

HVAC Systems Scope of Work

Work Included: Provide HVAC and exhaust systems installation and modifications as outlined herein and as needed for a complete and proper installation including, but not necessarily limited to:

1. Furnish and install gas heat/electric cooling roof top units and curbs. Provide systems complete with insulated supply and return ductwork, air devices, balance dampers, fire dampers, smoke dampers, smoke detectors, interlocks, vibration isolation, air filters, and additional items required for a complete and fully functional system.
2. Provide split system with furnace units, condensers, refrigerant piping, supply and return ductwork, outside air ductwork, air devices, system controls, throwaway filters, and all accessories required for a complete and fully functional system for core offices and classrooms.
3. Provide refrigerant split system with fan coil units, heat pumps or cooling only condensing units, refrigerant piping, supply and return ductwork, air devices, system controls, throwaway air filters, and all accessories required for a complete and fully functional system for areas identified on the drawings.
4. Provide electric baseboard heaters mounted for indicated rooms. Heater shall be provided with integral thermostat control, vandal proof covers, and fin guards.
5. Provide kitchen exhaust hood and associated upblast exhaust fans and ductwork systems for kitchen exhaust hood. Fans serving grease laden exhaust shall include NFPA ventilated roof curb, grease collection, and interface with hood controls. Grease hood exhaust ducts shall be welded black steel with fire rated insulation ductwrap.
6. Provide indirect fired gas make-up air unit for kitchen exhaust hood with, insulated supply air duct systems, temperature controls, interlock with kitchen hood exhaust operation.
7. Provide gas fired unit heaters where indicated on the drawings. Installation shall include gas piping, equipment hangers, flue, combustion air ducting, combination flue/combustion air roof/wall penetration kit, thermostat, summer/winter switch.
8. Building design shall include building pressure balance system to provide building pressure relief but still maintain building at slightly positive pressure.
9. Provide new toilet exhaust system exhaust fans and modify ductwork where necessary to meet current building code required exhaust air quantities. Provide individual exhaust fans in all spaces with mop service basins or service sinks.
10. Provide thermal and acoustical insulation for supply, return, and outside air duct systems. Ductwork shall be wrapped, except immediately at the unit for a minimum of 10ft. from the unit where the duct shall be lined with acoustical 3 pound density, 2 inch thick liner.
11. All air systems shall be balanced to the designed air flows by a NEBB certified contractor. Balance procedures and reporting shall be per NEBB Standard methods and procedures.
12. Provide building heating and cooling load calculations for determination of equipment sizes to be installed in each area to the owner for review and approval, prior to ordering equipment.

13. Mechanical contractor to furnish and install a “Supco” low pressure switch #SLP 2565 and a “Supco” SF 9602 ¼”MPT x ¼”MPT x ¼”FPT brass tee installed on high pressure side of all new and existing DX systems, RTU, and split systems. Wiring to alarm system by alarm contractor.
14. Coordinate installation of TPS control systems with TPS assigned control contractor. Controls shall be able to monitor temperature, humidity, CO2 and CO levels. Provide locking metal covers in locations of high traffic like corridors, gyms, cafeterias and as required by Owner.
15. Engineering work shall be completed by a degreed person holding a Bachelor of Science in Electrical Engineering, licensed in the State of Oklahoma as a Professional Engineer, and in direct control of work performed in their office by qualified design staff.
16. Demolition:
 - Disconnect, remove, and prepare existing systems for completion of the Scope of Work of this section and as affected by other sections noted herein.
 - If pipe, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and make repairs.
 - Work abandoned in place: Cut and remove back to system main. Cap piping and patch surface to match final finish. Permanently mark all work abandoned in place and not operation.
 - Removal: Remove equipment and materials from the Project site to approved location daily.
 - Required disconnection or interruption of existing building systems shall be coordinated with the Owner prior to performing Work. All buildings users and departments affected by the interruption shall be notified as directed by the Owner within the time frame required by the Owner.
 - All equipment removed as a part of this Work shall be discarded in proper manner according to all applicable laws and removed completely from this site.

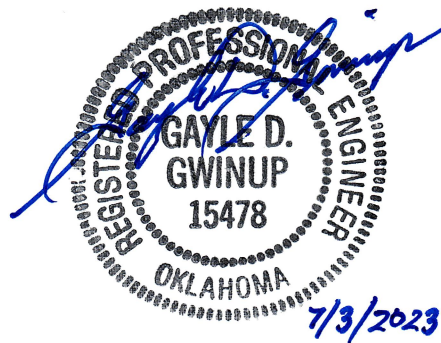
HVAC Design Criteria:

1. Heating and cooling calculations shall be done in compliance with ASHRAE methods and data for the building materials, outside ambient design temperatures for 2-1/2% column for summer and 1% column for winter, interior conditions shall be 75 deg. F. summer design and 70 deg. F. winter design, outside air shall be provided at current code requirements for cfm per person, special spaces and use areas shall be designed around recommendations as outlined by most current ASHRAE Standards of design and application.
2. Duct systems shall be designed using current SMACNA and ASHRAE Standards of design for pressure classification, ductwork dimensions, and velocities for system types and equipment installed. Duct velocities shall be as recommended for low velocity systems for branch main and branch ducts. Main duct velocities may are not to be at velocities that generate radiated noise. Duct system shall be designed to provide required static pressure at terminal VAV unit inlet to meet manufacturer’s performance criteria and requirements.
3. Outside air ventilation shall be provided at current building code required CFM/person. Cafeteria spaces shall have occupancy calculated at 10 square feet per occupant. Assembly

auditoriums shall be calculated based on the number of seats and normal presentation occupancy.

4. Air devices shall be selected to provide required throw and with NC levels of 25 or less. Lay-in air devices shall be provided where grid ceilings are installed. Gasketed, flange frame devices shall be provided for sidewall, duct mounted, and gyp board ceiling installations. Aluminum eggcrate grilles shall be provided for supply diffusers located near kitchen hood installation. Perforated ceiling grilles are not approved.
5. Ventilation requirements are to be designed per code.
6. Refer to other sections of the project manual specification for additional system and equipment requirements.

END OF SECTION



ELECTRICAL SCOPE OF WORK

PART 1 GENERAL

1.01 QUALIFICATIONS:

- A. Engineering work shall be completed by a degreed person holding a Bachelor of Science in Electrical Engineering, licensed in the State of Oklahoma as a Professional Engineer, and in direct control of work performed in their office by qualified design staff.

1.02 CODES:

- A. All materials and workmanship shall comply with all latest adopted applicable codes, specifications, local ordinances, industry standards, latest edition of the N.E.C. and Utility Company regulations. In no case will work or materials inferior to these specifications be accepted even if permitted by code.
 - 1. NFPA 70 - National Electric Code (NEC) 2017 Edition
 - 2. Oklahoma State Fire Marshal Building Plan Review Submittal Requirements
 - 3. NFPA 72 - National Fire Protection Association (NFPA) 2016 Edition
 - 4. NFPA 101 - Life Safety Code, 2015 Edition
 - 5. International Building Code (IBC) 2015 Edition
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards, utility company regulations and the contract documents, the most stringent will govern.
- C. Non-compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws local ordinances, industry standards, utility company regulations and without receiving instructions from owner, he shall bear all costs arising in correcting the deficiencies and corrections to comply with codes or standards. Written approval of any changes must be received before subject work is done. Failure to do so will result in corrections being made by the contractor at his expense.

1.03 PROJECT STANDARDS:

Engineer of Record shall follow the project standards outlined in this section for final submitted Construction Documents and Specifications.

- A. Coordinate purchase of materials with Construction Outlined Schedule and Phasing.
- B. Procurement: Coordinate purchase of materials with construction outlined Schedule and Phasing.

- C. Electrical systems to be grounded and bonded in accordance with the latest adopted NEC 2017 Edition. MDFs and IDF's require intersystem bonding per NEC 2017 Article 250.94.
- D. Determine electrical characteristics and requirements of all Division 23 equipment.
- E. Provide tabulation of removed and new loads per NEC Art. 220-87 to be utilized for utility coordination upon final load calculations.
- F. Perform voltage-drop calculations from service entrance to the furthest outlet. Voltage-drop not to exceed 5%. Size and de-rate branch circuits to maintain a 3% maximum voltage-drop. Provide 2% maximum voltage drop for feeders from switchboards or main distribution board to branch circuit panelboards.
- G. Provide RTU branch circuit voltage-drop calculation results on a schedule for each of the roof HVAC electrical plans.
- H. Provide voltage-drop results on each of the branch panelboards serving the new HVAC rooftop equipment.
- I. Specify all new electrical equipment and systems per TPS Guideline Specifications. Copies can be provided by TPS Bond Office.
- J. Coordinate with Owner and other disciplines for proposed conduit routing.
- K. Existing and new/modified panelboard and switchboard schedules shall be tabulated and indicated on sheets in final signed Construction Documents.
- L. Provide One-Line Diagrams, Feeder Schedules, and all diagrams necessary to illustrate the complete electrical system on final sealed Construction Documents by a Registered Professional Electrical Engineer.
- M. Photometric calculations for NORMAL and EMERGENCY lighting shall be submitted to Owner for approval prior to final sealed Construction Documents. Illustrate new ceiling grid, ceiling heights, and layout of Owner's Standard fixtures in new work.
- N. Provide Owner's standard LED flat panel 2x4 fixture for the following:
 - 1. Classroom: 35-footcandle average at 30" AFF.
 - 2. Storage and Corridors: 20-footcandle average at floor level.
 - 3. Kitchen: 55-footcandle average at floor level.
- O. Provide Owner's standard emergency light fixtures and space per NFPA 101 for average 1-footcandle at the floor level.

- P. Coordinate the design/engineering of all new and existing low-voltage systems with Owner. Provide diagrams illustrating all low voltage systems. Low-voltage systems include but not limited to the following:
1. Fire Alarm System – Existing to remain. Provide manufacturer expansion cards and power supplies for additional appliances and initiation devices.
 2. Security System – Existing to remain. Provide manufacturer expansion cards and power supplies for additional appliances and initiation devices.
 3. Building Management System - Existing to remain. Coordinate raceway and support requirements with TPS Controls Contractor.

1.04 OWNER STANDARDS SUMMARY:

Engineer of Record (EOR) shall follow the Owner's standard guidelines summarized in this section and detailed in Section 260400 – Electrical System Specifications and 271500 – Premise Cabling to be obtained from TPS Bond Office.

A. Hangers and Supports:

1. Conduit and Cable Support Devices:

- i. Steel and malleable-iron hangers, clamps and associated fittings listed for types and sizes of raceway or cable to be supported as described in NECA 1 and NECA 101.
 - ii. Tie wire not acceptable means.
2. Minimum hanger rod size for raceway: 1/4" diameter.
3. Single conduit support: Spring-steel clamps for 1-1/2" and smaller raceway
4. J-Hooks: (3) level, 4" wide, 6' on-center in corridor accessible ceiling cavity. Support new and existing CAT 6 cabling for low-voltage systems.

B. Conductors and Cables:

1. Service entrance: 600V THHN insulated copper or aluminum.
2. Line Voltage: 600V THHN/THWN insulated and color coded for voltage.
3. Solid wire: No. 10 and smaller.
4. Stranded wire: No. 8 and larger.
5. MC Cable: Limited use allowed only for lighting whips, millwork, small vibrating equipment and existing closed partition walls. NOT ALLOWED FOR HOMERUN CIRCUITS.

C. Raceways and Boxes:

1. EMT: Set screw type, 3/4" minimum for power circuits and 1" raceways for low-voltage cables.
2. IMC: Roof mounted equipment branch feeder on 4" equipment rails, sizes adjusted for derating and ambient temperature.

3. LFMC: Short motor connections or where subject to vibration.
 4. Expansion Fittings: Required where raceway crosses building boundaries.
 5. Underground Raceways: PVC Schedule 40, 30" below finished grade minimum.
 6. Boxes: 4" square by 2-1/8" deep steel for interior locations. Weatherproof with while-in-use and gasketed covers for exterior locations.
- D. Panelboards:
1. Rated 400-Amps and below with standard enclosure depth.
 2. Phase and Neutral Bus: Copper, 100% neutral.
 3. Hinged front covers.
 4. Pull box on top of surface mounted panelboards.
 5. Panels may utilize a manufactured rooftop panel to minimize penetrations thru existing roof. Mounting means and methods shall be approved with Owner and roof manufacturer prior to design and installation.
 6. Warranty: Five years.
- E. Wiring Devices:
1. NEMA WD 1, NEMA WD 6, UL Listed and labeled.
 2. GFCI outlets: 125V, 20A, 5-20R, UL 498 and FS WC-596, side-wired, feed-thru with nylon face and Tamper-Resistant below 5'-6".
- F. Low-Voltage Color Code:
1. Refer to Owner specification Section 271500 – Premise Cabling, for low voltage cabling color codes, devices and additional device raceway requirements.
- G. Fire Alarm System (Existing to Remain):
1. Engineer of Record shall coordinate with school site conditions and Owner prior to final Construction Documents with fire alarm requirements. Main FACP to be relocated from office to expanded MDF closet.
- H. Security System (Existing to Remain):
1. Control panel shall be Ademco Vista-250BP Commercial Burglary Partitioned Security System or equivalent. Provide Owner approved security devices.

PART 2 SCOPE OF WORK

2.0 1 DEMOLITION:

Site Inspection of existing electrical systems shall be performed by the awarded contractor. Documentation of existing electrical conditions shall be provided to the

Engineer of Record (EOR) engaged by the contractor for the electrical design of Work with copies provided to Owner. Phasing of demolition shall be documented and provided to the EOR and Owner for review, coordination, and comment prior to demolition.

