
  - a. Staff-generated Emergency calls shall be treated as the second highest system priority. Therefore, all Emergency calls shall announce at the top of the call queue of their respective Admin Station or Admin Group. Should that Emergency call go unanswered for 15 seconds, the call shall be re-routed to an alternative speaker station. Then, a tone will prompt the caller to make a verbal call for help and announces to the Emergency link station "Emergency." During the transfer, the original administrative telephone shall continue to ring the distinctive Emergency Ring. Should the Emergency Transfer-to-Station have an associated Admin Station, it will also ring for the Emergency call.
  - b. The Emergency Transfer-to-Station shall be software configurable.
  - c. Systems failing to transfer unanswered Emergency calls or failing to immediately connect to the designated Admin Station shall not be deemed as equal.
  
9. There shall be a Facility Wide Emergency All-Call feature. The Emergency All-Call shall be accessed from designated Admin Stations or the Nyquist Dashboard or by the activation of an external contact closure that shall give a microphone input Emergency status. The Emergency All-Call function shall have the highest system priority and shall override all other loudspeaker-related functions including Time Tones, Normal All-Call or Zone Pages, or Audio Distribution.
  - a. Considering that Emergency calls are to be treated with the highest level of concern, systems that do not regard Emergency All-Call with the highest priority shall not be deemed as equal.
  - b. Upon touching the Directory icon, a menu shall appear on the Admin Station display prompting the user to select the desired menu.
  - c. The Emergency All-Call shall capture the highest-level system priority and shall be transmitted over all speakers in the facility. It shall also be capable of activating an external control output, which can be used to activate external relays to automatically override volume controls, local sound systems, or strobe circuits.
  - d. This Emergency All-Call feature can have a four-digit pin number associated with it that would be required to use the feature or override someone that is already using this feature.
  - e. Systems without Emergency All-Call or systems with All-Call that cannot be activated by external means or that do not capture complete system priority or activate an external relay, shall not be acceptable.
  
10. There shall be unlimited Alarm Tones (four by default). Each may be accessed by dialing \*91 and the two-digit tone number from any Admin Station, SIP Trunk, or FXO/FXS system interface. These Alarm Tones are separate from the Time Tones. Users shall be able to add an unlimited number of Alarm Tones to the system by uploading MP3 or WAV files. Systems that do not allow the user to upload MP3 and WAV files to customize the Alarm Tones or need to use external alarm/tone generators or special software or have less than four Emergency Alarm Tones shall not be acceptable.
  
11. Upon touching the Directory icon on an Admin Station, a menu shall appear on the display prompting the user to select from the sub-menus. The Alarms sub-menu is the first available. This precludes the user from having to memorize complicated key sequences to access Alarm Tones.
  
12. There shall be unlimited I/O Controller relay driver outputs accessible and controllable by properly authorized users via an Administrative Web UI. These outputs remain set until accessed and reset. Users shall have the ability to review the status of each relay driver output. Users shall be prompted through fields via a plain English menu, precluding users from having to remember any dialing sequences to control this feature. The system shall support an unlimited number of I/O Controllers, and each I/O Controller shall be able to interact with any and all other I/O Controllers on the system (i.e., an input on one I/O Controller can trigger an output on one or more different I/O Controllers). Systems that require the user to remember complicated dialing schemes or prompt the user via cryptic commands shall not be acceptable.

13. The I/O Controller can create a contact closure when the following operations are performed in the system:
  - a. 911 call placed
  - b. Audio Distributed
  - c. Alarm is played
  - d. Announcement is played
  - e. All-Call preformed
  - f. Multi-Site All-Call performed
  - g. Multi-Site Emergency-All-Call
  - h. Emergency-Call
  - i. Emergency-All-Call
  - j. Audio-Disabled
  - k. Page
14. The system shall provide software controlled and programmable control outputs for external relay activation for use with strobe lights, magnetic locks, card access systems, motion detectors, cameras, or any low-voltage, dry contact creating device. Systems using dedicated security stations for control of external functions shall not be acceptable.
15. The system shall be capable of interfacing to PSTN/PBX/iPBX via both FXO/FXS line and SIP trunk connectivity.
16. The system shall be capable of providing each facility (i.e., (i.e., Nyquist location) an unlimited number of incoming FXO/FXS or SIP trunk lines that can be designated by the user to ring the designated Day Admin or Night Admin. Where an Admin Station is designated to receive outside line calls, the incoming call's Caller ID information shall appear on the display. The system shall also provide the ability to make outside line calls from Admin Stations. This ability shall be programmable for each Admin Station and there shall be an unlimited number of CoS available to assign to any station.
17. The system shall be capable of supporting DID, DISA, and Security DISA functions.
  - a. The system shall provide a password-protected Security DISA feature that shall only be accessible from authorized Police, Fire, Emergency personnel, or an off-premise security office that monitors the facility's security system. The Security DISA feature shall function as follows: Upon dialing the Security DISA phone number, the caller will receive a dial tone from the system, after which he or she must enter the assigned Security DISA passcode on the dial pad. Upon confirmation, the system will present the dial tone again and will allow the authorized personnel to dial any station/classroom on the system and monitor the activity without any pre-announce tone or privacy beep. This will allow the authorized personnel to audibly assess the situation and determine what actions need to be taken.
  - b. All DISA and Security DISA calls shall be automatically recorded by the system for later playback review and/or retrieval by authorized personnel and/or authorities.
18. The system shall provide for field-programmable three-, four-, five-, or six-digit architectural station numbers.
19. There shall be an automatic level control for return speech during amplified-voice communications.
20. Each station loudspeaker shall be assignable to all or any combination of Paging, Time, and/or Audio Zones. Systems that do not provide unlimited Paging, Time, and/or Audio Zones shall not be acceptable.

21. There shall be unlimited schedules with unlimited programmable events per facility. Each event shall sound one user-selected tone or external audio source. It shall be possible to assign each schedule to a day of the week or to manually change schedules from an authorized user via a web-based UI. Systems that do not provide unlimited schedules, events, and tones, or that require software to be installed on a PC to perform these functions shall not be acceptable.
  - a. The system shall provide multiple concurrent schedules per facility/location to accommodate split facilities (for example., combined Elementary and Middle School, combined Middle and High School, etc.).
  - b. The system must be capable of providing Class Change Music to be played from an external audio source or audio files that are stored in playlists on the system during class change periods or whenever a facility wants music to be played in an area (i.e., (i.e., one or more Time Zones) on an automated schedule.
  - c. Each event shall be able to be directed to any one or more of the unlimited Time Zones.
  - d. Each of the unlimited Time Zones shall have a programmable, customizable Preannounce Tone and volume control that is unique unto itself.
  - e. Each event shall play any of the Normal tones or external audio. Each event may utilize a different tone. For example, the system shall be capable of sending the gymnasium, shop classes, and pool a separate, unique time tone to indicate "clean up." Minutes later, the entire facility can be sent a different time tone to indicate class change.
  - f. Each of the unlimited Time Tones may be manually activated by selected VoIP Admin Phones or via an authorized user with access to the Web UI. These tones shall remain active as long as the telephone remains off-hook or until canceled from the keypad or the Nyquist Web UI.
  - g. Systems that do not provide an unlimited number of schedules or do not provide automatic activation of schedules shall not be acceptable.
22. Internal Master Clock shall be included, allowing an unlimited number of events per facility. Systems that do not provide an internal master clock or that must supply an external master clock to meet these specifications shall not be acceptable.
23. The Nyquist E7000 is capable of synchronizing with an NTP server and automatically adjusting the Daylight Savings Time for any time zone in the world. The server that the Nyquist E7000 application is running on can also be used as an NTP server for other systems on the LAN (for example, IP Clocks and control systems).
24. There shall be a Zone Page/All-Call Page feature that is accessible by selected Admin Phones and FXO/FXS or SIP connection to the PSTN or PBX/iPBX.
25. There shall be an option to play a pre-announce tone at any loudspeaker selected for voice paging.
26. There shall be a voice-intercom feature that is accessible by CoS authorized staff phones, all Admin VoIP phones, and Admin Web UIs.
  - a. There shall be a privacy beep played every 15 seconds at any selected loudspeaker to indicate that an intercom call is in progress.
  - b. There shall be a pre-announce tone played at any selected loudspeaker for intercom call communication.
  - c. For special applications, the privacy and pre-announce tone signals shall be capable of being disabled during system initialization.
  - d. There shall be a switch over to private telephone communications should the person at the classroom loudspeaker pick up his or her Staff Station and dial \*3 to transfer the call down to the associated classroom Staff Station.

27. There shall be various levels of telephonic communication accessible by all Admin Stations and Staff Stations.
  - a. Staff Stations must be capable of being programmed to ring one Admin Station during day hours and a different Admin Station during night hours. Day and Night start hours shall be configurable. Staff Stations shall be capable of being assigned to any Admin station. Systems that limit the number and assignment of staff call-ins to an Admin Station shall not be acceptable.
28. Each VoIP speaker or ASB speaker equipped with a call switch (analog or digital) shall be configurable as one of three call-in types, as follows:
  - a. Normal/Emergency
  - b. Urgent/Emergency
  - c. Emergency
29. Call buttons programmed for access Normal / Emergency or Urgent / Emergency shall be able to initiate an Emergency call by repeated flashing of the phone's hook switch, or repeated pressing of the DCS or the Call Switch. Systems that require additional switches and/or conductors to initiate an Emergency call, shall not be acceptable.
30. Normal and Urgent calls shall be placed into the queue for the designated Admin Station or Admin Web UI.
31. Each Admin Station call queue shall first be sorted per call priority (for example, Emergency, then Urgent, and then Normal). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls per priority and order received shall not be acceptable.
  - a. The display shall simultaneously display a minimum of three intercom calls pending.
  - b. Additional calls beyond three shall be indicated by a scrolling option on the right-hand side of the screen thus prompting the user that additional calls are waiting.
32. It shall be possible to answer any incoming call by picking up the handset while it is ringing. It shall not be necessary to press any buttons to answer a call unless the call has dropped into the queue.
33. Staff Stations shall receive a dial tone upon going off-hook. Outgoing calls are made by dialing the desired station. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be a switchover from loudspeaker to private telephone communication when a person picks up the handset, dials \*3, and presses Enter/OK.
34. Staff Stations shall be programmable for any type of system access, provided by or restricted by the following CoS options:
  - a. CoS Name
  - b. Call-in Level
  - c. Zone Paging
  - d. All-Call Paging
  - e. Emergency All-Call
  - f. Inter-Facility Call/Page
  - g. Audio Distribution
  - h. Remote Pickup
  - i. Join Conversation
  - j. Call Forwarding
  - k. Walking Class of Service
  - l. External Call Routing
  - m. Call Transfer/3-way Calling
  - n. Manually Activate Tone Signals
  - o. Call Any Station

- p. Manage Recordings
  - q. Monitor Calls
  - r. Monitor Locations
  - s. Conference Admin
  - t. Conference User
  - u. Voicemail
  - v. Record Calls
  - w. Activate Alarm Signals
  - x. Disable Audio
  - y. Enable Audio
  - z. Allow Callee Auto-answer
  - aa. District Paging
  - bb. Inter-Facility Features
  - cc. Manage Output Contacts
  - dd. Execute Routines
35. Each Station in a facility can have a unique CoS programmed with an unlimited number of CoS combinations.
36. Staff Stations shall be able to make a Normal call to any Admin Station by dialing the Admin Station's extension number. Staff Stations shall also be able to initiate an Emergency Intercom Call by dialing \*\*\*\*. Emergency Calls shall ring the Designated Day/Night Admin Station. The system shall provide for each station to have a Personal Identification Number (PIN). By dialing the PIN at any system telephone, the administrator shall have access to Emergency paging regardless of the restrictions on the phone being used.
37. Admin Stations shall receive a dial tone upon going off-hook. Outgoing calls are made by dialing the desired stations. Incoming calls can be directed to the telephone or to the associated loudspeaker for a hands-free reply. There shall be an automatic switchover from loudspeaker to private telephone communication should the person pick up his or her handset.
38. The display shall normally show the time of day and day of week, bell schedule name, and the numbers of a minimum of three stations calling-in, along with the call-in status of each station (Normal, Urgent, Emergency). The Admin Station's display shall indicate the station number being dialed from the Admin Station.
39. The display shall also provide user-friendly menu selections to assist the operator when using the Nyquist system. Displays shall be in English for maximum ease-of-use. Systems that require the operator to memorize long lists of operating symbols or control codes shall not be acceptable.
40. Admin Stations shall be programmable for any type of system access, providing or restricting the following CoS options:
- a. Call-in Level
  - b. Zone Paging
  - c. All-Call Paging
  - d. Emergency All-Call
  - e. Inter-Facility Call/Page
  - f. Audio Distribution
  - g. Remote Pickup
  - h. Join Conversation
  - i. Call Forwarding
  - j. Walking Class of Service
  - k. External Call Routing
  - l. Call Transfer/3-way Calling
  - m. Manually Activate Tone Signals

- n. Call Any Station
  - o. Manage Recordings
  - p. Monitor Calls
  - q. Monitor Locations
  - r. Conference Admin
  - s. Conference User
  - t. Voicemail
  - u. Record Calls
  - v. Activate Alarm Signals
  - w. Disable Audio
  - x. Enable Audio
  - y. Allow Callee Auto-answer
  - z. District Paging
  - aa. Inter-Facility Features
  - bb. Manage Output Contacts
41. Execute Routines
42. Program selection and its distribution or cancellation shall be accomplished from a designated Admin Station with the assistance of the menu display system. Distribution and cancellation shall be to any one or combination of speakers, any Audio Zone or Audio Zones, or All Zones. It shall be possible to provide an unlimited number of program channels for the user to pick from.
- a. It shall be possible via an Admin Station to manually initiate any of the unlimited Normal Tones or Emergency Tones. The Tones shall be separate and distinctly different from the Alarm Tones. The Tone selected shall be capable of being played one time, continuously until it is canceled, or until the administrative display phone is placed back on-hook.
  - b. Each Admin Station shall maintain a unique queue of all stations calling that Admin VoIP phone.
43. VoIP Wall Baffle and VoIP Ceiling Speakers shall be configurable as either a VoIP Speaker Only or as a VoIP Speaker with DCS.
- a. The Bogen Nyquist VoIP speakers are powered via PoE. Use an 802.3af compliant PoE network switch port or PoE Injector to power these speakers. One PoE network switch port or PoE Injector is required per VoIP speaker.
  - b. VoIP speakers can be equipped with a DCS that can be programmed as a Normal/Emergency, Urgent/Emergency, or Emergency Only and shall be able to initiate an Emergency call by touching the DCS one, two, or three times depending on the CoS and current call state of the DCS. If the station is authorized for Privacy Mode, the users can touch and hold for 4 seconds to enable Privacy Mode or hold for four seconds to disable Privacy Mode. Systems that require mechanical, membrane, or an additional number of switches to initiate an Emergency call, shall not be acceptable.
  - c. Emergency Calls from VoIP Speaker with DCS shall have priority over the Normal and Urgent calls in the queue on the Admin Stations and will show up at the top of the list. Systems that do not provide priority for Emergency Call shall not be acceptable.
  - d. Normal and Urgent calls shall be logged into queue for the designated Admin Stations.
    - Admin Stations shall ring for when they receive a call, and then the call will be removed from the queue when the call is answered or when the Admin Queue times out (default is 30 minutes).
  - e. Each queue call shall first be sorted by call priority (Emergency, then Urgent, and then Normal). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls by priority and order received, shall not be acceptable. The display shall simultaneously show a minimum of three staff calls pending. Additional staff calls beyond three shall be indicated by an arrow pointing down thus prompting the Admin user that additional calls are waiting.