A. Power Distribution Systems:

1. Field verify, trace, and document existing removed interior hydronic HVAC classroom unit circuits fed from switchboard or panelboard. Provide documentation of circuits removed to the Engineer of Record to be used in new work.
2. Remove existing fused disconnect to existing roof HVAC units scheduled to be replaced.
3. Remove branch feeder serving existing Roof HVAC units from distribution switchboard or panelboard where raceway does not comply with the TPS Guideline Specification for the environment or undersized for new load.
4. Remove control wiring from room thermostats/sensors to removed units. Identify raceways that can be reused in new work and label.
5. Remove existing panelboards that have been modified with residential type panel interiors and panels that are obsolete or have fused switches for branch circuits. Coordinate requirements of panel replacement with existing wall types and provide means to relocate panel or modify adjacent surfaces to match existing.
6. Remove existing chillers branch feeders once system has been drained and removed.
7. Document and publish demolition drawing of actual existing conditions indicating devices and locations of fire alarm panel and security devices work.

B. Kitchen:

1. Coordinate with Owner and HVAC contractor the kitchen exhaust hood system to be removed. Remove existing LED fixtures and store in safe/clean location.
2. Relocate existing ovens and equipment to new hood locations. Remove surface mounted devices on walls where new stainless steel sheet metal will be mounted at new hood cooking areas.

C. Lighting:

1. Coordinate with Owner and HVAC contractor the classroom and other rooms where the complete ceiling grid system is to be removed. Remove existing LED fixtures and store in safe/clean location.
2. Remove and dispose properly fluorescent lighting in corridors and classrooms to be replaced with new LED flat panel 2x4 fixtures.

D. HVAC:

1. Coordinate all HVAC work with Division 23 contractor prior to and during demolition work.

2. Remove and disconnect power to all existing mechanical units per Division 23 scope.
 3. Remove and disconnect power and controls to existing roof top units.
- E. Fire Alarm System (Existing to Remain):
1. Coordinate fire alarm system requirements with TPS representative: Sam Troglin, 918-746-6410.
 2. Indicate new fire alarm devices and cabling to accommodate new HVAC equipment duct detectors and smoke dampers.
 3. Indicate new I/O devices which match the U.L. Listed FACP.
 4. Provide U.L. Listed power supplies for expansion (as required).
- F. Security System (Existing to Remain):
1. Coordinate security system requirements with TPS representative: Sam Troglin, 918-746-6410.
 2. Indicate to remove and reinstall existing security devices, cabling and provide new to accommodate new HVAC equipment.
 3. Indicate new devices which match the U.L. Listed security system.
 4. Refer to TPS General Specifications for Premise Wiring Section 271500.

2.0 2 New Work:

After demolition of the existing electrical systems provide new electrical system installation and modifications as outlined herein and required for a complete and proper working electrical system to serve the new building mechanical equipment and other building electrical distribution systems installed as described in Owner provided criteria. Phasing of new Work shall be documented and provided to the Electrical Engineer of Record and Owner for review, coordination, and comment prior to issuing for construction.

- A. Lighting:
1. Reinstall existing stored LED fixtures after the new ceiling grid is reinstalled. Provide temporary lighting during removal phase.
 2. Replace classroom lighting with TPS standard LED flat panel fixture, occupancy sensors, power packs and dimmer switch.
 3. Replace corridor lighting with TPS standard LED flat panel fixture, occupancy sensors and power packs.
- B. Power Distribution:
1. Coordinate with local utility company 3-year peak-load to determine if existing switchgear has capacity to serve new loads.
 2. Modify or provide new design for 208Y/120V and 480Y/277V Distribution Switchboards that serve the existing building loads and new HVAC loads on the roof.

3. Extend or route new feeders to new roof equipment distribution switchboards from existing main switchgear located at rear exterior of building that served removed chiller equipment.
4. Modify existing/replaced HVAC electrical distribution and low-voltage controls:
 - (a) Indicate sizing of new fused disconnects at replaced HVAC units and route new conductors in existing raceway back to source.
5. Provide new 3-Pole breaker in existing or new distribution source to serve new HVAC panelboards located on the roof or provide new switchboard on roof to distribute to new roof mounted panels rated for the environment.
 - (a) Route new branch circuits on roof to new HVAC systems replacing the removed chiller/hydronic systems in raceway type approved by TPS Guideline Specifications.
 - (b) Provide new fused disconnect switches rated for the environment at each unit. Non-fused switches shall be allowed that meet the NEC requirements and equipment manufacturer requirements. Calculation to be provided by the contractors Engineer of Record.
 - (c) Route new raceway for various control cable to classroom BMS control board. Coordinate locations with Division 23 and TPS controls contractor.
6. Require testing of existing conductors for reuse by meg-ohm insulation testing and direct to replace all conductors failing tests. Provide written report with cost estimate prior to replacing failed conductors.
7. Survey existing branch circuits and document index to be used on new construction documents issued by the Engineer of Record.
8. Provide completed circuit index for all switchboards, distribution panels, and branch circuit panelboards. Locate index inside equipment door.
9. Remove circuits and feeders to abandoned equipment, to be removed in demolition. Electrical legends to indicate breakers or revised sections are 'SPARE'.
10. Provide new phenolic labels for each switchboard, panelboards and equipment disconnects. Label shall indicate where the distribution circuit is fed from.
11. Reinstall existing fire alarm devices that are code compliant, magnetic hold-opens, pull-stations, and cabling. Provide I/O module and power supplies for HVAC duct detectors to communicate with existing FACP as required.
12. Provide combination smoke/fire dampers and duct detectors where required. Indicate new fire alarm devices to meet local codes and approved by Authority Having Jurisdiction (AHJ). Fire alarm devices shall not be installed until the contractor receives final shop drawings approved by the AHJ.
13. Provide new alarm controls for each new HVAC unit and route cabling back to main security control panel located in existing 'MDF/IDF' closet. Coordinate sensors for HVAC system with Division 23 contractor. Refer to specifications.
14. Kitchen:
 - (a) Relocate existing ovens and equipment wiring devices to new hood locations. Provide new wiring devices and disconnects rated for the environment as required.

- (b) Provide power for new roof mounted package makeup air unit and new exhaust fans per Division 23 specifications.
- (c) Reconnect or connect new Ansul Fire Suppressions system and interconnect to existing fire alarm zone.
- (d) Reinstall removed existing lighting as required.

PART 3 EXECUTION

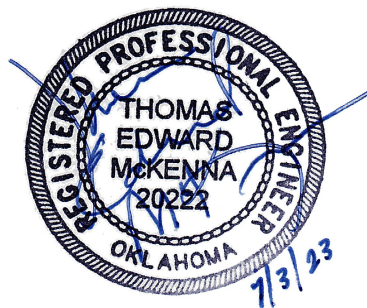
3.0 1 DIVISION OF WORK

- A. Power Distribution
 - 1. Design: By Oklahoma Licensed Professional Electrical Engineer of Record.
 - 2. Materials/Installation: By Division 26 Contractor.
- B. Fire Alarm System Modifications (Existing to Remain)
 - 1. Design: By NICET level 4 contracted vendor; Obtain location of Devices from approved shop drawings and indicate on Construction Documents.
 - 2. Materials/Installation: By Owner contracted vendor.
- C. Security System (Existing to Remain)
 - 1. Design: By Owner contracted Vendor; Obtain location of devices from vendor shop drawings and indicate on Construction Documents.
 - 2. Materials/Installation: By Owner contracted vendor.

3.0 2 TPS DESIGN PARAMETERS:

- A. Design shall comply with all published TPS standards.
- B. Design shall comply with the Advanced Energy Design Guide for K-12 School Buildings.
- C. Provide final As-Built drawings signed from the Engineer of Record to the TPS Bond Office for final payment applications.

END OF SECTION



Plumbing Scope of Work:

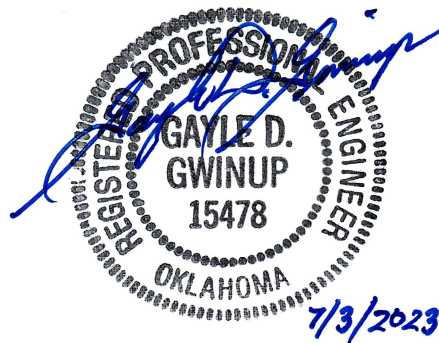
Work Included: Provide plumbing systems installation and modifications as outlined herein and as needed for a complete and proper installation including, but not necessarily limited to:

1. Provide gas piping system required for the installation of all new gas fired equipment and appliances, and the continued service to all existing gas piping systems. Gas piping system shall include all required pressure regulators, relief piping, valves, unions, cathodic protection, electrical grounding, and accessories required for a complete system. Contractor shall coordinate with ONG to provide certified testing to comply with the system provider “Zero” leak policy for all new and existing gas piping.
2. Provide condensate piping system from all HVAC equipment and route to an approved receptor. Provide galvanized condensate piping system on the roof, route to roof drains or downspouts. Terminate with a turn down. Condensate piping installed within the building shall be fully insulated and provided with a vapor barrier.
3. Engineering work shall be completed by a degreed person holding a Bachelor of Science in Mechanical Engineering, licensed in the State of Oklahoma as a Professional Engineer, and in direct control of work performed in their office by qualified design staff.
4. Demolition:
 - Disconnect, remove, and prepare existing systems for completion of the Scope of Work of this section and as affected by other sections noted herein.
 - If pipe, insulation, or equipment to remain is damaged or disturbed, removed damaged portions and make repairs.
 - Work abandoned in place: Cut and remove back to system main. Cap piping and patch surface to match final finish. Record all work abandoned in place on record drawings. Permanently mark all work abandoned in place and not operational.
 - Removal: Remove equipment and materials from the Project site to approved location daily.
 - Required disconnection or interruption of existing building systems shall be coordinated with the Owner prior to performing Work. All buildings users and departments affected by the interruption shall be notified as directed by the Owner within the time frame required by the Owner.
 - All equipment removed as a part of this Work shall be discarded in proper manner according to all applicable laws and removed completely from this site.

Plumbing Design Criteria:

1. Provide shut-off gas valve and union at each piece of gas fired equipment and service penetration through exterior wall and roof.
2. Provide manual and automatic shut-off valves at kitchen cook line service.
3. Valves and fittings shall be full size of the line they serve unless otherwise noted.
4. Make change in pipe size note on the plans after last fitting of larger pipe. When supply pipes are larger than equipment tappings, reduce size immediately prior to entry.

END OF SECTION



SECTION 09511

SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCES

- A. ASTM C 635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 1997.
- B. ASTM C 636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 1996.
- C. ASTM E 580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint; 1996.
- D. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.03 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 6 x 6 inch in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 12 inches long, of suspension system main runner.

1.04 QUALITY ASSURANCE

- A. Installer shall be a company specializing in the installation of suspended acoustical ceilings with a minimum of three years documented experience.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.06 PROJECT CONDITIONS

- 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. Install acoustical units after interior wet work is dry.

1.07 EXTRA MATERIALS

- A. See Section 01600 - Product Requirements, for additional provisions.
- B. Provide 5 percent of total acoustical unit area of each type of acoustical unit for Tulsa Public Schools' use in maintenance of project.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc or CertainTeed
 - a. Classrooms, Halls, Offices & Cafeterias: 2' x 4' Armstrong #1729 Humiguard Plus-Fine fissured with BioBlock paint on face and back of panels; 2 x 4 CertainTeed HHF-197, High Humidity, Fine-fissured with BioShield paint on face and back of panel. Color: White
 - b. Gymnasiums and designated high abuse areas: 2' x 4' Armstrong #860 Armatuff or #862 where plans indicate fire rated is required; 2 x 4 CertainTeed PSB-197 (Fire-rated). Color: White
 - c. Libraries: 2' x 2' Armstrong #1910 Humiguard-Plus, Ultima/very fine texture with BioBlock paint on face and back of panels; 2 x 2 CertainTeed #1222-OVT-1-Symphony NRC-.65 - .70 x 5/8". Color: White.
 - d. Kitchens, Restrooms & Classroom Toilet Rooms: 2' x 4' Armstrong #605 Ceramaguard with BioBlock/BioShield & Humiguard-Max; 2 x 4 or CertainTeed Vinylrock 1140-CRF-1 (Fire-rated) or 1100-CRF-1 (Non-perforated) BioBlock/BioShield & Humiguard. Color: White

2. No Substitutions: See Section 01600 - Product Requirements.
- B. Acoustical Panels: ASTM E 1264 Type III, Painted mineral fiber, conforming to the following:
 1. Size: 24 x 24 inches, or 24 x 48 inches.
 2. Thickness: 5/8 inches.
 3. Composition: Wet felted.
 4. Density: 1.0 lb/cu ft.
 5. NRC Range: 0.55 to 0.65.
 6. Edge: Square.
 7. Surface Color: White.
 8. Surface Pattern: Non-directional fissured.

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 1. Armstrong World Industries, Inc.
 2. Chicago Metallic Corp.
 3. CertainTeed
 4. Substitutions: See Section 01600 - Product Requirements.
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
 1. Profile: Tee; 15/16 wide face.
 2. Construction: Double web, Hot dipped galvanized.
 3. Finish: white over galvanized substrate.
- C. Match Acoustical Tile Manufacturer with same grid manufacturer to obtain 15-year warranty. 15/16" Grid System. Color: White.

2.03 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636, ASTM E 580, 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. Locate system on room axis according to reflected ceiling plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. 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.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
 2. Overlap and rivet corners.
- L. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.03 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 units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 ERECTION TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.05 SCHEDULE

- A. See Room Finish Schedule.

END OF SECTION

SECTION 09901

PAINTS AND COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.

1.02 REFERENCES

- A. Painting and Decorating Contractors of America–P.D.C.A. Type 1 Manual.
- B. ASTM D 4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 1992 (Re-approved 1997).

1.03 DEFINITIONS

- A. P.D.C.A. standards and interpretations.