- f. It shall be possible to answer any incoming call simply by picking up the handset while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.
44. System programming shall be from an authorized Nyquist Admin User via any web browser. A valid username and password shall be required to gain access to the following programmable functions:
- a. System Parameters – Allow installers to adjust core system parameters.
  - b. Zones – Allow installers to create and modify Paging, Time, and Audio Zones.
  - c. Schedules – Allow installers and administrators to create Bell Schedules for the facility, predefine alternative schedules to run. Holiday Events prevent the bells from ringing on a school holiday. The system shall allow an unlimited number of schedules to operate simultaneous within a facility.
  - d. Admin Groups – Allow the installer to create, modify, and delete software groupings of admin phones that can ring when a station calls in with a call switch.
  - e. CoS Configuration – Allow the installer to create, modify, and delete CoS groups that can have the following features defined: Call in Level, Zone Paging, All-Call Paging, Emergency All-Call, Inter-Facility Call/Page, Audio Distribution, Remote Pickup, Join Conversation, Call Forwarding, Walking Class of Service, External Call Routing, Call Transfer/3-way Calling, Manually Activate Tone Signals, Call any Station, Manage Recording, Monitor Calls, Monitor Locations, Conference Admin, Conference User, Voicemail, Record Calls, Activate Alarm Signals, Disable Audio, Enable Audio, Allow Callee Auto-answer, District Paging, Inter-Facility Features, and Execute Routines.
  - f. Stations – Allow the installer to set up, modify, delete stations, set up Page Exclusion, view stations' status, and add a station.
  - g. Bridge Devices – Allow the installer to install the Nyquist ASBs.
  - h. Audio – Allow the installer to upload and manage Announcements, Playlists, Announcements, Songs, and Tones. The must support the uploading of both MP3 and WAV files making Audio file management simple for users. Systems that limit the size of Audio files shall not be considered equal.
  - i. Users – Allow the installer to manage users by giving them the proper Role and assign an Extension if needed.
  - j. Roles – Allow the installer to limit user to the following: create, delete, edit, restart server, sort menu, systems update, manage, import/export, restore, settings, or view.
  - k. Facilities – Allow the installer to set up the district wide facilities for remote paging and calling.
  - l. Outside Line – allow the installer to set up FXS and FXO ports for inbound and outbound system calling.
  - m. SIP Trunks – allow the installer to set up SIP trunks into the facility for inbound or outbound calling.
  - n. Call Details – allow the installer to review the historical system activities that can be used for incident investigation or system troubleshooting.
  - o. System Backup/Restore – allow the installer to preform system backup or restores and allow the backups to be scheduled to run automatically.
  - p. System Logs – allow the installer to view and export Server, Nyquist-Intercom, and Web Server logs that can be used for trouble shooting and technical assistance.
  - q. Paging Exclusions – allow the installer to view and edit station that are excluded from paging.
  - r. Firmware – is used to update Nyquist appliances.
  - s. Routines – Allow installers to create routines that are a sequence of actions, that the Nyquist system executes as a result of an input trigger. Routines can support crisis plans for situations such as school lockdowns, weather events, or emergency evacuations
  - t. Alert Filters – Allow installers to select the National Weather Alerts that the facility needs to monitor for such as weather events, earthquakes, tsunami, volcanoes, public health, power outages, and many other emergencies.

- u. Help –Provides information about the system, online help topics, and System Administrator Manual.
  - v. Systems not capable of supporting web-based configuration and control, or require plugins or dedicated application software, shall not be deemed as equal.
  - w. Systems that require a Serial-to-Ethernet converter, or require additional application software on a PC for configuration and/or control shall not be deemed as equal.
45. Admin Groups
46. Admin Stations can be placed into Admin Groups, which are used if incoming calls are not answered by the assigned Admin Station or the Day or Night Admin associated with the Admin Station. Admin Groups act as an always answer feature by providing an alternate list of Admin Stations. If an incoming call is not answered by the assigned Admin Station within 30 seconds for normal calls or 15 seconds for emergency calls, all Admin Stations in the Admin Group will ring.
47. If Call Forwarding is enabled at the Admin Station, Nyquist tries the forwarded extension. If that station does not answer or is busy, the call timeout is reduced to 15 seconds. After 15 seconds, the call rolls over to the Admin Group.
48. If an Emergency level call receives no answer, the Admin Group will ring if the Day Admin or Night Admin does not answer.
49. Admin Stations can be assigned to multiple Admin Groups. A Day or Night Admin can also be assigned to one or more Admin Groups.
50. Call Detail Reporting
- a. The Call Details feature allows the viewing and/or printing of detail records of every call in a facility in a call log format. Calls include scheduled announcements, paging, and internally and externally made or received telephone calls.
51. System Backup/Restore
- a. The system backup feature allows users with access to back up the system database, voicemail, and recordings.
  - b. The system restore allows users with access to perform a system restore of previously backed up database, voicemail, and/or recordings.
  - c. The installer also can set up an automatic backup that can be performed daily, weekly, or monthly.
52. System Log Files
- a. A log file records either events or messages that occur when software runs and is used when troubleshooting the system. The following parts of the Nyquist system generate log files:
    - Server (This provides access to the Debian Linux OS server log files.)
    - Intercom (This provides access to the Intercom application server log files)
    - Web Server (This provides access to the web server log files.)
  - b. From the web-based UI, system logs can be viewed directly or exported via download to a PC, Mac, or Android device and then copied to removable media or attached to an email to technical support.
53. Paging Exclusions
- a. For school testing and exams, the administrators shall be able to put stations into Page Exclusion mode. During this time, the stations will only receive Emergency All-Call pages – not music, tones, or All-Calls. Emergency pages will still be heard at the station even if that station is set to exclude paging.



54. Firmware
  - a. Installers can manage the available firmware. Because the Nyquist E7000 is constantly evolving and changing new versions of firmware will become available and the Firmware section allow installers or authorized users the ability to upload, check for updates, or configure the system to automatically download new firmware for later installation. Systems that cannot automatically check for new software are not considered equivalent.
55. Routines are designed to automatically launch a procedure, or sequence of actions, that the Nyquist system executes as a result of an input trigger.
56. Some of the events (triggered by dashboard, IP Phone, I/O Controller contact, or Routines API) that can be created are as follows:
  - a. Lockdown Routines
  - b. Emergency Evacuation Routines
  - c. Fire Alarm Routines
  - d. Weather Alert Routines
57. As you can see the power of Routines can support your facilities crisis plans for situations such as lockdown, lockout, weather events, or emergency evacuations.
58. Alert Filters Configuration - The Common Alerting Protocol (CAP) is an international standard format for emergency alerting and public warning. It is designed for all hazards related to weather events, earthquakes, tornado, tsunami, volcanoes, public health, power outages, and many other emergencies.
59. CAP elements and values are used when configuring alert filters for your Nyquist system. This part of the configuration allows installers to select or "Enable" or disable the filters needed for each facility. This filtered information can then be displayed on the NQ-GA10PV through the campus.
60. The growing list of information that can currently be displayed are as follows: 911 Telephone Outage, Administrative Message, Air Quality Alert, Air Stagnation Advisory, Arroyo And Small Stream Flood Advisory, Ashfall Advisory, Ashfall Warning, Avalanche Advisory, Avalanche Warning, Avalanche Watch, Beach Hazards Statement, Blizzard Warning, Blizzard Watch, Blowing Dust Advisory, Blowing Dust Warning, Brisk Wind Advisory, Child Abduction Emergency, Civil Danger Warning, Civil Emergency Message, Coastal Flood Advisory, Coastal Flood Statement, Coastal Flood Warning, Coastal Flood Watch, Dense Fog Advisory, Dense Smoke Advisory, Dust Advisory, Dust Storm Warning, Earthquake Warning, Evacuation - Immediate, Excessive Heat Warning, Excessive Heat Watch, Extreme Cold Warning, Extreme Cold Watch, Extreme Fire Danger, Extreme Wind Warning, Fire Warning, Fire Weather Watch, Flash Flood Statement, Flash Flood Warning, Flash Flood Watch, Flood Advisory, Flood Statement, Flood Warning, Flood Watch, Freeze Warning, Freeze Watch, Freezing Fog Advisory, Freezing Rain Advisory, Freezing Spray Advisory, Frost Advisory, Gale Warning, Gale Watch, Hard Freeze Warning, Hard Freeze Watch, Hazardous Materials Warning, Hazardous Seas Warning, Hazardous Seas Watch, Hazardous Weather Outlook, Heat Advisory, Heavy Freezing Spray Warning, Heavy Freezing Spray Watch, High Surf Advisory, High Surf Warning, High Wind Warning, High Wind Watch, Hurricane Force Wind Warning, Hurricane Force Wind Watch, Hurricane Local Statement, Hurricane Warning, Hurricane Watch, Hydrologic Advisory, Hydrologic Outlook, Ice Storm Warning, Lake Effect Snow Advisory, Lake Effect Snow Warning, Lake Effect Snow Watch, Lake Wind Advisory, Lakeshore Flood Advisory, Lakeshore Flood Statement, Lakeshore Flood Warning, Lakeshore Flood Watch, Law Enforcement Warning, Local Area Emergency, Low Water Advisory, Marine Weather Statement, Nuclear Power Plant Warning, Radiological Hazard Warning, Red Flag Warning, Rip Current Statement, Severe Thunderstorm Warning, Severe Thunderstorm Watch, Severe Weather Statement, Shelter In Place Warning, Short Term Forecast, Small Craft Advisory, Small Craft Advisory For Hazardous Seas, Small Craft Advisory For Rough Bar, Small Craft Advisory For Winds, Small Stream Flood Advisory, Snow Squall Warning, Special Marine

Warning, Special Weather Statement, Storm Surge Warning, Storm Surge Watch, Storm Warning, Storm Watch, Test, Tornado Warning, Tornado Watch, Tropical Depression Local Statement, Tropical Storm Local Statement, Tropical Storm Warning, Tropical Storm Watch, Tsunami Advisory, Tsunami Warning, Tsunami Watch, Typhoon Local Statement, Typhoon Warning, Typhoon Watch, Urban And Small Stream Flood Advisory, Volcano Warning, Wind Advisory, Wind Chill Advisory, Wind Chill Warning, Wind Chill Watch, Winter Storm Warning, Winter Storm Watch, and Winter Weather Advisory.