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on all finishing products.
- C. Verification samples: submit a minimum of (3) three painted 6" x 10" (+/-) "pull down" samples, illustrating selected colors and textures for each color and system selected. Each sample to be identified on the backside with project ID and project color number. One set of samples will be returned to the CM, to remain at the job site for reference.
- D. Submit sealer and stain finishes on material on which that particular finish is to be used.
- E. Manufacturer's instructions: Indicated special surface preparation procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- G. MSDS for each product to be utilized.

1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section with minimum three (3) years experience.
- B. Job Foreman: Company shall have a job foreman who speaks English on the job site during normal working hours (with a minimum of 5 years experience).

1.06 REGULATORY REQUIREMENTS

- A. Comply with safety recommendations of MSDS for each product utilized.
- B. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees Fahrenheit and a maximum of 90 degrees Fahrenheit, in ventilated area, and as required by manufacturer's instructions.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

1.09 EXTRA MATERIALS

- A. See Section 01600 - Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Paints: Pittsburgh Paint Co.
- B. Transparent Finishes: Pittsburgh Paint Co.
- C. Stains: Pittsburgh Paint Co.
- D. Primer Sealers: Pittsburgh Paint Co.
- E. Substitutions: See Section 01600 - Product Requirements.

2.02 MATERIALS

- A. Provide best of their respective kinds, delivered to job in original unopened containers, plainly marked with manufacturer's name, name of product and color. A schedule of colors will be prepared by TPS upon receipt of all paint samples and other items required for color selections.
 - 1. Materials: PPG, SHERWIN-WILLIAMS, KELLY MOORE, BENJAMIN MOORE, and PORTER. Submit product information for equal material to TPS for approval prior to color selections.

2.03 PAINT SYSTEMS – EXTERIOR

- A. Paint WE-OP-3A - WOOD, Opaque, 3 coats
 - 1. One coat of PPG 17-941 Seal Grip Interior/Exterior Alkyd Universal Wood Primer
 - 2. Two coats of PPG 78 Line Sun-Proof Exterior 100% Acrylics Semi-Gloss Enamel
- B. Paint WE-OP-3L - WOOD, Opaque, 3 coats
 - 1. One coat of PPG 6-609 Speedhide Exterior Latex Wood Primer.
 - 2. Two coats of PPG 78 Line Sun-Proof Exterior 100% Acrylics Semi-Gloss Enamel
- C. Paint CE-OP-3L - CONCRETE/MASONRY, Opaque, 3 coats
 - 1. One coat of PPG 6-7 Speedhide Interior/Exterior Latex Block filler
 - 2. Two coats of PPG 78 Line Sun-Proof Exterior 100% Acrylics Semi-Gloss Enamel
- D. Paint GE-OP-3L - GYPSUM BOARD AND PLASTER, Opaque, 3 coats
 - 1. One coat of PPG 17-921 Seal Grip Interior/Exterior Universal Acrylic Primer
 - 2. Two coats of PPG 78 Line Sun-Proof Exterior 100% Acrylics Semi-Gloss Enamel
- E. Paint ME-OP-3A - FERROUS METALS, Unprimed, 3 coats
 - 1. One coat of PPG 6-208 Speedhide Interior/Exterior Rust Inhibitive Metal Primer
 - 2. Two coats of PPG 90-474 Pitt-Tech DTM Acrylic Satin Enamel
- F. Paint MgE-OP-3L - GALVANIZED METALS, 3 coats
 - 1. One coat of PPG 90-712 Pitt-Tech DTM Acrylic Metal Primer
 - 2. Two coats of PPG 90-474 Pitt-Tech DTM Acrylic Satin Enamel
- G. Paint MaE-OP-3A - ALUMINUM and COPPER, Unprimed, 3 coats
 - 1. One coat of PPG 97-687 Polyclutch Wash Primer
 - 2. Two coats of PPG 90-474 Pitt-Tech DTM Acrylic Satin Enamel
- H. Paint E-PAV - PAVEMENT MARKING PAINT
 - 1. Two coats of Richards 3007 Lead Free Yellow Latex Traffic Coating

2.04 PAINT SYSTEMS - INTERIOR:

- A. Paint WI-OP-3A - WOOD, Opaque, 3 coats
 - 1. One coat of PPG 17-956 Seal Grip Interior Alkyd Wood Primer/Under coater
- B. Paint WI-OP-3L - WOOD, Opaque, 3 coats
 - 1. One coat of PPG 6-2 Speedhide Interior Latex Wood Primer
 - 2. Two coats of PPG 6-500 Speedhide Interior Latex Semi-Gloss
- C. Paint WI-TR-V - WOOD, Transparent, Varnish, No Stain
 - 1. Three coats of PPG 43886 Clear Polyurethane Satin Varnish (Sand between each coat)
- D. Paint WI-TR-VS - WOOD, Transparent, Varnish and Stain
 - 1. One coat of PPG 44500 Oil Wiping Stain
 - 2. Three coats of PPG 43886 Clear Polyurethane Satin Varnish (Sand between each coat)
- E. Paint CI-OP-3L - CONCRETE / MASONRY, Opaque, 3 coats
 - 1. One coat of PPG 6-7 Speedhide Interior/Exterior Latex Block filler
 - 2. Two coats of PPG 6-500 Speedhide Interior Latex Semi-Gloss
- F. Paint MI-OP-3A - FERROUS METALS, Unprimed, 3 coats
 - 1. One coat of PPG 6-208 Speedhide Interior/Exterior Rust Inhibitive Alkyd Metal Primer
 - 2. Two coats of PPG 6-1110 Speedhide Interior Alkyd Semi-gloss Enamel
- G. Paint MI-OP-2A - FERROUS METALS, Primed, 2 coats
 - 1. Touch up if needed with PPG 6-208 Speedhide Interior/Exterior Rust Inhibitive Alkyd Metal Primer
 - 2. Two coats of PPG 6-1110 Speedhide Interior Alkyd Semi-Gloss Enamel
- H. Paint Mgl-OP-3A - GALVANIZED METALS, 3 coats
 - 1. One coat of PPG 6-209 Speedhide White Galvanized Metal Primer
 - 2. Two coats of PPG 6-1110 Speedhide Interior Alkyd Semi-Gloss Enamel
- I. Paint Mai-OP-3A - ALUMINUM, Unprimed, 3 coats
 - 1. One coat of PPG 97-687 Polyclutch Wash Primer
 - 2. Two coats of PPG 6-1110 Speedhide Interior Alkyd Semi-Gloss Enamel
- J. Paint GI-OP-3L - GYPSUM BOARD AND PLASTER, 3 coats
 - 1. One coat of PPG 6-2 Speedhide Interior Latex Primer.
 - 2. Halls and other rooms: Three coats of PPG 6-500 Speedhide Interior Latex Eggshell
 - 3. Classrooms: Two coats of PPG 6-411 Speedhide Interior Latex Eggshell

- K. Paint GI-OP-2E - GYPSUM BOARD AND PLASTER, Water Born Epoxy (Toilets, Kitchen, Drinking Fountains)
 - 1. One coat of PPG 17-921 Seal-Grip Interior/Exterior Acrylic Latex Primer/Sealer
 - 2. Two coats of PPG 16-510 Pitt-Glaze Precatalyzed WM Semi-Gloss Epoxy
- L. Existing Lockers – Wash with Peso. Sand to achieve a smooth surface free of all nicks and scratches by sanding to a featheredge.
 - 1. Two coats of PPG 95-8000 Pitt-Thane Ultra Urethane Enamel

2.05

2.06 SURFACES NOT TO BE PAINTED:

- A. Surfaces permanently concealed from view, unless noted to receive finish.
- B. Materials or equipment with a complete factory applied finish unless otherwise noted.
- C. Finish hardware unless specifically noted otherwise or previously painted.
- D. Non-ferrous metals unless specifically noted otherwise or previously painted.
- E. Plumbing fixtures.
- F. Lighting Fixtures.

2.07 ACCESSORY MATERIALS

- A. Accessory Materials: Linseed oil, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- B. Patching Material: Latex filler – Gyp Board and Block
 - 1. Plaster Walls
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 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.

- D. Notify Architect of any incompatibilities of specified finish on substrates, including existing finishes.
- E. Contractor shall measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.

3.02 PREPARATION

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- F. Gypsum Board Surfaces to be Painted: Clean thoroughly all wallboard surfaces to be painted. Sand smooth all rough surfaces. Fill minor defects with filler compound. Spot prime defects after repair.
- G. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- K. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes

and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

- L. Interior Wood Items to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- M. Exterior Wood to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- N. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied. Prime concealed surfaces.
- O. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- P. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
- Q. Plaster Walls:

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Apply finishes at manufacturer's recommended spreading rate to provide total dry film of not less than 5 mils.
- C. Apply material without reduction except as specifically required by label direction; reduction shall be the minimum permitted.
- D. Provide uniform color and finish; the number of coats specified being a minimum, provide any additional coats to produce work satisfactory to TPS.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Apply each coat to uniform appearance.
- G. Sand wood surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. Fire hose cabinets, air registers and grilles, flanges around ceiling fixtures, exposed electrical panel boards, primed hardware, etc., shall be painted to match adjacent surfaces unless factory finished such as aluminum registers and grilles.

- K. Where paint finish is specified on CMU, take special care to assure that every pore or irregularity of CMU texture is solidly and uniformly filled with block filler, adding extra coats to coarse textured units as necessary to provide a finish acceptable to TPS. Apply textured coating to uniform finish.
- L. Where Epoxy finish is specified on CMU, take special care to assure that every pore or irregularity of CMU texture is solidly and uniformly filled with block filler, adding extra coats to coarse textured units as necessary to provide an easily washable finish acceptable to TPS and local Health Department.
- M. Apply material without reduction except as specifically required by label direction; reduction shall be the minimum permitted.

3.04 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Paint shop-primed equipment, unless indicated otherwise.
- B. Paint rooftop equipment furnished with or without factory finish only as indicated on the drawings.
- C. Paint piping, equipment, conduits, vents, etc., on roof as indicated on the drawings. Identification labels will be provided by Mechanical Contractor.
- D. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.05 CLEANING

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. On completion of work, carefully clean all glass, hardware, factory finished surfaces, etc., and remove all misplaced paint and stain spots or spills and leave in a condition acceptable to TPS.
- C. Provide trash dumpster on site for debris collection as contractor may not use TPS dumpster.

TECHNICAL INFORMATION

General Requirements:

1. Owner shall provide the contractor with one location at each site to store supplies.
2. Contractor shall remove debris from the site daily. School shall be ready to be used each and every day that school is in session. Contractor shall clear all paint supplies from the classrooms.
3. **Minimum Preparations** are listed below for pricing unit cost items:
 - a. Doors varnished – wash, sand and apply two coats of polyurethane with staining agent.
 - b. Doors painted – wash, sand and apply one coat of rust inhibitive primer and two coats of alkyd enamel. New Doors to receive one coat of XIM primer and two coats of alkyd enamel.

- c. Single or double jambs – wash, sand and apply one coat of rust inhibitive primer and two coats of alkyd enamel.
- d. Single doorjamb and transom – wash, sand and apply one coat of rust inhibitive primer and apply two coats of alkyd enamel
- e. Single doorjamb, transom, and sidelight – wash, sand, and apply one coat of rust inhibitive primer and apply two coats of alkyd enamel
- f. Single doorjamb, transom and double sidelights – wash, sand, and apply one coat of rust inhibitive primer and apply two coats of alkyd enamel
- g. Painted base, moldings and chair rail – wash, sand and apply two coats of alkyd enamel
- h. Wall-mounted handrail – varnish or alkyd enamel as required
- i. Radiators – clean and spray with alkyd enamel
- j. Freestanding spindled handrail (stairwell, etc.) –
- k. Toilet Partitions – same procedure and finish as lockers
 - l. Accent Stripe – Acrylic latex
- m. Open bookcases, varnished (repaint) – same procedure and finish as doors
- n. Open bookcases, varnished (new) – same procedure and finish as doors
- o. Open wood bookcases, epoxy – wash, sand and apply one coat of XIM and one coat of water-borne epoxy
- p. Cabinets with doors, (all ext. & int. of doors only) – one coat of XIM Product and one coat of water-borne epoxy
- q. Cabinets with doors, epoxy (ext. & int. of doors only) – wash, sand and prime with XIM Product and apply one coat of water-borne epoxy
- r. Gyp walls, latex – using two coats of acrylic semi-gloss. New walls shall be primed and receive 3 coats of semi-gloss.
- s. Gyp walls, epoxy – All restrooms. One coat of P. V. A. Prime and one coat of water-borne epoxy
- t. Block walls, latex – two coats of acrylic latex semi-gloss.
- u. Existing block walls, epoxy – solvent base, apply one coat of P. P. G. grip and seal, and one coat of water-borne epoxy
- v. Lockers, face side only – wash exterior surfaces and remove paint from numbered plates; power sand to feather edge, chipped paints, and scratches; apply one coat of primer using P. P. G. Multi-prime #97-680; apply one finish coat of P. P. G. Pitthane #95-8600 and two coats of alkyd enamel; mask and protect all numbering plates and protection plates on lockers.
- w. Acoustical lay-in ceilings and grid – apply one coat of P. P. G. Grip & Seal
- x. Existing metal cabinets – apply same finish as lockers
- y. HVAC and Uni-vent Units and Grilles – Paint using same procedure as for lockers.
- z. Exterior Waterproofing: Brick, Stucco, Block- Use Siloxane by Coronado Paint. Do not apply in temperatures above 90 Degrees. Apply per manufacturers recommendations.
- aa. Polymix: Prepare wall and apply paint per Manufacturer recommendations
- bb. Glazed Tile Epoxy:
 - 1. Power sand to dull glazed tile. 2. Prime tile using XIM,
 - 3. Apply tow coats of P. P. G. Polyurethane epoxy gloss #95-1 series
- cc. Glazed Tile Multi-Color:
 - 1. Power sand to dull surfaces, 2. Apply one coat of XIM, 3. Prime with acrylic latex to match background of multi-color, 4. Apply multi-color such as Poly-mix or equal per manufacturer’s specifications, 5. Apply one coat of Non-ambering polyurethane

- dd. Sealant: Polyurethane sealant Vulkem 116 or equal. Do not apply to damp or contaminated surfaces. Clean all smears with Xylol or Toluol before sealant cures. Color: Match the adjacent material. Bronze, Buff or Almond. Owner to approve color.
- ee. Poured quartz floor: Manufacturer Benjamin Moore or equal. Prepare floor and apply per manufacturers directions. Color to be determined by Owner.
- ff. Painted Urethane Floor: Manufacturer: Benjamin Moore or equal. Prepare floor and apply paint per manufacturers recommendations.