61. Systems that are not capable of displaying National Weather Service CAP information to give advanced warning to facilities shall not be considered equal.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine conditions, with the installer present, for compliance with requirements and other conditions affecting the performance of the Nyquist E7000 Series Educational System.
- B. Do not proceed until unsatisfactory conditions have been corrected.

#### **3.2 EQUIPMENT MANUFACTURERS REPRESENTATIVE**

- A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.
- B. As further qualification for bidding and participating in the work under this specification, the manufacturer's representative shall hold a valid C-10 Contractor's License issued by the Contractor's State License Board of New York. The manufacturer's representative shall have completed at least 10 projects of equal scope, giving satisfactory performance, and shall have been in the business of furnishing and installing sound systems of this type for at least five years. The manufacturer's representative shall be capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and that there will always be an authorized distributor assigned to service the area in which the system has been installed.
- D. The contractor shall furnish a letter from the manufacturer of the equipment. This letter shall certify that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible, and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of five years after final acceptance of the project by the owner.

#### **3.3 DIVISION OF WORK**

- A. While all work included under this specification is the complete responsibility of the contractor, the following division of actual work listed shall occur:
- B. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work, shall be furnished and installed completely by the electrical contractor.
- C. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing and complete maintenance for one year after final acceptance of the project by the owner, shall also be the responsibility of the manufacturer's authorized representative.

### 3.4 INSTALLATION

- A. The installation, adjustment, testing, and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed in accordance with the manufacturer's approved shop drawings.
- B. Low-voltage wiring may be run exposed above ceiling areas where they are easily accessible.
- C. The contractor shall install the new system at the location shown on the plans.
- D. All Staff Stations and Call Switches shall be wall-mounted:
  - 1. Mount at 54" AFF.
  - 2. All wiring should be concealed.
  - 3. Verify exact location with architect.
  - 4. Avoid mounting near doors to prevent students from activating and running out of the rooms.
- E. Admin Stations can be desk or wall mounted.
- F. Speaker and telephone lines run above ceiling and not in conduit shall be tie-wrapped to a ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.
- G. Connect field cable to each Analog Speaker transformer using UL butt splices for #22 AWG wire.
- H. Contractor shall provide a minimum of eight hours of configuration and operational instruction to school personnel.
- I. On the first school day following installation of the Nyquist System, the contractor shall provide a technician to stand by and assist in system operation.
- J. Mark and label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc. where XXX is the room number.
- K. No graphic room number shall exceed the sequence from 000001 through 899999.
  - 1. All outside speakers shall be on a separate Page Zone and Time Zone.
  - 2. All zones shall be laid out not to exceed 40 Watts (@25V) maximum per zone.
  - 3. All hallway speakers shall be tapped at 1 Watt (@25V) maximum.
  - 4. All outside horns shall be tapped at 3.75 Watts (@25V) maximum.
  - 5. All classroom speakers shall be tapped at ½ Watt (@25V) maximum.
  - 6. Large rooms, such as cafeterias, shall be tapped at 2 Watts (@25V) maximum.
- L. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.
- M. Protection of Cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or T and B wire-ties, or hook and loop cable management. Edge protection material shall be installed on edges of holes, lips of ducts, or any other point where cables or harnesses cross a metallic edge.
- N. Cable identification: Cable conductors shall be color-coded and individual cables shall be individually identified. Each cable identification shall have a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.

- O. Shielding: Cable shielding shall be capable of being connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in the same manner as conductors.
- P. Provide complete "in service" instructions of system operation to school personnel. Assist in programming of telephone system.

### **3.5 GROUNDING**

- A. The contractor shall provide equipment grounding connections for Integrated Telecommunications / Time / Audio / Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.
- B. The contractor shall provide ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.
- C. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- D. The contractor shall note on their drawings the type and locations of these protection devices and all wiring information.
- E. The contractor shall furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground buss bar.

### **3.6 DOCUMENTATION**

- A. Provide the following directly to the Supervisor of Technology Services.
  - 1. One printed copy of all field programming for all components in system.
  - 2. One copy of all diagnostic software with a copy of field programming data for each unit.
  - 3. One copy of all field wiring runs, location, and end designation of system.

**END OF SECTION**

**SECTION 26 0900**

**GUARANTEE**

**PART 1 - GENERAL**

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

**1.1 GUARANTEE**

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

**END OF SECTION**



**SECTION 31 2316  
EXCAVATION**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Excavating, trenching, and backfilling for site utilities.
- B. Dewatering.
- C. Temporary excavation support and protection systems.
- D. Preparing subgrades for all excavated areas.
- E. Drainage course.
- F. Select fill.
- G. Subbase course for asphalt paving.
- H. Final grading

**1.3 RELATED REQUIREMENTS**

- A. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 01 7000 - Execution: Project conditions; protection of bench marks, scoping, temporary bracing and shoring, dewatering, and water control.
- C. Section 03 3000 - Cast-in-Place Concrete.
- D. Section 32 1216 - Asphalt Paving.
- E. Section 32 1313 - Concrete Paving.
- F. Section 32 9220 - Restoration of Turf Areas.

**1.4 REFERENCE STANDARDS**

- A. All references apply to the latest revisions of the publications.
- B. ASTM D422: Particle Size Analysis of Soils
- C. ASTM D1556: Density and Unit Weight of Soil in Place by the Sand-Cone Method
- D. ASTM D1557: Laboratory Compaction Characteristics of Soil Using Modified Effort
- E. ASTM D2922: Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
- F. ASTM D2974: Moisture, Ash and Organic Matter of Peat and other Organic Soils
- G. ASTM D3017: Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
- H. ASTM D4318: Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)
- I. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

**1.5 MATERIAL EVALUATION/QUALITY CONTROL**

- A. Geotechnical Engineer shall submit copies of reports to YPS Office of Facilities Management. Include date of site visit, description of work observed, and summary of observations and recommendations.

**1.6 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Refer to individual sections for additional requirements
- C. Project Record Documents: Record drawings at project closeout according to Section 01 7800 - Closeout Submittals. Show locations of installed support materials left in place, including referenced locations and depths, on drawings.
- D. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.
- E. Product Data: For the following:
  - 1. Sieve Analysis, Proctor Compaction Test and Certification of Specification Compliance for each fill materials and mix design proposed for flowable fill at least 15 days before start of backfilling. Flowable fill submittal shall include ASTM C 1260 test results.
  - 2. Each type of plastic warning tape.
  - 3. Geotextile.
  - 4. Contractor shall submit copies of proposed materials with locations, methods and operations of backfilling and compaction.
- F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
  - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
  - 2. Laboratory compaction curves according to ASTM D 2487 for each on-site or borrow soil material proposed for fill and backfill.
  - 3. Optimum moisture-maximum density curve for each soil material.
- G. Pre excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

#### **1.7 QUALITY ASSURANCE**

- A. Comply with: New York State Department of Transportation (NYSDOT) "Standard Specifications for Construction and Materials". Notify YPS Office of Facilities Management of conflicts with these specifications.

#### **1.8 DEFINITIONS**

- A. Excavation shall mean the excavation, removal, stockpiling, and/or satisfactory disposal of all materials encountered within the limits indicated or specified other than rock or ledge. Excavated materials shall include, but not be limited to removal of material encountered above subgrade elevations indicated, earth materials such as peat, organic or inorganic silts, clay, sand, gravel, pavements, cobble and boulders less than 1.0 cubic yard in volume, soft or disintegrated rock which, in the opinion of the Construction Manager and YPS Office of Facilities Management, can be removed without blasting or drilling; pavement, brick and concrete masonry, and all obstructions not specifically included in another Section and subsequent disposal of materials removed
- B. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of YPS Office of Facilities Management. Unauthorized excavation and remedial work directed by YPS Office of Facilities Management shall be at Contractor's expense.
  - 1. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification unless otherwise directed by YPS Office of Facilities Management.
- C. Excavation is classified as "unclassified" and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered, pavements and other obstructions visible on ground surface, underground structures, utilities and other items indicated to be demolished and removed, together with earth and other materials, including rock.
- D. Backfill: Soil material or controlled low-strength material used to fill an excavation.



1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- E. Fill: Soil materials used to raise existing grades.
- F. Drainage Fill: Layer supporting concrete pavement, stairs, ramps, site utilities, and manholes used to minimize capillary flow of pore water.
- G. Select Fill: Soil material to raise existing grades supporting concrete pavement, stairs, ramps, site utilities, and manholes.
- H. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- I. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt road and pavement walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below select fill, drainage fill, and topsoil materials.
- L. Controlled Low Strength Material:

#### **1.9 PROJECT CONDITIONS**

- A. **Refer to Section 01 7000 for scoping requirements.**
- B. Verify existing grades and notify YPS Office of Facilities Management of differing conditions.
- C. Verify that survey bench mark and intended elevations for the Work are as indicated.
- D. Project Site Information: A geotechnical report has not been prepared for this Project.
- E. The contractor, subject to approval of the YPS Office of Facilities Management may make additional test borings and conduct other exploratory operations as necessary.
- F. Existing Utilities: Locate existing underground utilities in work area before starting earthwork operations.
  1. Where utilities are to remain in place, provide adequate means of protection during earthwork operations.
  2. If uncharted or incorrectly charted piping or other utilities are encountered during excavation, consult with utility YPS Office of Facilities Management immediately for directions. Cooperate with YPS Office of Facilities Management and public and private utility companies to keep services and facilities in operation. Repair damaged utilities as required by utility owner.
    - a. Do not interrupt existing utilities serving facilities occupied by YPS Office of Facilities Management or others during occupied hours except when permitted in writing by YPS Office of Facilities Management and then only after acceptable temporary utility services have been provided.
      - a) Provide minimum two (2) or five (5) days notice to YPS Office of Facilities Management and receive written notice to proceed before interrupting utilities.
- G. Demolish and remove from site existing underground utilities indicated to be removed. Coordinate with utility companies and MEP prime contractors for shutoff of services if lines are active.

#### **1.10 OWNER'S REPSONSIBILITY**

- A. The Owner will provide an existing conditions survey of the property which is incorporated into the Contract Drawings.
- B. The Owner reserves the right to change final grades.

#### **1.11 CONTRACTOR'S REPSONSIBILITY**

- A. The Contractor shall provide adequate personnel and equipment to complete the Work as specified herein and within the agreed upon Project Construction Schedule. The Contractor shall employ qualified English-speaking supervisor who shall provide adequate and efficient coordination of the Work. The

supervisor shall be present on the site on a continuous full-time basis and shall have the authority to act on behalf of the Contractor.

- B. Prior to the beginning of any site grading, the Contractor shall make sufficient checks on the topographic conditions to satisfy him/herself that the existing elevations are as shown by the topographic survey and on the Contract Drawings. Should any discrepancies be found they shall be reported to the YPS Office of Facilities Management and Fuller and D'Angelo, P.C. in writing prior to commencement of any work.
- C. The Contractor shall review all Drawings, Specifications and all other information included in Contract Documents and shall determine the quantities of the work to be completed and be responsible for the assumptions made in determining the cost of the Work.
- D. The Contractor shall coordinate and complete his work in such a manner as to interfere as little as possible with all other contractors and/or subcontractors working on the site.

#### **1.12 PROTECTION**

- A. The Contractor shall contact Dig Safe a minimum of 48 hours prior to performing any excavation and shall maintain current Dig Safe authorization numbers during all excavation activities. Protect structures, utilities, monitoring wells, property monuments, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. The Contractor shall be responsible for actual cost of repair or replacement of any items damaged as a result of construction activities, including any professional services required for inspection of repairs and replacement.
- B. Trees and Shrubbery:
  - 1. Existing trees and shrubbery to remain shall be protected from injury during construction.
  - 2. Except as otherwise directed, cutting and trimming of existing trees will not be permitted.
  - 3. All existing trees to remain and which may be damaged by construction operations shall be boxed and placed and protected and all such protection shall be maintained until completion of the work.
- C. Existing Utilities:
  - 1. Excavation and backfill operations shall be done in such a manner as to prevent cave-ins of excavations or the undermining, damage, or disturbing of existing utilities and structures or of new work.
  - 2. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities, structures, new work, and in accordance with the requirements of the particular utility company.
  - 3. Any excavation improperly backfilled or where settlement occurs shall be reopened to the depth required, then refilled with new materials and compacted, and the surface restored to the required grade and condition, at no additional cost to the Owner.
- D. Paved surfaces:
  - 1. Do not operate equipment that will cause damage on paved surfaces that are to remain. Any damage to existing roads or other paved surfaces caused by construction equipment shall be repaired at no additional cost to Owner.
- E. Property:
  - 1. Any damage due to excavation, backfilling or settlement of the backfill or injury to persons or damage to property occurring as a result of such damage, shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Owner, shall be borne by the Contractor, at no additional cost to the Owner.

#### **1.13 PRODUCT HANDLING**

- A. Store materials to preserve their quality and fitness for work.

#### **1.14 WORKMANSHIP**

Contractor shall be responsible for correction of work not conforming to specified requirements. Correct deficient work as directed by YPS Office of Facilities Management.

- A. Remove work found to be defective. Replace with new acceptable work.

**PART 2 PRODUCTS -**

**2.1 UNCLASSIFIED EXCAVATION**

- A. Excavation for this project shall be "unclassified".
  - 1. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
- B. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, other materials or unauthorized excavation.
- C. Pipes and conduits shall be provided with 6 inches of Pipe Zone Bedding material to eliminate differential settlement.

**2.2 SOIL MATERIALS**

- A. Excavations General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, and PT or a combination of these group symbols.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
  - 2. Materials containing excessive amounts of water, plastic clay, vegetation, organic matter, debris, pavement, stones or boulders over 3 inches in greatest dimension, frozen material, and material which, in the opinion of the Geotechnical Engineer will not provide a suitable foundation or subgrade.
- D. General Fill Material: Soil materials free of clay, rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
  - 1. **Not to be used against basement or retaining wall.**
- E. Select Fill: Sound and durable, well-graded sand and gravel, free of deleterious materials such as pyritic shale, organics, or contaminants of a chemical, mineral, or biological nature and conforming to New York State Department of Transportation, paragraph 304-2.02, Type 2 and the following limits of gradation:
 

100%	passing a 2" sieve.
30-90%	passing a #10 sieve.
10-70%	passing a #40 sieve.
0-5%	passing a #200 sieve

  - 1. Location: Use for sub-base fill under pavements, over undisturbed soil, and .
- F. Drainage Fill: ASTM C-33 Blend 57, a blend of NYSDOT No. 1 and No. 2 crushed stone that complies with material specification requirements of Article 703-02 for crushed stone and the following limits of gradation:

% Passing By Weight	Sieve Size
100%	1" sieve.
40-50%	3/4"
25-60%	passing a 1/2" sieve.
10-30%	passing a 3/8" sieve
0-10%	passing a # 4 sieve.



- e. Green: Sewer systems.

### **PART 3 EXECUTION**

#### **3.1 TOPSOIL STRIPPING AND STOCKPILING**

- A. Stripping and Stockpiling of Topsoil: Strip topsoil from areas to be excavated or filled, areas within proposed building limits and paving areas and stockpile where shown on the plans. Stockpiled topsoil shall be free of subsoil, stones, clods of hard earth, plants or their roots, sticks or other matter not conducive to plant growth. Stockpiling shall be coordinated by the Contractor and shall comply with the requirements of Section .
  - 1. All top soil removed from the site shall be inventoried and quantities submitted to the YPS Office of Facilities Management

#### **3.2 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.
  - 1. Resurvey benchmarks during installation of excavation support and protection systems and notify Yonkers Public Schools if any changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

#### **3.3 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Fuller and D'Angelo, P.C..
- F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- G. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- H. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

#### **3.4 TEMPORARY EXCAVATION SUPPORT AND PROTECTION**

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.

#### **3.5 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrade, and from flooding Project site, and surrounding area.
- B. Protect subgrade from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
  - 2. Install continuous dewatering system, as required to keep subgrade dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
- C. The Contractor shall provide, maintain and operate pumps of adequate capacity required to maintain excavations, pits, trenches and depressions within the Contract Limit Lines as well as the Buildings free of water accumulated at any time and as necessary to permit the proper installation of the work required under all contracts. Disposal of pumped water shall be done with due respect to the rights of adjoining

buildings. All costs in connection with the removal of water as above provided for shall be borne by the Contractor.

### **3.6 EXPLOSIVES**

- A. Explosives: Do not use explosives.