END OF SECTION

SECTION 12492

MANUAL ROLLER SHADES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Manual roller shades

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM E 21 - Standard Test Method for Elevated Temperature Tension Tests of Metallic Materials.
 - 2. ASTM E 22 - Recommended Practice for Conducting Long Time High Temperature Tension Test of Metallic Materials.
 - 3. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - 4. ASTM G 22 - Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.
- C. Underwriters Laboratories Inc. (UL).

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Latest edition of Manufacturer's literature including:
 - 1. Performance data and installation procedures meeting the requirements herein. Including installation details, styles, material descriptions, profiles, features, finishes and operating instructions.
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Mounting details and Installation methods.
- C. Maintenance Data: Submit instructions and precautions for cleaning and maintenance, operating hardware and controls as applicable.
- D. Manufacturer's Material Safety Data Sheet (MSDS) for each product being used.
- E. Submit working hand sample or mock up shade (mock up shade may be used as a final shade if approved).
- F. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, product details and finishes, installation details, operational clearances, wiring diagrams if applicable, and relationship to adjacent work.
- G. Window Treatment Schedule: Submit a schedule with same room designations indicated on the Drawings; including but not limited to opening sizes and key to typical mounting details.
- H. Samples:
 - 1. Submit two 4" x 6" samples of shade fabric material indicating color.

2. Submit two 4" x 6" samples of the fascia material indicating color.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Engaged in manufacturing of products of similar type to that specified, with a minimum of 10 years successful experience.
- B. Installer Qualifications: Minimum 2 years successful experience installing similar products.
- C. Single Source Requirements: To the greatest extent possible, provide products specified in this section from a single manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Product to be delivered in manufacturer's original packaging.
- B. Products to be handled and stored to prevent damage to materials, finishes and operating mechanisms. Store in a clean, dry area, laid flat to prevent sagging and twisting of packaging.

1.06 PROJECT CONDITIONS, COORDINATION AND SEQUENCING

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
 1. Building shall be enclosed; windows, frames and sills shall be installed and glazed.
 2. Wet work shall be complete and dry.
 3. Ceilings, window pockets, electrical and mechanical work above window covering shall be complete.

1.07 WARRANTY

- A. Minimum 5 year.

PART 2 - PRODUCTS

2.01 Manufacture and Product Description

- A. InPro
 1. Clickeze
 2. Arid solar screen fabric
 3. Fabric Color: Charcoal/Sable
- B. Springs Window Fashions (SWF) Contract
 1. Shading Systems
 2. Double-Take T300
 3. Fabric Color: Grey/Bronze
- C. Substitution Request: Not permitted

2.02 Manual Roller Shades

- A. Product: manual roller shade
 1. **Shade fabric** shall be flame retardant, fade and stain resistant, anti-static, anti-microbial.
 - a. Passes NFPA 701-1999 FR

- b. Passes ASTM-G21 and G22
- c. Shades with railroaded fabric will have heat-welded seams.
- d. Fabric Style: 3% Openness
- e. Shading Coefficient with single 1/4" clear glass: 0.65-0.68
- f. All shades within a room shall be from the same dye lot

2. **Roller tube** shall be extruded aluminum engineered with a channel to accept fabric spline. The tube size will be determined by the manufacturer based on window size and fabric selection.

3. **Clutch** system shall be made of glass-reinforced, polyester thermopolymer (PBT) for wear resistance, smooth operation and corrosion resistance. The clutch is comprised of multi-banded, steel springs that lock the shade in any position when operating the control loop. The clutch mechanism is bi-directional and never requires adjustment or lubrication.

4. **Control loop** shall be a #10 stainless steel bead chain. Bead stops attached to the chain protect the shade from over rotation. Bead stop shall be placed so that no more than the hembar shows below fascia when shade is fully rolled up.

- a. Length of chain shall be from mechanism to 48-inches above finished floor.

5. **Idler** end shall be made of high strength, glass-reinforced, polyester thermopolymer (PBT) for wear resistance, smooth operation and corrosion resistance.

6. **Lift assist system** shall be a heavy-duty torsion spring located inside the roller tube. The mechanism reduces the pull force allowing easy lifting of larger shades.

7. **Spline system** shall consist of a PVC spline heat-welded to the shade fabric and inserted into a channel on the roller tube. The spline system allows for adjustability on-site and ease in changing fabric panels in the field.

8. **Hem bar** shall be an aluminum extrusion enclosed in a fabric hem pocket with heat-welded seams and ends. Optional fabric wrapped hem bar.

9. **Battens** shall be enclosed in a heat-welded pocket providing additional stabilizing on large shades. Batten placement will be determined by the manufacturer based on window size and fabric selection.

10. **Installation brackets** shall be .125" thick steel and can accommodate overhead, side and face mounting. Optional dual shade brackets shall hold two shades in one bracket assembly. Coupled shades shall be connected with a linking bracket mechanism.

11. **Mounting:**

- a. Typically outside mounted.
- b. Measure so a run of fascias are butting next to each other with no gaps and out to wall on ends.
- c. Control loop shall typically be on the right side of the window unless access does not meet accessibility codes. Do not order without confirming with a site visit once millwork has been finalized.

2.03 ACCESSORIES

- A. **Fascia panel** shall be 4.25" or 7.625" dual shade snap-on design and made of .062" thick extruded 6063 T-5 aluminum alloy

1. Finish: either a powder-coated finish to match window mullion that is bronze or a clear anodized finish for window mullions of a color other than bronze, see drawings for specific colors.
 2. Brackets shall be universal and shall be clear anodized finish.
- B. **End Caps.** Same finish as fascia shall be placed at all fascia's; even fascias that are close; no exposed ends.
- C. **Locking Chain Guide.** User to identify each location per window due to odd situations.

2.04 FABRICATION

- A. Fabricate shades to hang flat without buckling or distortion.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Installer shall be responsible for inspection of jobsite, approval of mounting surfaces, blocking for shade brackets or pocket assemblies, suspended acoustical or gypsum ceiling for recessed shades, verification of field measurements and installation conditions. Installation shall commence when satisfactory conditions are met.
- B. Do not proceed with installation until substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.02 INSTALLATION

- A. Install window treatments in accordance with manufacturer's instructions including the following.
1. Install with adequate clearance to permit smooth operation of the shades throughout entire operational range.
 2. Adjust and balance window coverings to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.03 CLEANING AND PROTECTION

- A. Clean surfaces after installation in accordance with manufacturer's written instructions. Do not use cleaning methods involving heat, bleach, abrasives, or solvents.
- B. Protect installed products until completion of project. Repair damaged or improperly installed before Substantial Completion.

END OF SECTION

SECTION 15730
UNITARY AIR CONDITIONING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Split System Gas Furnaces and Air Conditioners

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
1. ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems.
 2. ANSI/ASHRAE/IESNA 90.1 Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 3. ANSI Z21.47 Gas-Fired Central Furnaces.
- B. Air-Conditioning and Refrigeration Institute (ARI):
1. ARI 270 Sound Rating of Outdoor Unitary Equipment.
 2. Units certified by CSA International and ratings are certified by GAMA.
- C. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE):
1. ASHRAE 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI approved).
 2. ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality.
- D. Underwriters Laboratories, Inc. (UL):
1. UL 1995 Standard for Safety for Heating and Cooling Equipment.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements: Provide products and systems that have been manufactured, fabricated and installed to following criteria:
1. ANSI/ASHRAE/IESNA 90.1.
 2. ANSI Z21.47.
 3. UL 1995.
- B. Performance Requirements:
1. Packaged Gas Electric:
 - a. Natural Gas Supply Pressure: 7 in. w.c. (1.7 kPa).

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract.
- B. Product Data: Submit product data for specified products.
- C. Shop Drawings:
1. Submit shop drawings in accordance with Section 15000 - Submittal Procedures.
 2. Indicate:
 - a. Equipment, piping and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
 - b. Piping, valves and fittings shipped loose showing final location in assembly.

- c. Control equipment shipped loose, showing final location in assembly.
- d. Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.
- e. Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.
- f. Details of vibration isolation.
- g. Estimate of sound levels to be expected across individual octave bands in dB.
- h. Type of refrigerant used.

D. Quality Assurance:

- 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
- 2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- 3. Manufacturer's Instructions: Manufacturer's installation instructions.

1.05 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
- C. Warranty: Commencing on Date of "substantial completion",
 - 1. Compressors: 5 years (limited).
 - 2. Other System Components: 1 year (limited).
 - 3. Aluminized Heat Exchangers: 20 years (limited).
 - 4. Stainless Steel Heat Exchangers: 20 years (limited).

PART 2 PRODUCTS

2.01 GAS FURNACES

- A. Manufacturer: Lennox Industries. (NO SUBSTITUTIONS)
- 2. System:
 - a. Flanges on supply air opening for easier alignment of evaporator coil.
 - b. Units shall be capable of both direct vent and non direct vent applications.
 - c. Units shall operate at a maximum 56 dBA sound level on high fire cycle.
 - d. Furnace shall be variable speed.
 - e. Furnaces shall be 94% A.F.U.E. or higher.
 - f. Furnace shall have ultra low blower speed for low volume continuous ventilation.
 - g. Furnaces are to be Multi Position without any field modification or additional kits.
 - h. Timed off Delay.
 - i. Power Entry: Electrical [And gas] connections on left or right side of furnace.
 - j. Cabinet: Heavy gauge, cold rolled steel construction. Pre-painted cabinet-finish.
 - k. Insulation: Fully insulated cabinet with foil faced insulation on sides and back of heating compartment and mat faced insulation in the blower compartment.

- l. Access Panels: Tool-less latches on blower and burner doors. Spring tensioner and door isolators to eliminate vibration noises during operation.
 - m. Manufacturer to provide addressable duct mounted "Firelite" #D350RP smoked detector for all systems 2000cfm and larger.
 - n. Flue condensate piping to be run in schedule 40 PVC.
4. Evaporator Coils: Pressure and leak tested to 500 psi (3445 kPa). nonferrous coils with enhanced aluminum fins mechanically bonded to durable copper tubes. Expansion valves shall be factory installed on upflow applications and field installed on other orientations.
5. Gas Heating System:
- a. Primary Aluminized heat exchanger and secondary stainless steel heat exchanger.
 - b. In-shot type gas burners constructed of aluminized steel.
 - c. Surelight Hot Surface Igniter: Tungsten heater element sandwiched between two plates of silicon nitride.
 - d. Electronic flame sensor controls: flame rollout switch; limit controls and two stage gas valve with staging control and combustion air proving switch on combustion air inducer.
 - e. Able to use LPG/propane [With optional kit].
 - f. Complete service access provided for controls and wiring.
6. Supply Air Blower:
- a. Variable Speed Direct Drive Blower- Variable Speed motor maintains specified air volume from 0 through .8 in. w.g. static range.
 - b. Blower wheel statically and dynamically balanced.
 - c. Variable Speed Controller will be a separate component from variable speed motor.
7. Surelight Ignition Control:
- a. Solid state control board to operate unit.
 - b. Adaptive technology of ignition control board continuously monitors and adjusts the igniter power to operate at minimum temperature required for ignition, prolonging igniter life.
 - c. Watch-guard type circuit automatically resets ignition controls after one hour of continuous thermostat demand after lockout, eliminating nuisance calls for service.
 - d. Two LED lights for troubleshooting.
 - e. Control interfaces variable speed motor with thermostat and optional CCB I humidity control.
8. Gas Heating Controls:
- a. Remote thermostat[s] as indicated on drawings. (Honeywell model TH220D, with metal locking cover.)
 - b. Two stages of heating control from room sensor.
 - c. To turn off heat and keep supply air fan running if overheat limit occurs.
 - d. To shut off gas heat if flame rollout occurs.
 - e. To turn off heat if induced airflow is too low.

- f. To shut off gas valve if flame not sensed.
- g. To shut off unit if gas valve is energized with no demand for heat.

AIR CONITIONER UNITS

- 9. Condenser Coils:
 - a. Pressure and leak tested to 500 psi (3445 kPa), nonferrous coils with enhanced aluminum fins mechanically bonded to durable copper tubes.
- 10. Cabinet: Heavy usage steel cabinet with five station metal wash process. Powder paint finish for superior rust and corrosion protections. Drainage holes provided in base section for moisture removal.
- 11. Condenser Fan Motor: Permanently lubricated, permanent split capacitor; totally enclosed from weather, dust and corrosion; resiliently mounted; overload protected.
 - a. Capable of operating down to 45 degrees F without installation of additional controls. Low ambient kits to allow operation to 30 degrees.
- 12. Refrigeration System:
 - a. Self-sealing, discharge, suction and liquid line service gauge ports, expansion valves and crankcase heater, all field installed.
 - b. Copper tubing not to touch sharp metal surfaces.
 - c. Low Pressure switch (field installed). See plans for project requirement.

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 120 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.

B. TAB Conference: Meet with Owner on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

- a. The Contract Documents examination report.
- b. The TAB plan.
- c. Coordination and cooperation of trades and subcontractors.
- d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Owner.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 15 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 15 Section "Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 15 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

- a. Report the cleanliness status of filters and the time static pressures are measured.
4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 15 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 TOLERANCES

- A. Set HVAC system's air flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.