### **3.7 EXCAVATING GENERAL**

- A. Underpin adjacent structures that could be damaged by excavating work.
- B. Excavate to accommodate construction operations.
  - 1. Excavate to the specified elevations.
  - 2. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
  - 3. Cut utility trenches wide enough to allow inspection of installed utilities.
  - 4. Hand trim excavations. Remove loose matter.
  - 5. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- C. Notify YPS Office of Facilities Management of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Provide temporary means and methods, as required, to remove all water from excavations until directed by . Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- F. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- G. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

### **3.8 FILLING AND BACKFILLING**

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.
- B. Install underground warning tape at buried utilities .

### **3.9 REPAIR**

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 2323.

### **3.10 STABILITY OF EXCAVATIONS**

- A. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace, where sloping is not possible because of space restrictions or stability of material excavated, to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

### **3.11 EXCAVATION FOR UTILITY TRENCHES**

- A. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: 12 inches on each side of pipe or conduit.
  - 2. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
  - 3. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
  - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
  - 5. Bed pipe in bedding and backfill material as described in Part 2, including 6 inches below pipe to 12 inches above pipe. Material shall be thoroughly compacted.

6. The balance of the trench shall be filled with bedding or backfill material placed in 12 inch maximum lifts thoroughly compacted to subgrade for crushed stone drainage layer or to subgrade for pavement stone base as applicable.

### **3.12 SUBGRADE INSPECTION**

- A. Notify YPS Office of Facilities Management when excavations have reached required subgrade.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by YPS Office of Facilities Management, without additional compensation.

### **3.13 UNAUTHORIZED EXCAVATION**

- A. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by YPS Office of Facilities Management without additional compensation.

### **3.14 STORAGE OF SOIL MATERIALS**

- A. Stockpile borrows material and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
  2. Provide tarp or erosion control fabric on stockpile material and a silt fence around stockpiled material.
  3. Material stockpiled outside the contract area shall be in locations approved by the Owner. If areas are not available store material off site at contractor's expense.

### **3.15 BACKFILL**

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  2. Surveying locations of underground utilities for record documents.
  3. Inspecting and testing underground utilities.
  4. Removing concrete formwork.
  5. Removing trash and debris.
  6. Removing temporary shoring, bracing, and sheeting.
  7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

### **3.16 UTILITY TRENCH BACKFILL**

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section Cast-in-Place Concrete
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch , to a height of 12 inches over the utility pipe or conduit.
  1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Backfill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

### 3.17 FILL

- A. Place and compact fill material in layers to required elevations as follows:
  - 1. Under grass and planted areas, use satisfactory soil material.
  - 2. Under walks and pavements, use satisfactory soil material and drainage fill.
  - 3. Under steps and ramps, use select fill and drainage fill.
  - 4. Under building footings, foundations and slabs on grade, use select fill and drainage fill.
- B. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.18 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.19 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
  - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 98 percent.
  - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 98 percent.
  - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent.

### 3.20 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
  - 1. Lawn or Unpaved Areas: Plus or minus 1 inch .
  - 2. Walks: Plus or minus 1/2 inch .
  - 3. Pavements: Plus or minus 1/2 inch .

### 3.21 FINISH GRADING

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.
  - 3. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.



4. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).
5. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).

### **3.22 SELECT FILL COURSES**

- A. Place select fill course free of mud, frost, snow, or ice.
- B. Place select fill course as follows:
  1. When thickness of compacted course is 6 inches or less, place materials in a single layer.
  2. When thickness of compacted course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches thick when compacted.
  3. Compact select fill course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557

### **3.23 DRAINAGE FILL**

- A. Under slabs-on-grade, pavements, and walks place drainage course on prepared subgrade and as follows:
  1. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
  2. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches thick when compacted.
  3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

### **3.24 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Fuller and D'Angelo, P.C. before placement of foundations.
- C. Testing Agency: The YPS Office of Facilities Management will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- D. Allow testing agency to inspect and test the following:
  1. Confirmation of existing structure, foundation depths and undisturbed soil levels.
  2. Compaction of in place soil.
  3. Supply and compaction of select fill.
  4. Subgrade and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
  2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

### **3.25 CLEANING**

- A. Remove excavated material that is unsuitable for re-use from site.
- B. Remove excess excavated material from site.

**3.26 PROTECTION**

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.
- F. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- G. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
- H. Scarify or remove and replace soil material to depth as directed by YPS Office of Facilities Management; reshape and recompact.
- I. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
- J. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

**3.27 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove all surplus soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION**

**SECTION 32 1216  
ASPHALT PAVING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Aggregate base course.
- B. Road Paving: Double course bituminous concrete paving.
- C. Walkway Paving: Single course bituminous concrete paving.

**1.3 RELATED REQUIREMENTS**

- A. Section 31 2316 - Excavation: Paving sub base.
- B. Section 32 1313 - Concrete Paving: Concrete walks and curbs.

**1.4 REFERENCE STANDARDS**

- A. New York State Department of Transportation
- B. AI MS-2 - Asphalt Mix Design Methods; 2015.
- C. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt  
1. Pavements," unless more stringent requirements are indicated.

**1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
- B. Material Test Reports: For each paving material.

**1.6 QUALITY ASSURANCE**

- A. Supplier shall be a paving-mix supplier registered with and approved by the New York DOT.
- B. Perform Work in accordance with State of New York Highways standard.
- C. Obtain materials from same source throughout.

**1.7 FIELD CONDITIONS**

- A. Prime and Tack Coats: Minimum surface temperature of 60 deg F
- B. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
- C. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- D. Place bitumen mixture when temperature is not more than 15 F degrees (8 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. General: Asphalt concrete and all related items shall meet the requirements of NYSDOT Section 400
- B. Aggregate for Base Course shall be Type 4 and conform to the requirements of Section 304 of the NY State DOT Specifications.
  - 1. Gradation shall conform to the following:

a.	Sieve Size Designation	Percent Passing by Weight
b.	3 inch	100%
c.	2 inch	90-100%
d.	1/4 inch	30-65%
e.	No. 40	5-40%
f.	No. 200	0-1%

- C. Binder Course: Type 3, NYSDOT Sections 401, 403
- D. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Water: Potable.
- F. Surface Course: Type 6F, NYSDOT Sections 401, 403.
- G. Tack Coat: In accordance with State of New York Highways standards 702-90.
- H. Joint Sealer: Hot Applied, Polymeric Sealant
  - 1. Single component, 100% virgin polymer.
  - 2. Compling with: ASTM D3405; AASHTO M 301
  - 3. Manufacturer:Hi-Spec; W.R. Meadows, Inc,Hanpshire, Il. [www.wrmeadows.com](http://www.wrmeadows.com)

## 2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Refer to NYDOT Specification.
- B. Submit proposed mix design of each class of mix for review prior to beginning of work.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Compact sub base in accordance with section 31 2316 - Excavation.
- D. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
- E. Review condition of subgrade and preparatory work.
- F. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

### 3.2 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct lay down and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
- D. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- E. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

- F. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- G. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- H. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- I. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### **3.3 BASE COURSE**

- A. Proof roll subbase surface with a ten (10) ton static steel wheel roller to check for unstable or otherwise unsuitable areas, as determined by the Architect. Replace and recompact all unsatisfactory areas, as approved by the Architect, prior to commencement of paving operations.
- B. Construction of crushed stone base shall be in accordance with the applicable requirements of Section 304 of the New York State Specifications and as required herein.

### **3.4 PREPARATION - PRIMER**

- A. Apply primer in accordance with State of New York Highways standards.
- B. Use clean sand to blot excess primer.

### **3.5 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with State of New York Highways standards.

### **3.6 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Asphalt concrete shall not be applied on a wet surface or when the air temperature is below 45 degrees F. unless otherwise directed, or when weather conditions would prevent proper construction
- B. Install Work in accordance with State of New York Highways standards 400 unless otherwise specified..
- C. Place asphalt within 24 hours of applying primer or tack coat.
- D. Place to 3 inch (76 mm) compacted thickness.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

### **3.7 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place binder course to 3 1/2" inch (89 mm) compacted thickness.
- C. Place wearing course within two hours of placing and compacting binder course.
- D. Place wearing course to 2 inch (51 mm) compacted thickness.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

### **3.8 JOINTS**

- A. Construct joints between new and existing asphalt to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  - 3. Compact asphalt at joints to a density within 2 percent of specified course density.
  - 4. Apply continuous bead of joint sealant along entire length of new to existing joint.