3.9 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.10 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Engineer's name and address.
 6. Contractor's name and address.
 7. Report date.
 8. Signature of TAB supervisor who certifies the report.
 9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 10. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Notes to explain why certain final data in the body of reports vary from indicated values.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches , and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches .
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches , and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches .
 3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm .
- b. Total system static pressure in inches wg .
- c. Fan rpm.
- d. Discharge static pressure in inches wg .
- e. Filter static-pressure differential in inches wg .
- f. Cooling-coil static-pressure differential in inches wg.
- g. Heating-coil static-pressure differential in inches wg.
- h. Outdoor airflow in cfm .
- i. Return airflow in cfm .
- j. Outdoor-air damper position.
- k. Return-air damper position.
- l. Vortex damper position.

E. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

- 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 15950

SECTION 230000

MECHANICAL SPECIAL CONDITIONS

PART 1 GENERAL

1.01 CODES AND STANDARDS:

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations. In no case shall work or materials inferior to these specifications be accepted even if permitted by code.
- B. In cases of differences between codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the contract documents, the most stringent shall govern.
- C. Non-compliance: Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, and utility company regulations he shall bear all costs arising in correcting the deficiencies.
- D. Engineering work shall be completed by a degreed person holding a Bachelor of Science in Mechanical Engineering, licensed in the State of Oklahoma as a Professional Engineer and in direct control of work performed in their office by qualified design staff.

1.02 INSTALLATION AND ARRANGEMENT:

- A. The contractor shall install all mechanical work to permit removal (without damage to other parts) of all mechanical and electrical parts requiring periodic replacement or maintenance. The contractor shall arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, filters, starters, motors, control components and to clear the opening of swinging and overhead doors and access panels.
- B. Excavation and backfill:
- C. Trench excavation: Trenches shall be of necessary width for the proper laying of the pipe, and the banks shall be as nearly vertical as practical. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum over-depth of 4 inches. Over-depths in rock excavation and unauthorized over-depths shall be back-filled with washed river sand, thoroughly tamped. Whenever unstable soil, as determined by the owner, is encountered in the trench bottoms, soil shall be removed to the depth required and the trench back-filled to the proper grade with coarse sand, fine gravel or other suitable material, as hereinafter specified.
 - 1. Depth of cover: Trenches shall be provided for the following minimum depths of cover from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown:
 - a) Two feet minimum cover: Gas
 - 2. Protection of existing utilities: Existing utility lines to be retained but uncovered during excavation operations, shall be protected from damage during excavation and back-filling and if damaged, be repaired by the contractor at his expense.

3. Back-fill: Trenches shall not be back-filled until all required tests and inspections have been performed and until the systems conform to the drawings and specifications.
 - a) Normal back-fill: Where compacted back-fill is not specified, trenches shall be carefully back-filled to a depth of 6 inches over top of pipe with crusher run, then with the excavated materials approved for back-filling consisting of earth, loam, sandy clay, sand and gravel, soft shale or other materials, free from large clods of earth or stones over 2 1/2 inch maximum dimensions, deposited in 6 inch layers and thoroughly and carefully rammed until the pipe has a cover of not less than 1 foot layers and tamped. Settling the back-fill with water will be permitted, and will be a requirement when directed by the owner. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition as approved by the owner.
 - b) Crusher Run back-fill: Shall be used for full depth of excavation under slabs on grade, building structure, concrete paving and asphaltic concrete paving.
 - c) Test for displacement if sewers: Storm and sanitary sewer mains will be checked by the owner to determine whether any displacement of the pipe has occurred after the trench has been back-filled to 2 feet or more above the pipe. A light will be flashed between manhole locations. If the illuminated interior of the pipelines shows poor alignment, displaced pipe or other defects, such defects shall be remedied by the contractor.

1.03 SUBMITTALS:

- A. The contractor shall submit to the owner for review conformance and compliance with the specifications and the contract drawings, information covering the material and equipment that he proposes to furnish. Such submittals shall indicate where the proposed equipment or material will be installed, and shall include sufficient manufacturer's information to determine that the material is in accordance with the specifications. Any material or equipment that is not in accordance with the specification requirements may be rejected. A minimum of two (2) copies of the submittals are required and shall be bound in two (2) 3-ring binders complete with index and tabs for each item. Partial submittals will not be accepted.
- B. Submittals will be required on the following materials.
 1. Pipe and Pipe fittings
 2. Identification of Pipe
 3. Supports, Anchors and Seals
 4. Valves, Cocks and Faucets
 5. Vibration Isolation
 6. Piping and Equipment insulation
 7. Duct Insulation
 8. Plumbing systems
 9. Air Distribution Equipment (Fans)
 10. Ductwork
 11. Duct Accessories
 12. Air Outlets
 13. Air Treatment Equipment (filters) at Roof-top and AHU Units
 14. Roof-Top Units and Thermostats.
- C. Shop Drawings and submittals information shall be clearly indexed and marked to indicate the proposed items of equipment, as well as to indicate under which paragraph of the specifications each item of the equipment is described.

- D. Submittals that list only the specified capacities of equipment instead of the actual proposed capacities will not be acceptable except when, by coincidence, the proposed values are identical to those specified. The contractor will be required to indicate in the submittal information the actual operating characteristics of the proposed equipment at the specified design conditions.

1.04 DRAWINGS BY CONTRACTOR:

- A. Record Drawings- The contractor shall furnish to the owner CAD record drawings consisting of three (3) sets of 11" x 17" prints (To be bound in O&M Manuals), one (1) full size set of prints and one (1) disk, showing the piping and ductwork for the HVAC and plumbing systems. Piping sizes, rerouting, etc., for both under floor and above ceiling piping shall be shown. In addition to these drawings, a complete set of approved ductwork shop drawings and temperature control shop drawings shall be included in this set of drawings.
 - 1. CAD Record drawings shall incorporate all change and field orders. (No separate or supplemental drawings).
 - 2. All equipment schedules to be revised to reflect installed manufacturer model numbers and capabilities.

1.05 EQUIPMENT AND MATERIALS:

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. The equipment to be furnished under each section of the specifications shall be essentially the standard product of a United States of America manufacturer, manufactured in the U.S. A., regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest and approved design.
- B. Delivery and storage: Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection until installed. All items subject to moisture damage (such as controls, motors and electrical equipment) shall be stored in dry, heated spaces.
- C. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
- D. Protection: Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work fixtures, equipment and materials shall be cleaned and polished thoroughly. Damage or defects developing before acceptance of the work shall be made good at the contractors' expense.

1.06 IDENTIFICATION FOR MECHANICAL EQUIPMENT:

- A. Identification for mechanical equipment shall be provided and furnished under mechanical section, using item numbers and nomenclature as shown on the mechanical drawings, or as per owner's direction.
- B. Roof top air conditioning units, fans, etc., furnished by the contractor shall be identified. Nameplates shall conform to MIL-P-15024 Phenolic. Nameplates shall be red with white background and shall have 1 1/2 " letters. If the equipment, identified, is too small to accept this size nameplate, as determined by the owner, the size of the lettering may be reduced to 1/2" size. Plates shall be adhesive backed or be riveted to equipment.

- C. Items to be identified and nomenclature used shall be submitted to the owner for approval.

PART 2 MATERIALS

2.01 FIRE STOP-PENETRATION SEALANT:

- A. All penetrations through fire rated floors and walls shall be sealed with "Flameseal" as manufactured by Nelson Electric or equal product, to prevent the passage of smoke, fire, toxic gas or water through the penetration either before, during, or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. (Equal products by 3-M Products, DOW Corning Corp., or approved equal).
- B. No flammable material may be used to line the chase or hole in which the fire stop material is to be installed.
- C. Damming materials shall be left in place after the seal is complete. All such materials shall be non-flammable.
- D. The sealant shall be placed into the hole after each duct or pipe has been spread apart to allow approximately 1/2" of material to be placed to fill all voids around and between them. No duct or pipes may be touching each other and thereby allow voids to form in the fire stop.
- E. The sealant shall remain resilient and pliable to allow for the removal and/or addition of duct or pipe without the necessity of drilling holes. It shall adhere to itself perfectly to allow nay and all repairs to be made with the same material. It shall allow for vibration, expansion and/or contraction of anything passing through the penetration without affecting the seal, or cracking crumbling or spalling.
- F. The sealant products shall have been subjected to fire exposure in accordance with standard time-temperature curve in the Standard, UL 263, ASTM E119, and NFPA 251. The fire-stop products shall have also been subjected to the hose stream test in accordance with UL 10B. The sealant shall be UL classified as a Fill, Void or Cavity Material for use in Wall or Floor Openings.
- G. All materials shall be installed per manufacturer's installation instructions.

PART 3 EXECUTION

3.01 AIR SYSTEMS, AIR DISTRIBUTION TEST AND BALANCE:

- A. The contractor shall balance, adjust and test air moving equipment and air distribution and/or exhaust systems as herein specified. All instruments used shall be accurately calibrated and maintained in good working order. If requested, the tests shall be conducted in the presence of the owner responsible for the project and./or his representative. Provide test and balance reports in operating and maintenance manuals. Provide list of filter sizes and quantities for each piece of equipment requiring filters.
- B. Air balance and testing shall not begin until system has been completed and is in full working order. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.

- C. Test and Balance to be performed by N.E.B.B Certified Contractor and reports submitted to owner (Include in O&M Manual).

3.02 INSTRUCTION TO OWNER:

- A. The contractor shall instruct the operating personnel of the owner in the proper operation and maintenance of all elements of the mechanical system. A competent representative of the contractor shall provide instructions as required to fully prepare the owner to operate and maintain the mechanical systems.

3.03 OPERATING AND MAINTENANCE MANUALS:

- A. Spare parts lists, operating instructions, manufacturer's recommended preventative maintenance instructions and specification sheets for each item of the mechanical equipment shall be submitted, in triplicate, by the contractor at the pay application for 75% completion. All payment requests over 75% will be denied until this information is received. Provide three (3) copies in 3-ring binders. Manuals to be three-ring binders with project name, contractors name, index and shall include all approved shop drawings. Provide manufacturer's installation and start-up instructions. Provide written step by step instructions for owner-start-up of systems. Manuals shall include list of HVAC equipment requiring filters. List to show each equipment filter quantities and sizes. Include all City of Tulsa, final inspections.
- B. Each manual to include copies of "City of Tulsa" Electrical and Mechanical "Final Inspections." List of air filter sizes and quantities for each piece of equipment. Provide 11" x 17" building "Record Drawings", in each manual. Manuals shall include list of HVAC equipment requiring filters. List to show equipment filter quantities and sizes. Include all City of Tulsa, final inspections.
- C. Manuals shall include contractors name, address, and phone number. Manuals to be indexed and include electrical, plumbing, HVAC, and Fire Alarms Record Drawings and data.

END OF SECTION

SECTION 230060

PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Natural gas system piping

1.02 RELATED WORK:

- A. Section 230090: Supports, Anchors and Seals
- B. Section 230210: Vibration Isolation

1.03 QUALITY ASSURANCE:

- A. Welding materials and labor to conform to ASME Code and applicable state Labor Regulations
- B. Use welders fully qualified and licensed by the state authorities
- C. Gas Piping: International, NFPA and Local Code for natural gas burning appliances and equipment

PART 2 PRODUCTS

2.01 PIPE:

<u>Service</u>	<u>Material</u>
Natural Gas (buried)	Polyethylene (orange) SDR 11.
Natural Gas (unburied)	Steel Schedule 40, black.

2.02 FITTINGS:

<u>Service</u>	<u>Material</u>	<u>Joint</u>
Natural Gas, low pressure exposed in equipment room	Malleable iron Class 150 banded, air tested for pipe sizes 2" & smaller	Threaded
	Steel same thickness as pipe for size 2 1/2" & larger	Welded
Natural Gas, low pressure concealed in ceilings, chases, walls & all medium pressure, exposed or concealed	Forged steel socket weld, class 2000 sizes 1 1/2" & smaller	Welded (socket)
	Steel same thickness as pipe for sizes 2" & larger	Welded
Natural Gas, buried, outside building	Polyethylene (orange)	Heat Fusion

Use factory fabricated butt weld fittings for welded steel pipes.

2.03 UNIONS AND COUPLINGS:

- A. Size 2 1/2" and under: Class 150 malleable iron, bronze to iron ground joint unions for threaded ferrous piping air tested for gas service, all bronze for copper piping.
- B. Size 3" and over: 150psi forged steel slip-on flanges for ferrous piping, 150psi bronze flanges for copper piping. Gaskets: 1/16" thick performed synthetic rubber-bonded asbestos.
- C. Use grooved mechanical couplings to engage and lock grooved or shouldered pipe ends and to allow for some angular deflection, contraction and expansion. Couplings consist of malleable iron housing clamps, C-shaped composition sealing gaskets and steel bolts. Use galvanized couplings for galvanized pipe.

2.04 EQUIPMENT AND VALVE IDENTIFICATION:

- A. General: Make it possible for the personnel operating and maintaining the equipment and systems to readily identify the various pieces of equipment, valves, etc., by marking them. For piping identification refer to Section 15061.
- B. Bakelite Plates: Clearly mark all equipment. Refer to Section 15000, Para. 1.10.
- C. Valve Charts and Tags:
 - 1. Each valve shall have affixed to it a valve tag, 1/8" thick brass, 1 1/2" diameter, attached with copper-clad steel wire or other approved material. Machine engrave or stamp on each tag an identifying number or combination number and letter.
 - 2. Mount, framed under glass, a typed valve schedule listing all valve numbers, locations and the service of the valve. Submit copy of valve chart to owner for approval.

PART 3 EXECUTION

3.01 PREPARATION:

- A. Ream pipes and tubes. Clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

3.02 CONNECTION:

- A. Screw joint steel piping up to and including 2 1/2". Weld piping 3" and larger, including branch connections.
- B. Make screwed joints with full cut standard taper pipe threads with code-approved, lead-free, non-toxic joint compound.
- C. Use main-sized saddle type branch connections for directly connecting branch lines in steel piping if main is at least one pipe size larger than the branch for up to 6" mains and if main is at least two pipe sizes larger than branch for 8" and larger mains.

- D. Provide non-conducting type connections wherever joining dissimilar metals in open systems. Brass adapters and valves are acceptable.

3.03 INSTALLATION, ROUTE AND GRADES:

- A. Provide and install 12-gauge (minimum) copper trace wire for all buried plastic pipe and plastic pipe sleeves.
- B. Provide continuous plastic ribbon marker labeled 'Gas Line' one foot directly above all buried gas piping.

3.04 TESTING:

- A. Test gas piping at 20psig for six (6) hours for medium or high-pressure gas and minimum of 10psig for six (6) hours for low-pressure gas (less than 16 oz.). Coordinate with ONG for “Zero” leak testing procedures prior to placing gas piping system for service.
- B. In case of defects, they shall be made good to the satisfaction of the owner and the work re-tested without delay. Such work shall be done without additional charge.
- C. Give owner two days notice before tests are made. Do not draw water off pipe or cover pipes until examined by owner's representative. Acceptance of tests does not imply acceptance of piping layout or practices contrary to the plans and specifications.

END OF SECTION

SECTION 230090

SUPPORTS, ANCHORS AND SEALS

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Pipe hangers, anchors and supports
- B. Duct hangers and supports
- C. Flashing for mechanical equipment
- D. Sleeving for mechanical equipment

1.02 RELATED WORK

- A. Section 230060: Pipe and Pipe Fittings
- B. Section 2300840: Ductwork

1.03 REFERENCE STANDARDS:

- A. Pipe Supports: ANSI B31.1, Power Piping
- B. Duct Hangers: SMACNA Duct Manuals

PART 2 PRODUCTS

2.01 PIPE HANGERS, ANCHORS AND SUPPORTS:

- A. Hangers: Pipe sizes 1/2" to 1 1/2"; adjustable wrought steel ring
- B. Hangers: Pipe sizes 2" to 4" and Cold Pipe sizes 6" and over, adjustable wrought steel clevis
- C. Wall Support: Pipe sizes to 3", cast iron hook
- D. Wall Support for pipe sizes 4" and over: Welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 6" and over
- E. Design hangers to impede disengagement by movement of support pipe. Provide retainer clips where "C" clamps are installed
- F. Provide plastic-coated hangers and supports for copper piping or provide approved packing between hanger or support and piping
- G. Vertical Support: Steel riser clamps for steel pipe, copper-plated clamps for copper pipe
- H. Anchor piping as recommended by expansion joint and pipe guide manufacturer. After these anchor points are established, transmit anchor point loading forces to general contractor for coordination of appropriate building structural members to support such forces. Submit anchor design to owner with submittals for approval.

- I. Contractor shall be responsible for all temporary-piping supports that shall be required while permanent supports are being installed.
- J. Sheet metal insulation shields shall extend a minimum of 6" on each side of hanger.

2.02 HANGER RODS:

- A. Provide steel hanger rods threaded both ends or continuous threaded. Diameter of rod shall be sized for support loads of equipment installed under operating conditions.

2.03 DUCT HANGERS AND SUPPORTS:

- A. Hangers: Galvanized steel band iron
- B. Wall Supports: Galvanized steel band iron or fabricated angel bracket
- C. Vertical Support at Floor: Rolled angle

2.04 FLASHING:

- A. Steel Flashing: 26 gauge galvanized steel
- B. General Flashing: Provide sheet neoprene for waterproofing of floor drains
- C. Caps: Steel. 22 gauge minimum, 16 gauge at fire resistance structure

2.05 SLEEVES:

- A. Pipes through Floors: Form with 18 gauge galvanized steel
- B. Pipes through Beams, Walls, Fire Proofing, Footings, and Potentially Wet Floor: Form with steel pipe or 18 gauge galvanized steel.
- C. Round Ducts: Form with galvanized steel
- D. Size large enough to allow for movement due to expansion and to provide for continuous insulation

PART 3 EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

- A. Support horizontal steel and copper piping as follows:

Nominal Pipe Size (In.)	Maximum Distance Between Support (Ft.)	Hanger Rod Diameter (In.)
1/2" to 1"	6 ft.	3/8"
1 1/2" to 2"	9 ft. *	3/8"
2 1/2" to 3"	10 ft *	1/2"
4"	12 ft. *	5/8"

MAXIMUM 8FT SPACING ON ALL PIPING ON ROOF

B. Support horizontal PVC or CPVC piping as follows:

Nominal Pipe Size (in.)	Maximum Distance Between Support (ft.) Sch. 40	Hanger Rod Sch. 80	Diameter (in.)
1/2" to 1 1/4"	3	4	3/8"
1 1/2" to 2"	4	5	3/8"
3" to 4"	5	7	1/2"

- C. Install hangers to provide minimum 1/2" clear space between finished covering and adjacent work. Where structure is protected with gypboard, seal around each pipe hanger that penetrates fire proofing.
- D. Place a hanger within one foot of each horizontal elbow.
- E. Use hangers that are vertically adjustable 1 1/2" minimum after piping is erected.
- F. Support horizontal cast iron soil pipe near each hub, joint or fitting with 10 feet maximum spacing.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Where practical, support riser piping independently of connected horizontal
- I. Pipe supports on roof to be a manufactured polycarbonate resin similar to "Mird Industries", and appropriately sized for pipes. All pipes supports on roof to be set on 3/4" pad. Provide sized 1/4" steel plate on pad for pipe 3" diameter and larger.

3.02 LOW VELOCITY DUCT HANGERS AND SUPPORTS:

A. Rectangular Duct Hanger Minimum Sizes:

- 1. Duct 1/2 of perimeter Up to 30": 1" x 22 gauge at 8'
- 2. Duct 1/2 of perimeter 31" to 72": 1" x 20 gauge at 8' spacing
- 3. Duct 1/2 of perimeter 73" to 96": 1" x 18 gauge at 8' spacing
- 4. Duct 1/2 of perimeter Over 96": 1" X 18 gauge at 8' spacing

B. Horizontal Duct on Wall Supports Minimum Sizes:

- 1. Duct up to 18" wide: 1 1/2" x 16 gauge or 1" x 1/8" angle at 8' spacing
- 2. Duct 19" to 40" wide: 1 1/2" X 1 1/2" X 1/8" angle at 4' spacing

C. Vertical Duct on Wall Supports Minimum Sizes:

- 1. Ducts up to 24" wide: 1 1/2" x 16 gauge; 25" to 36" wide: 1" x 1" x 1/8" angle at 12'-0" spacing.
- 2. Ducts 37" to 48" wide: 1 1/4" x 1 1/4" x 1/8" angle at 12'-0" spacing.

- D. Round Duct Hanger Minimum Sizes:
 - 1. Duct up to 24" diameter: 1" x 22 gauge at 8' spacing
 - 2. Duct 25 to 36" diameter: 1" x 20 gauge at 8' spacing
 - 3. Duct 37 to 50" diameter: Two (2) 1" x 20 gauge at 8' spacing
 - 4. Duct 51 to 60" diameter: Two (2) 1" x 18 gauge at 8' spacing
- E. Support all ductwork in such a manner as to provide the minimum distance from top of ductwork to bottom of structure or fire proofing. Coordinate clearance requirements with other trades.

3.03 EQUIPMENT BASES AND SUPPORTS:

- A. Construct supports of structural steel members or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- B. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

3.04 PRIMING:

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

3.05 FLASHING:

- A. Flash and counter flash where mechanical equipment passes through weather or water proofed walls, floors and roofs.
- B. Provide vent and soil pipes projecting 12" minimum above finished roof surface with aluminum flashing and neoprene boot or neoprene flashing and boot. For pipes through outside walls, turn flange back into wall and caulk.
- C. Provide curbs for mechanical roof installations 12" high minimum. Flash and counter flash as required by roofing manufacturer to meet roof warranty requirements.

3.06 SLEEVES:

- A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- B. Extend sleeves through potentially wet floor 1" above finished floor level. Caulk sleeves full depth and provide floor pile.
- C. Where piping or ductwork passes through floor, ceiling or wall, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.
- D. Install chrome-plated escutcheons where piping passes through finished surfaces.

END OF SECTION

SECTION 230210

VIBRATION ISOLATION

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Inertia bases
- B. Vibration isolators

1.02 RELATED WORK:

- A. Section 230060: Pipe and Pipe Fittings
- B. Section 230820: Air Distribution Equipment (Fans)

1.03 REFERENCE STANDARDS:

- A. Provide and install mechanical equipment so that Average Noise Criteria Curves, as outlined in ASHRAE Guide, are not exceeded.
- B. Vibration isolation shop drawings shall show isolator locations, load on each isolator, inertia slab dimensions, and include installation instructions.

1.04 SHOP DRAWINGS:

- A. Submit shop drawings in accordance with Section 230000.

1.05 INSPECTION:

- A. Provide inspection services by vibration isolation equipment and materials manufacturer's representative for final installation and provide written report that installation is in accordance with specifications and manufacturer's recommendations.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Amber-Booth
 - 2. Vibration Eliminator Co.
 - 3. Mason
- B. Substitutions: Items of same function and performance are acceptable in conformance with Section 15000.

2.02 VIBRATION ISOLATORS:

- A. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box.

Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30-degree capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install vibration isolators for all mechanical motor-driven equipment.
- B. Provide spring hangers for all suspended motor driven equipment.
- C. Provide spring isolators for all motor driven equipment not located on slab on grade applications.
- D. Provide one inch waffle type isolation pads under all chillers. All chiller piping to have rubber bellows type pipe isolators.

END OF SECTION

SECTION 230258

DUCT INSULATION

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Duct thermal insulation
- B. Adhesives, tie wires, tapes
- C. Recovery

1.02 RELATED WORK

- A. Section 230250: Piping and Equipment Insulation

1.03 SUBMITTALS:

- A. Submit shop drawings and samples in accordance with Section 15000.
- B. Submit shop drawings which indicate complete data, a list of materials proposed for this project and indicate thickness of material for individual services.

1.04 JOB CONDITIONS:

- A. Delivery material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.
- B. Perform work at ambient and equivalent temperatures as recommended by the adhesive manufacturer.

1.05 ALTERNATIVES:

- A. Alternative insulations are subject to approval. Alternatives to provide same thermal resistance within 10%, at normal conditions as material specified.

PART 2 PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
 - 1. Owens-Corning
 - 2. Manville
 - 3. Certain-Teed
 - 4. P.P.G.

2.02 GENERAL:

- A. Adhesives and Insulation Materials: Composite fire and smoke hazard ratings maximum 25 for Flame Spread and 50 for Smoke Developed. Adhesives to be waterproof.
- B. All insulation materials shall be approved for ceiling plenum installation.

2.03 MATERIALS AND COMPONENTS:

- A. Round and Rectangular Ducts: Flexible fibrous glass insulation, "K" value at 75 degrees F. maximum 0.179 Btu/hr/sq. ft/deg F./hr. with factory applied reinforced aluminum foil vapor barrier.
- B. Kitchen Hood exhaust duct: Cover the surface of the duct and on all sides with listed materials and products and the materials are installed in accordance with the conditions of the listing and manufacturer's instructions and are acceptable to the authority having jurisdiction.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Round and Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 6" wide strips on 16" centers. Provide 16 gauge annealed tie wire tied, spiral wound or half hitched at 16" centers for securing duct insulation until adhesive sets. Butt insulation and seal joints and breaks with 2" lap of foil adhered over joint.
- B. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.

3.02 INSULATION THICKNESS SCHEDULE

Duct and Equipment	Insulation Thickness (In.)
Round and Rectangular Supply, Return, and Outside Air Ducts	2"

END OF SECTION

SECTION 230771

PACKAGED ROOF TOP HEATING/COOLING UNITS

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Packaged roof top heating/cooling unit (RTU)
- B. Roof mounting frame

1.02 RELATED WORK:

- A. Section 26000: Electrical supply and hook-up to equipment
- B. Section 23000: Utility supply and hook-up to equipment

1.03 QUALITY ASSURANCE

- A. Meet the requirements of UL and applicable codes.
- B. Test and rate cooling systems to ARI Standard 210.

1.04 SUBMITTALS:

- A. Submit shop drawings and product data in accordance with Section 15000.
- B. Submit manufacturer's installation instructions.
- C. Submit manufacturer's descriptive literature, operating instructions and maintenance and repair data.

1.05 WARRANTY:

- A. Provide 5 year unconditional part warranty on heat exchangers.
- B. Provide 5-year unconditional parts warranty on compressor units.

PART 2 PRODUCTS

2.01 MANUFACTURER:

- A. Units shall be products of a manufacturer who provides local service personnel from factory representative, franchised dealer or certified maintenance service shop.
- B. Acceptable Manufacturer's: NO SUBSTITUTION
 - 1. Lennox

2.02 TYPE:

- A. Provide roof mounted units having two (2) stage gas burner and electric refrigeration.
- B. Units shall be self-contained, packaged, factory assembled and pre-wired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filter, direct expansion cooling coil, compressor, condenser coil, fan, curbs, and or insulated curb adapters, see RTU schedule on drawings..

2.03 CONSTRUCTION:

- A. Cabinet: Steel with bonderized, baked enamel finish, hinged access doors or removable access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gauge, with access doors or removable panels, minimum 20 gauge.
- B. Insulation: Neoprene-coated glass fiber on surfaces where conditioned air is handled. Protect edges from erosion.
- C. Heat Exchangers: Stainless Steel; of welded construction.
- D. Supply Fan: Centrifugal type rubber-mounted V-belt drive, adjustable variable pitch motor pulley, or multi-speed direct drive and rubber isolated hinge mounted motor as scheduled. Complete fan assembly shall be isolated.
- E. Air Filter: 2"thick glass fiber, Farr 30/30, disposable media in metal frames arranged for easy replacement.