### **3.9 PATCHING AND REPAIRS**

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base or as required to install new utilities. Recompact new subgrade.
  - 1. Tack coat faces of excavation and allow to cure before paving.
  - 2. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Crack and Joint Filling: Fill entire length of joint between new and existing asphalt with asphalt joint sealing material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints. Apply in accordance with manufacture's requirements for application temperature and heating requirements.
- C. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. of surface.
  - 1. Allow tack coat to cure undisturbed before paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### **3.10 TOLERANCES**

- A. Flatness: Maximum variation of 1/4 inch (6 mm) measured with 10 foot (3 m) straight edge.
- B. Compacted Thickness: Within 1/4 inch (6 mm) of specified or indicated thickness.
- C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements

### **3.11 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for quality control.
- B. YPS will pay for and provide field inspection and testing, as they deem necessary. Coordinate with testing agency and provide samples a in accordance with AI MS-2.

### **3.12 DISPOSAL**

- A. Except for material indicated to be recycled, if any, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
- B. Do not allow excavated materials to accumulate on-site

### **3.13 PROTECTION**

- A. Immediately after placement, protect pavement from mechanical injury for three (3) days or until surface temperature is less than 140 degrees F (60 degrees C).

**END OF SECTION**

**SECTION 32 1313  
CONCRETE PAVING**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SECTION INCLUDES**

- A. Concrete sidewalks and curbs.
- B. Miscellaneous site concrete.

**1.3 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants: Sealing joints.
- B. Section 31 2316 - Excavation: Preparation of site for base and drainage course.
- C. Section 32 1216 - Asphalt Paving: Asphalt wearing course.

**1.4 REFERENCE STANDARDS**

- A. ACI 301 - Specifications for Structural Concrete; 2016.
- B. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI 305R - Guide to Hot Weather Concreting; 2010.
- D. ACI 306R - Guide to Cold Weather Concreting; 2016.
- E. ACI 308 - Standard Specification for Curing Concrete
- F. ACI 309R - Guide for Consolidation of Concrete
- G. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars. - 2017
- H. ASTM A884 Standard Specification For Epoxy-Coated Steel Wire And Welded Wire Fabric For Reinforcement - 2014
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2016, with Editorial Revision (2016).
- J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
- K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2018.
- L. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- M. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- N. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- O. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.
- C. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

- D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials and aggregates.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Admixtures.
  - 4. Curing compounds.
  - 5. Bonding agent or adhesive.
  - 6. Joint fillers.

#### **1.6 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- B. Installer Qualifications: An experienced installer, with a minimum of five (5) years experience, who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Ready-Mixed Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
  - 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
  - 2. Verification of Performance: Provide ready-mixed concrete from a concrete supplier approved by the Hydrophobic Concrete Admixture Manufacturer and authorized to dispense the Hydrophobic Concrete Admixture Manufacturer's waterproofing materials.
- D. Testing Agency Qualifications: An independent testing agency, retained and paid for by the Owner, will conduct the testing indicated, as documented according to ASTM E 548.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Conform to provisions of the Section 01 6000 - Product Requirements and the Hydrophobic Concrete Admixture Manufacturer instructions.
- B. Mixing and Delivery: Conform to ASTM C94.
- C. Sampling at Delivery: Conform to ASTM C172. Cure 4-inch by 8-inch cylinders to provisions of ASTM C31 and compression test compressive strength of cylinders to ASTM C39.
- D. Batch Tickets: Conform to ASTM C94 Option A or C. Accompany each load, fully executed, and signed. Log in with inspector at time of entry. Conform to Source Quality Control requirements specified by this Section.
  - 1. Include water content and water withheld at batch plant.
  - 2. Indicate time to nearest minute that batch was dispatched from plant, when it arrived at site, and when unloading began and was finished.
  - 3. Indicate ambient air temperature and concrete internal temperature at time of arrival.
  - 4. Make written record of water and other additives added to design mix, and the amount of concrete in the truck at the time of addition, after the mix truck left the batch plant.
- E. Reject concrete that has reached internal temperature of 89 degrees Fahrenheit or above and when temperature has risen 5 degrees in 10 minutes, indicating concrete is setting up prior to discharge.
- F. Store products in accordance with ACI 301. Do not use admixtures that have been in storage at project site for more than 12 months or which have been subjected to freezing, except as accepted by the Hydrophobic Concrete Admixture Manufacturer and by the structural engineer based on test results



## 1.8 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities

## PART 2 PRODUCTS

### 2.1 FORM MATERIALS

- A. Wood or steel form material, as selected by contractor, profiled to suit conditions.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
  - 1. Thickness: 1/2 inch (12 mm).
  - 2. Product:

### 2.2 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 80 (80,000 psi) (550 MPa) yield strength; deformed billet steel bars; epoxy coated.
- B. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars. - 2017
- C. ASTM A884 Standard Specification For Epoxy-Coated Steel Wire And Welded Wire Fabric For Reinforcement - 2014
- D. Dowels: ASTM A615/A615M, Grade 40 - 40,000 psi (280 MPa) yield strength; deformed billet steel bars; epoxy coated finish.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete.

### 2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Normal - Type I Portland cement, gray color.
- B. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- C. Water: Clean, and not detrimental to concrete.
- D. Air-Entraining Admixtures: ASTM C260/C260M.

### 2.4 ACCESSORIES

- A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. Slab Isolation Joint Filler: 1/2 inch (13 mm) thick, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.

### 2.5 CONCRETE MIX DESIGN

- A. Concrete Properties:
  - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; 4000 psi (275 MPa)
  - 2. Air Content: 6.0 percent for 3/4-inch (19-mm) maximum aggregate.
    - a. Exposed concrete shall be provided with air entraining of mixture.
  - 3. Maximum Slump: 4 inches (100 mm).
  - 4. Maximum Aggregate Size: 3/4 inch (19 mm).

### 2.6 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. The concrete ready mix supplier must contact the Waterproof Concrete Admixture Manufacturer before designing and testing any new mix designs, to receive guidance on achieving proper water absorption

characteristics. The concrete ready mix supplier must also report the test results to the Waterproof Concrete Admixture Manufacturer. All values must be within the manufacturer's specification limits.

1. Test result requirements for Waterproof Concrete Admixture in addition to engineer's performance requirements: Corrected thirty (30) minute water absorption, age at test 7 days (BS 1881-122):  
Not greater than 1.0%
2. All concrete materials used for testing must be same as concrete materials used for construction.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify compacted granular base is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Site verification of conditions:
  1. Verify that site conditions are acceptable for placement of waterproofed concrete.
  2. Do not proceed with concrete placement until conditions unacceptable to the Hydrophobic Concrete Admixture Manufacturer are corrected.
- D. Suitable Condition of Reinforcing Steel:
  1. At the time concrete is placed, reinforcement shall be free from mud, oil, or other nonmetallic coatings that decrease bond. Epoxy-coating of steel reinforcement in accordance with standards specified.

#### **3.2 SUBBASE**

- A. See Section 31 2316 - Excavation for construction of base course for work of this Section.

#### **3.3 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify YPS Office of Facilities Management and Construction Manager minimum 48 hours prior to commencement of concreting operations.

#### **3.4 FORMING**

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.
- D. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least twenty four (24) hours after concrete placement. Provide edge forms for all area where brick pavers or installed in concrete pavements.
- E. Forms for concrete curbs shall be steel or wood, straight or curved sections, free from warp, and of such construction that there will be no interference to inspection for grade or alignment. All forms shall extend for the full curb depth and shall be braced and secured adequately so that no displacement from alignment will occur during placing of concrete.

#### **3.5 REINFORCEMENT**

- A. Place reinforcement at top of slabs-on-grade.
- B. Place reinforcement in curbs as indicated.
- C. Interrupt reinforcement at expansion joints.
- D. Place dowels to achieve pavement and curb alignment as detailed.

#### **3.6 COLD AND HOT WEATHER CONCRETING**

- A. Follow recommendations of ACI 305R when concreting during hot weather.
- B. Follow recommendations of ACI 306R when concreting during cold weather.

- C. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
- D. Provide a minimum 6/6 x 6/6 welded wire fabric in all pavements

### 3.7 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Do not place concrete when base surface is wet.
- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

### 3.8 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 3/8 inch (10 mm) wide expansion joints at 20 foot (6 m) intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
  - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch (13 mm) of finished surface.
  - 2. Secure to resist movement by wet concrete.
- C. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- D. Provide scored joints.
  - 1. At 3 feet (1 m) intervals., or to match existing joint spacing or pattern.