2.04 BURNER:

- A. Gas Burner: Induced draft type burner with adjustable combustion air supply, pressure regulator, gas valve, manual shut-off, intermittent spark ignition, flame sensing device and automatic 100% shut-off.
- B. Gas Burner Safety Controls: Energized ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
- C. High Limit Control: With fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: From bonnet temperatures and independent of burner controls. Include switch for continuous fan operation.

2.05 EVAPORATOR COIL:

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection, capillary tubes and expansion valve.

2.06 COMPRESSOR:

- A. Provide hermetic compressor, 3600-RPM maximum resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, service valves and filter drier.

- B. Timed off circuit shall limit number of compressor starts to 12 per hour.

2.07 CONDENSER:

- A. Provide copper tube aluminum fin coil assembly with sub-cooling rows.
- B. Provide direct drive axial fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.
- C. Provide refrigerant pressure switch to cycle condenser fans.
- D. Provide hail guards.

2.08 SUPPLY/RETURN CASING:

- A. Dampers: Provide manual outside air dampers for fixed outside air quantity.
- B. Gaskets: Provide tight fitting dampers with edge gaskets.

2.09 OPERATING CONTROLS:

- A. Contractor shall coordinate with Owner designated controls contractor to furnish and install low voltage, adjustable combination thermostat/CO2 sensor to control burner operation heater stages in sequence with delay between stages and cooling stages in sequence of compressor and condenser fan, and supply fan to maintain temperature setting. Owner designated controls contractor shall also install CO sensor provided by Mechanical contractor. Owner designated controls contractor shall install control board and all conductors from control board to MDF/IFD room. Electrical contractor shall install all control wiring for Owner designated controls contractor. Owner designated controls contractor shall provide all terminations at all control and HVAC equipment. Mechanical contractor shall be responsible for all system start-ups. Controls contractor shall provide lockable metal covers for all control devices located in high traffic areas.
- B. Manufacturer to provide "Addressable" duct mounted "Firelite" #D350RP smoke detector for all units 2000 CFM and larger.
- C. Integrated Economizers: (as noted on drawings)
 - 1. Integrated integral-modulating type capable of simultaneous economizer and compressor operation.
 - 2. Includes all hardware and controls to provide cooling with outdoor air.
 - 3. Equipped with low-leakage dampers not to exceed 3% leakage, at 1" wg pressure differential (variable sliding economizer).
 - 4. Capable of introducing up to 100% outdoor air in minimum and fully open positions.
 - 5. Equipped with a gravity relief sliding plate damper (variable sliding economizer). Damper shall close upon unit shutoff.
 - 6. Parallel-blade economizer shall be equipped with a barometric relief damper with up to 305 of return air (004-007) or 45% of return air (008-014) relief. The variable sliding economizer is equipped with 15% of return air relief (004-014).

7. Designed to close damper during loss of power situations with emergency power supply (variable sliding economizer) or spring return built into motor (parallel blade economizer).
 8. Variable sliding economizer is a guillotine-style damper, and the other economizer is a parallel blade design.
- D. Solid State Enthalpy Control:
1. For use with variable sliding economizer package only.
 2. Capable of sensing outdoor air enthalpy content (temperature and humidity) and controlling economizer cut-in point to have minimum heat content air passing over the evaporated coil for most efficient system operation.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Mount new units on 24" high factory built roof-mounting frame providing watertight enclosure to protect ductwork and utility services, or insulated curb adapter for exist curbs. Provide wood nailer atop curb. Provide pitched roof curbs where required.
- B. Condensate drains to be galvanized and run to roof drain and connected to trap at RTU with flexible rubber coupler and S. S. Clamps.

END OF SECTION

SECTION 230820

AIR DISTRIBUTION EQUIPMENT (FANS)

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Fan accessories
- B. In-line fans
- C. Roof Mounted Exhaust Fans

1.02 RELATED WORK:

- A. Section 230210: Vibration Isolation
- B. Section 230840: Ductwork

1.03 QUALITY ASSURANCE:

- A. Submit shop drawings in accordance with Section 230000.
- B. Submit with shop drawings, operating point plotted on curves.
- C. Submit manufacturer's printed installation instructions.

1.04 JOB CONDITIONS:

- A. Do not operate fan for any purpose, temporary or permanent until ductwork is clean, filters in place, bearings lubricated and fan has been run under observation.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Provide and install items in schedule on the drawings.
- B. Manufacturer named items are for standard of reference and do not necessarily limit supply to name manufacturer. Items of same physical size, function and performance are acceptable in conformation with Section 15000. Approved manufacturers:
 - 1. Twin City
 - 2. Cook
 - 3. Greenheck
 - 4. Penn
 - 5. Carnes
- C. Equivalent fan selections shall not decrease motor horsepower, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20% from that specified.
- D. Fan performance based on sea level conditions.
- E. Refer to Fan Schedule on the drawings.

2.02 SELECTION AND BALANCING:

- A. Provide fans capable of accommodating static pressure variations of plus or minus 10%.
- B. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas of the building.
- C. Provide totally enclosed motor, shaft belt, pulley guard on belt driven fans.
- D. Provide safety screens where inlet or outlet is exposed.

2.03 PAINTING:

- A. Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

2.04 IN-LINE CABINET FANS:

- A. In-line shall be forward curve, direct cabinet type with resiliently mounted fan and motor. Motor bearings shall be permanently lubricated type.
- B. Housing shall be steel, insulated and of one of the sides shall be hinged and shall provide access for servicing.
- C. Furnish with back draft damper on fan discharge and disconnect switch.

2.05 ROOF TOP EXHAUST FANS:

- A. Down blast fans with direct drive motors.
- B. Curb with gravity back draft damper.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Supply and install sheaves as necessary for final air balancing.
- B. Install fans per manufacturer's requirements and recommendations.
- C. Install factory roof curb per roofing manufacturer's requirements to maintain integrity of roof warranty.

FAN SCHEDULE:

- D. Refer to Schedule on drawings.

END OF SECTION

SECTION 230840

DUCTWORK

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Ductwork
- B. Fasteners
- C. Sealants
- D. Duct cleaning

1.02 RELATED WORK:

- A. Section 230090: Supports, Anchors and Seals
- B. Section 230580: Fans
- C. Section 230860: Duct Accessories
- D. Section 230870: Air Outlets

1.03 REFERENCE STANDARDS:

- A. Fabricated in accordance with SMACNA duct manuals and ASHRAE handbooks.
- B. Construction ductwork to NFPA 90Am Air Conditioning and Ventilating Systems; NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

1.04 DEFINITIONS:

- A. Duct Sizes: Round and rectangular duct sizes are inside clear dimensions.
- B. Low Pressure: Static pressure in duct less than 2" w.g. and velocities less than 2,000 fpm.

1.05 SUBMITTALS:

- A. Submit in accordance with Section 15000.
- B. Submit sheet metal shop drawings including particulars such as gauge sizes and configurations prior to start of work.
- C. Confirm ductwork has been fabricated and installed in accordance with recommendations and SMACNA standards.

PART 2 PRODUCTS

2.01 MATERIALS:

A. Ducts:

1. General Duty: Build ductwork with new galvanized prime grade copper bearing steel sheets, gauges as tabulated in latest edition of ASHRAE Guide. All sides of all unlined ducts shall be cross-broken.
2. Kitchen Type 1: Build ductwork with new carbon steel or stainless steel. All joints shall have a liquid tight continuous external weld.

B. Fasteners: Use rivets and bolts throughout; sheet metal screws accepted on low-pressure ducts.

C. Sealant: Water-resistant, fire resistive, compatible with mating materials.

2.02 FABRICATION:

- A. Size round ducts installed in place of rectangular ducts from ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- B. Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 18"m cross break for rigidity. Open corners are not acceptable.
- C. Lap metal ducts in direction of airflow. Hammer down edges and slips to leave smooth duct interior.
- D. Construct tees, bends and elbows with radius of not less than 1 1/2 times width of duct on center line. Where not possible and where rectangular elbows used, provide double wall turning vanes. Space turning vanes to provide maximum efficiency and minimum resistance to air flow.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence where ever possible. Maximum divergence upstream of equipment to be 30 degrees and 45 degrees convergence downstream.
- F. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with two layers of sealant. Sealant to be equal to Hardcast Inc. Versa Grip. Apply sealant per manufacturer's requirements and recommendations.
- G. Coordinate location of low-pressure ductwork with conduit piping and structure to provide maximum head room and to provide a neat and orderly appearance.
- H. Construct plenums of galvanized panels joined by standing seams on outside of casing riveted or bolted on approximately 12" centers. Reinforce with steel angles and provide diagonal bracing. Tightly fit at apparatus and seal with two layers of sealant. Sealant to be equal to Hardcast Inc. Versa Grip. Apply sealant per manufacturer's requirements and recommendations.
- I. Secure adjustable dampers to operating rods; construct of a metal gauge heavy enough to prevent any bending, rattling or fluttering when systems are in operation. Equip all adjustable dampers in ductwork that is concealed with Young Regulators end bearings. No Young Regulators shall be installed on any ceiling.

- J. Exhaust ductwork shall conform to all requirements for low-pressure ductwork. Apply two part sealing system to all exhaust duct joints. Sealant to be equal to Hardcast Inc. FTA-20 system. Apply sealant per manufacturer's requirements and recommendations.

2.03 LOW PRESSURE DUCT GAUGES:

- A. Use gauges listed per the most recent published SMACNA standards for the system pressure and velocity classification at installed reinforcement spacing.

2.04 PLENUM GAUGES:

- A. Fabricate plenums in accordance with SMACNA duct gauges for pressure classification with adherence to reinforcement and panel width requirements.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Rigidly support all ductwork by hangers from above. Use galvanized straphangers, as previously specified in Section 15090, spaced to carry the load, but not further than eight (8) feet apart. All hangers shall be neatly installed and shall be truly vertical. All horizontal runs of ductwork shall be truly horizontal except those ducts that must slope to miss structural members of continuously grading piping. Hangers shall be sized to carry load adequately.
- B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide Pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, insulate material inside a metal ring.
- C. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment, which may be harmed by excessive dirt with filters, or bypass during cleaning.
- D. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- E. Connect diffusers to low pressure ducts with 5' maximum lengths of flexible duct and 90 hard elbow. Hold in place with strap or clamp. Provide spin-in extractor with damper at connection to main duct. (Not allowed in inaccessible plaster or gyp board ceiling spaces).
- F. At each point where ducts pass through partitions, seal joints around duct with non-combustible material.
- G. Reinforcement: All ducts requiring reinforcement shall be reinforced according to the latest publication of the SMACNA manual for the pressure and velocity classification and the installed duct section lengths.
 - 1. Material for reinforcement members shall be galvanized steel. All screws and washers shall be plated or galvanized.

END OF SECTION

SECTION 230860

DUCT ACCESSORIES

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Access doors
- B. Fire Dampers
- C. Balancing Dampers
- D. Backdraft Dampers
- E. Flexible Connections

1.02 RELATED WORK:

- A. Section 230950: Testing and Balancing
- B. Section 230210: Vibration Isolation
- C. Section 230840: Ductwork

1.03 QUALITY ASSURANCE:

- A. Fire dampers shall be UL listed and constructed in accordance with UL Standard UL555 Fire Dampers.
- B. Fusible links on fire dampers shall be constructed to UL Standard 33, Fusible Links for Fire Protection Service.
- C. Demonstrate re-setting of fire dampers to authorities having jurisdiction and owner's representative.
- D. Smoke dampers shall be UL listed and classified in accordance with UL Standard UL555 smoke control system and NFPA 90A and 92A.
- E. Access doors shall be UL labeled.

1.04 REFERENCE STANDARDS:

- A. Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems.
- B. Fabricated in accordance with ASHRAE handbooks and SMACNA duct manuals.

1.05 SUBMITTALS:

- A. Submit in accordance with Section 15000.
- B. Submit shop drawings of factory fabricated assemblies.

- C. Submit manufacturer's printed installation instructions.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturers:
 - 1. Air Balance
 - 2. Ruskin
 - 3. Controlled Air
 - 4. Vent Fabric
 - 5. Phillips-Aire
 - 6. Prefco
 - 7. Louvers and Dampers
 - 8. Safe-Air
 - 9. CESCO

2.02 ACCESS DOORS:

- A. Fabricated rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1" thick insulation with sheet metal cover.
- B. Provide two hinges and two sash locks for sizes up to 18" square, two hinges and two compression latches with outside and inside handles for sizes up to 24" x 48". Provide an additional hinge for larger sizes.

2.03 FIRE DAMPERS:

- A. Fabricated of galvanized steel or prime coated black steel weighted to close and lock in closed position when released by fusible links.
- B. Fire dampers in low-pressure ductwork shall be multi-blade type.
- C. Fire dampers shall have blades retained in a recess so free area of connecting ductwork is not reduced.
- D. Set or select fusible links for 160 degrees F. release (return air). Set or select fusible links for 212 degrees F. release (supply air).
- E. Access doors to Fire Dampers: Provide for each fire damper in ductwork an access door of a size and so located to provide adequate room for inspection and servicing of fire damper. Access doors shall be airtight and secured to duct with screws or other approved manner. Provide neoprene gasket between doors and ducts. Provide and install access doors in chase walls of other locations to provide access to ductwork and fire dampers located in an accessible space.