### 3.9 POURED-IN-PLACE CONCRETE CURBS

- A. Concrete curbs shall be as shown on drawings. Where curbs abut walkways the curbs shall be integral with the sidewalk.
- B. Poured-in-place concrete curbs shall conform to NYSDOT Specifications Section 609, "Curbing, Gutters and Concrete Mall" and appropriate materials section(s) 700 series, except as otherwise noted.
- C. Concrete shall be compacted with an approved immersion type mechanical vibrator. Forms shall be left in place 24 hours or until the concrete has sufficiently hardened so that they can be removed without injury to the curb. Upon removal of the forms, the exposed faces of the curb shall be immediately rubbed to a uniform surface. Rubbing shall be accomplished by competent finishers. No plastering will be permitted.
- D. Protect concrete surface from loss of surface moisture for at least 6 days by membrane curing compound. Burlap is not permitted.
- E. All expansion joints for concrete curbs shall be 1/2 inch premolded nonextruding filler as specified in Part 2 herein. Expansion material shall be one (1) piece to conform to the cross section of the curb.
- F. Curbs shall be cast with expansion joints. Expansion joints shall line up with joints in walk, maximum 15 feet O.C.

- G. The contractor shall keep the concrete curbs clean, aligned and protected from damage until final acceptance of the work. Blow out control joints prior to acceptance. Any curb damaged prior to the final acceptance of the work shall be repaired or replaced at the contractor's expense.

**3.10 FINISHING**

- A. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius ( 6 mm radius).
- B. Curbs and Gutters: Light broom, texture parallel to pavement direction.

**3.11 TOLERANCES**

- A. Maximum Variation From True Position: 1/4 inch (6 mm).

**3.12 FIELD QUALITY CONTROL**

- A. An independent testing agency, retained by the Owner, will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
  - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.
  - 2. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd (76 cu m) or less of each class of concrete placed.
  - 1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
  - 2. Perform one slump test for each set of test cylinders taken.
- C. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

**3.13 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Protect installed work from damage due to subsequent construction activity on the site.
- C. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

**END OF SECTION**

**SECTION 32 9220**  
**RESTORATION OF TURF AREAS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including School Facilities Management Contract Manual and Specifications and Division 1 Specification Sections, apply to this Section.
- B. In the event of discrepancies between the specifications and School Facilities Management Contract Manual and Specifications the School Facilities Management Contract Manual and Specifications shall prevail.

**1.2 SUMMARY**

- A. The contractor shall supply all materials, equipment, labor, incidentals and maintenance required in order to provide an acceptable stand of turf by top soiling and seeding of all disturbed areas including stripping topsoil, grading, placing topsoil, fertilizing and seeding, in accordance with the drawings and as specified.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Topsoil
  - 1. Stockpiled topsoil from site preparation, earthwork and trenching operations may be used.
  - 2. Topsoil shall not be used in a muddy or frozen condition.
- B. Fertilizer: Commercial fertilizer (14-28-15) shall have the following composition by weight: Nitrogen 14%; Phosphorous 28%; Potash 14%; as manufactured by Jonathan Green "New Seeding Lawn Fertilizer".
- C. The seed used shall be fresh, re-cleaned seed of the latest crop containing a blend of those listed below and shall be harvested from one field to ensure a uniform color and texture. Percentages of each grass type are to be within the given range for that type:
  - 1. Devine Perennial Ryegrass
  - 2. America Kentucky Bluegrass
  - 3. Apollo Kentucky Bluegrass
  - 4. Limousine Kentucky Bluegrass
  - 5. Midnight Kentucky Bluegrass
- D. Mulch: Mulch shall be approved salt hay or weed free straw and stabilized with a binder.

**PART 3 - CONSTRUCTION**

**3.1 GRADING AND SUBGRADE PREPARATION**

- A. Perform grading operations to bring subgrade to levels required and to contour indicated on the drawings.
- B. Completed subgrade shall be approved by YPS Office of Facilities Management before topsoil and seeding.
- C. The approved subgrade shall be scarified to a depth of 2 inches to permit mixing with rootzone material.
- D. Provide minimum 6" topsoil in all areas.

**3.2 SEEDBED PREPARATION**

- A. Seasonal and weather limitations - All operations including seedbed preparation shall be performed only when the soil is in proper condition to permit satisfactory work. Continuation of work at other than specified times or conditions shall proceed only with consent of the YPS Office of Facilities Management.
- B. Leveling - Any undulations or irregularities in the surface resulting from fertilization, tillage or any other causes shall be leveled prior to seeding. Flooded, washed out, or otherwise damaged areas shall be reconstructed and all grades reestablished in conformance with the drawings and specifications.

- C. Cleanup - Prior to seeding, the surface shall be cleared of all trash, debris and stone larger than 1-1/2 diameter and of all roots, brush, wire, grade stakes and other objects that could be a hindrance to maintenance operations and use.
- D. Fertilizing - After final seedbed preparation, apply fertilizer at the manufacturer's recommended rate indicated on the bag. Fertilizer shall be distributed evenly over all areas to be seeded by machine, or as otherwise approved by the YPS Office of Facilities Management, and shall be worked lightly into the top 1 inch of the rootzone mixture.

### **3.3 SEEDING**

- A. The contractor shall furnish and place all materials required for seeding in all top soiled areas.
- B. All areas to be seeded shall be thoroughly disked or otherwise loosened to a depth of 4 inches and shall be raked to true lines free from all unsightly variations, bumps, ridges, or depressions. All sticks, stones, roots or other objectionable material which might interfere with the formation of a finely pulverized seed bed shall be removed from the soil. Ground limestone and commercial fertilizer shall be applied as specified above.
- C. The soil shall then be raked to a smooth, even draining surface and compacted with an approved roller as directed by the Architect. Any depressions which occur shall be regraded and rerolled until a satisfactory grade is obtained.
- D. The rate of seeding shall be 10 lbs. per 1000 sq. ft. of area. Grass seed shall be sown by approved machine in such manner that a uniform stand will result and as indicated on the drawings for the upper field.
- E. Grass seed shall be sown preferably in the fall between August 25 and October 1, in the spring between March 15 and May 1, or at such other times as are approved by the YPS Office of Facilities Management. All seeding is to be done in dry or moderately dry soil and at times when the wind does not exceed a velocity of 5 miles per hour.

### **3.4 MULCHING**

- A. All seeded areas shall be mulched not later than three (3) days following seeding. Ground surfaces shall be completely covered at a rate of at least two (2) tons per acre.
- B. Mulch shall be anchored using jute or other approved netting properly fastened in place.
- C. Subsequent watering - Seed shall be watered as required to maintain adequate moisture in the soil. In the absence of rainfall, seed shall be watered at frequencies dictated by need.

### **3.5 HYDROSEEDING**

- A. The contractor shall have the option of hydroseeding the lawn areas at no increased cost to the YPS Office of Facilities Management and subject to the written approval of the YPS Office of Facilities Management. If the contractor selects this option, he shall submit to the YPS Office of Facilities Management for approval a complete specification of the hydroseeding operation he intends to follow. Hydroseeding with a cellulose fiber mulch is acceptable.

### **3.6 MAINTENANCE, REPLACEMENT, GUARANTEE AND FINAL INSPECTION**

- A. Maintenance operations shall begin immediately after seeding and shall be continued as required until provisional acceptance. Grass shall be kept in a healthy, growing condition by mowing, watering, weeding, cultivating, disposal of waste vegetation, fertilizing, spraying or spreading of approved materials to prevent or treat infestations of insects or disease and all other operations required to maintain a strong, vigorous and healthy stand of grass.
- B. Seeded areas that are dead, or in the opinion of the YPS Office of Facilities Management, in an unhealthy, unsightly or badly impaired condition, shall be replaced by the contractor as soon as reasonably possible after the unsatisfactory condition has become evident. No replacement shall be made when weather or soil is unfavorable for seeding. Such replacements shall be made in the same manner as specified for the original seeding.

### **3.7 ACCEPTANCE**

- A. Inspection of the work of seeding to determine provisional acceptance will be made by the YPS Office of Facilities Management upon written notice requesting such inspection submitted by the contractor at least seven (7) days prior to the anticipated date of inspection. Request may be made subsequent to the second mowing of the turf.
- B. After inspection the Contractor will be notified in writing by the YPS Office of Facilities Management of provisional acceptance of all work, or if there are any deficiencies of the requirements for completion of the work.
- C. All seeded areas shall be guaranteed for one (1) growing season commencing with the date of provisional acceptance.
- D. Upon provisional acceptance, the YPS Office of Facilities Management will assume general responsibility for maintenance of the lawn areas. The contractor shall, however, make periodic visits to the site during the guarantee period to advise the YPS Office of Facilities Management of proper maintenance procedures.
- E. At the expiration of the guarantee period, upon written request of the Contractor, inspection for final acceptance will be made by the YPS Office of Facilities Management. All remedial work to seeding work by the contractor shall be completed prior to the request for final acceptance.

**END OF SECTION**