2.04 DAMPERS:

- A. Dampers: Shall be single or multiple-opposed blade as required. Provide blank-off plates and conversions necessary to install smaller than duct size dampers.
- B. All damper frames are to be constructed of #13 gauge galvanized sheet metal and shall have flanges for duct mounting and a minimum of 2" stand-off handle.
- C. Damper blades shall not exceed 6" width. All blades are to be of corrugated type construction, fabricated from two sheets of #22 gauge galvanized sheet steel spot welded together. Blades are to be suitable for high velocity performance.
- D. Replaceable rubber seals are to be provided with the damper. Seals are to be installed along the top, bottom and sides of the frame and along each blade edge. Seals shall provide a tight closing, low leakage damper. Leakage and flow characteristic charts must be submitted to the owner prior to approval of dampers.
- E. All damper operators shall be of the molded rubber diaphragm piston type and shall be fully proportioning unless otherwise specified. They shall be quiet in operation and shall have ample power to overcome friction of damper linkage and air pressure acting on louvers to position dampers accurately and smoothly. Damper operator mounting arrangement shall be outside the air stream whenever possible.
- F. No damper operator shall drive more than 16sq. ft. of damper.
- G. Provide spin-in extractor with lockable volume damper where each round duct branch duct attaches to rectangular duct.

2.05 FLEXIBLE CONNECTIONS:

- A. Fabricated of neoprene coated flameproof fabric approximately 2" wide tightly crimped into metal edging strip and attach to duct and equipment by screws or bolts at 6" intervals.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Install items in accordance with manufacturer's printed instructions.

3.02 APPLICATION:

- A. Provide access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers and elsewhere as indicated. Review locations prior to fabrication.
- B. Provide 4" X 4" quick opening access doors for inspection at balancing dampers.
- C. Provide fire dampers at locations shown, and where ducts and outlets pass through floors and fire rated walls and ceilings, and where required by authorities having jurisdiction. Fire dampers shall be completed with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges. Refer to owner drawings for rated wall locations and fire ratings.

- D. Provide fire dampers at locations shown and where ducts and outlets pass through smoke barrier walls. Refer to architectural drawings for smoke barrier wall locations.
- E. Provide balancing dampers at points on low-pressure supply, return and exhaust systems where branches are taken from larger ducts as required for air balancing.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration.

END OF SECTION

SECTION 230870

AIR OUTLETS

PART 1 GENERAL

1.01 WORK INCLUDED:

- A. Diffusers
- B. Grilles and Registers

1.02 RELATED WORK:

- A. Section 230950: Testing, Adjusting and Balancing of Systems

1.03 QUALITY ASSURANCE:

- A. Make airflow tests and sound level measurements in accordance with applicable ADC equipment test codes and ASHRAE standards.
- B. Manufacturer shall certify cataloged performance and ensure correct application of air outlet types.

1.04 SUBMITTALS:

- A. Submit in accordance with Section 230000.
- B. Submit product data and shop drawings covering each item together with schedule of outlets.
- C. Submit manufacturer's installation instructions.

1.05 JOB CONDITIONS:

- A. Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedule of outlets.
- B. Check locations of outlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangements.
- C. Refer to architectural reflected ceiling plans for final location of air devices to be located in ceiling.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

- A. Provide and install items as listed in schedule on the drawings, complete in all respects.
- B. Other acceptable manufacturers:
 - 1. Titus
 - 2. Carnes-Empco (grilles & registers)

3. Krueger (grilles & registers)
4. Tuttle & Bailey
5. Metal-Aire (grilles & registers)
6. Ruskin (louvers)

2.02 APPLICATION:

- A. Provide air devices as required and as indicated on the drawings.
- B. Surface mounted supply outlets and diffusers to have sponge rubber gaskets, and mounted in a manner that will prevent any air leakage around edge.
- C. All supply outlets and diffusers shall have opposed blade dampers for control. Exhaust registers shall consist of grille faces combined with opposed blade dampers for balancing.
- D. Each low velocity branch duct, at the point of connection to a main duct, shall be provided with an adjustable volume controller with locking device, factory made, Titus AG-45, GenFlex #SM-2DEL, or GenFlex #DB-2DEL.
- E. All grilles, registers, volume controllers and ceiling diffusers shall be as shown in the schedule on the plans. If the contractor proposes to use devices made by another manufacturer, he must furnish, together with shop drawings and brochures, engineering data indicating proper air distribution patterns, pressure drops and other pertinent characteristics. Complete certified performance ratings are required.
- F. Where ceiling diffusers are shown as lay-in with face sizes less than 24 x 24, they shall be panel mounted for 24 x 24 grid lay-in application.
- G. Provide 90 degree adjustable sheet metal elbow at round neck diffuser connections to flexible duct runout.
- H. All supply air ceiling diffusers located within 10 feet of the kitchen hood shall be egg create and aluminum.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Install items in accordance with manufacturer's printed instructions.
- B. Paint ductwork visible behind air outlet matte black.

END OF SECTION



T U L S A

PUBLIC SCHOOLS

260400
Electrical Guidelines and Specifications

SECTION 260400

ELECTRICAL GUIDELINES AND SPECIFICATIONS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Work Included: Provide Design, Engineering and Construction Documents incorporating the Owner's Guidelines and Specifications defined herein, with proper installation of materials, assemblies and equipment including, but not limited to:

1. Utility coordination and service entrance modifications for power and low-voltage systems.
2. Basic Electrical Materials and Methods.
3. Grounding.
4. Hangers and Supports.
5. Conductors and Cables.
6. Raceways and Boxes.
7. Lighting Control Devices.
8. Switchboards as needed for new, modifications and replacement to serve the building(s) loads.
9. Distribution panelboards as needed for new, modifications and replacement to serve the building(s).
10. Wiring Devices.
11. Enclosed Switches and Circuit Breakers.
12. Interior and Exterior Lighting.
13. Enclosed Controllers.
14. Other items and services required to complete the systems.
15. Service voltage for this project is 480V and 208V: Phase conductor colors per NEC.

B. Drawings:

1. These Design Guidelines and Specifications are accompanied by floor plans of the building showing the general location of the work. Exact locations shall be subject to the approval of the Owner who reserves the right to make any reasonable changes in locations indicated, prior to rough-in, without cost to the Owner. While the general run of feeders, branches, and conduits are indicated on the Drawings, it is not intended that the exact routing of circuits or locations of conduits be determined by Conceptual Drawings. Detailed arrangements of all Work shall be subject to the Owner's approval.

C. Related Work:

1. Documents affecting Work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

D. Temporary Power:

1. Arrange, provide and pay for the costs of installing temporary power to the site in accordance with the requirements of Division 1.

1.02 QUALITY ASSURANCE:

- A. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Codes and Ordinances:
 - 1. The installation shall comply with requirements of all applicable laws, codes and ordinances including those of the state, county and city.
 - a) NFPA 70 - 2017.
 - b) NFPA 72 – 2016 (including FM Directives)
 - c) NFPA 101 – 2017.
 - 2. Where these Drawings, Design Guidelines and Specifications show more stringent requirements than required codes, the more stringent shall prevail.
 - 3. The Work shall comply with current standards of the serving utility companies.
- C. Permits, Fees and Licenses:
 - 1. The Contractor shall obtain and pay for all permits, fees and licenses, for Work required under these Specifications.
- D. Utility Company Fees:
 - 1. Coordination of existing utilities and easements including fees associated with the project shall be included in the Work.
- E. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.03 EXAMINATION OF SITE:

- A. Visit the site, inspect the existing conditions and check the Drawings and Specifications to be fully informed of the requirements for completion of the Work.
- B. Lack of such examination shall not justify a request for extra compensation to the Contract price.

1.04 MATERIAL AND EQUIPMENT:

1.05 SUBMITTALS:

A. SHOP DRAWINGS AND SUBMITTAL DATA

- 1. Process shop drawings and submittal data to ensure that the proposed materials, equipment and devices conform to the requirements of the Contract Documents, and that there are no omissions or duplications. Provide layouts, fabrication information and data for systems, materials, equipment and devices proposed for the project.
 - a) Shop drawings shall be drawn on a scale not less than ¼ inch equals 1 foot showing actual dimensions. Shop drawings shall include, but not be limited to:
 - b) Switchboards
 - c) Distribution Panelboards

2. Submittal data (manufacturer's catalog data) shall include Manufacturer's Specifications, product literature and other data needed to demonstrate compliance with the specified requirements, but not be limited to the following:
 - a) Equipment: Switchboards, Panelboards, Transformers, Disconnect Switches, Enclosed Controller, Circuit Breakers, Fuses, etc.
 - b) Materials: conduit, conductors, connectors, supports, etc.
 - c) Lighting Fixtures and Lamps.
 - d) Wiring Devices.
 - e) Lighting Control Devices – Sensors, Dimming, etc.
 - f) Low-Voltage Clock and Intercom System – (Valcom).
 - g) Low-Voltage Data outlet devices and Cabling systems.
 - h) Security and Camera Systems – (Existing)
 - i) Addressable Fire Alarm System – (Firelite).
3. Manufacturer's recommended installation procedure which, when approved by the Owner, will become the basis for accepting or rejecting actual installation procedures used on the work.
4. The submittal data shall not consist of manufacturer's catalogs or cut sheets that contain no indication of the exact item offered. The submission on individual items shall designate the exact item offered.
5. Do not submit detailed quantitative listings of materials, equipment and devices. It is the Contractor's responsibility to provide proper sizes and quantities to conform to Contract Documents.
6. Assemble submittals on related items procured from a single manufacturer in brochures or other suitable package form, rather than submitting a multiplicity of loose sheets.
7. The Contractor shall submit shop drawings whenever equipment proposed varies in physical size and arrangement from that indicated thus causing rearrangement of equipment space, where tight spaces require extreme coordination between this work and other work, where called for elsewhere in these Specifications and where specifically requested by the Owner. Shop drawings shall be prepared at a scale of not less than ¼ inch equals 1 foot.

B. SUBSTITUTIONS

1. Where a single manufacturer is mentioned by trade name or manufacturer's name, it has been done in order to establish a standard rather than to discriminate against an equal product made by another manufacturer.
2. Where multiple manufacturers are listed in the Owner's drawings and/or specification, none other than those manufacturers will be accepted.
3. Substitute manufacturers will be considered prior to bid only. The substitute manufacturer shall submit a complete copy of the appropriate technical specification section minimum ten (10) business days prior to bid with each sub-paragraph noted with the comment, "compliance", "deviation" or "alternate". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number, shall be indicated.
4. By noting the term "compliance" or "C", it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
5. By noting the term "deviation" or "D", it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified. Manufacturer shall indicate all deviations.
6. It shall be understood that space allocations have been made on the basis of present and known future requirements and the dimensions of items of equipment or devices

of a particular manufacturer whether indicated or not. If any item of equipment or device is offered in substitution which differs substantially in dimension or configuration from that indicated on the Drawings or specifications, provide as part of the submittal ¼ inch equals 1 foot scaled drawings showing that the substitute can be installed in the space available without interfering with other portions of the work or with access for operations and maintenance in the completed project.

7. Where substitute equipment or devices requiring different arrangement or connections from that indicated is accepted by the Owner, install the equipment or devices to operate properly and in harmony with the intent of the Contract Documents, making all incidental changes in piping, ductwork or wiring resulting from the equipment or device selection without any additional cost to the Owner. The Contractor shall pay all additional costs incurred by other portions of the work in connection with the substituted equipment or device.
8. The Owner reserves the right to call for samples of any item of material, equipment or device offered in substitution, together with a sample of the specific item when, in their opinion, the quality of the item and/or the appearance is involved, and it is deemed that an evaluation of the item may be better made by visual inspection.
9. When any request for a substitution of material, equipment or device is submitted and rejected, the item named in the Contract Documents shall be furnished. Repetitive submittal of substitutions for the same item will not be considered.

C. Samples:

1. When requested by the Owner, promptly provide samples of items scheduled to be exposed in the final structure.
2. When specifically, so requested by the Contractor and approved by the Owner, approved samples will be returned to the Contractor for installation on the Work.

D. Record Drawings:

1. Comply with pertinent provisions of Division 1.
2. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below.

E. Manual:

1. Upon completion of this portion of the Work, and as a Condition of its acceptance, deliver the operation and maintenance manual to the Owner complied in accordance with the provisions of Division 1 of these specifications. Include within each manual.
 - a) Copy of the approved Record Documents for this portion of the Work.
 - b) Copy of each circuit directories.
 - c) Copy of each warranty and guaranty.

1.06 GUARANTEE:

- A. The Contractor guarantees all Work against any defects due to faulty workman-ship or material and that all raceways, ducts and piping are free from foreign material, obstructions, holes or breaks of any nature.
- B. Upon written notice from the Owner or Owner, the Contractor shall promptly remedy without cost to the Owner any defects occurring within a period of one (1) year from the date of final acceptance.

1.07 WARRANTY:

- A. The Contractor shall properly execute in the Owner's name all Manufacturers' standard warranty certificates applying to equipment installed on the project and shall deliver said certificates to the Owner at completion of the job. All warranty cards shall also be properly executed and delivered to the supplier or Manufacturer's representative for Manufacturer's records. Standard warranties for equipment shall be not less than one (1) year.

PART 2 PRODUCTS AND EXECUTION

2.01 UTILITY COORDINATION AND SERVICE ENTRANCES:

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate power and low-voltage outages with Owner 10-days prior to work.
- D. Coordinate sleeve selection and application with selection and application of fire-stopping specified.
- E. Coordinate utility company requirements for demarcations and service provider terminations for complete and operable systems.

2.02 BASIC ELECTRICAL MATERIALS AND METHODS:

- A. Provide only materials that are new and of the type and quality specified. Where Underwriter's Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.
- B. All materials and equipment shall be new, of the same type and manufacturer, of the best quality and design, free from defects and meet the requirements of UL and NFPA where standards are established for those items and assemblies.
- C. Manufacturer's nameplate affixed in a conspicuous place will be required on each major component of equipment stating Manufacturer's name, address and catalog number.
- D. Manufacturer's name and model number used herein and on the Drawings establish type and quality required. Equal products may be considered if submitted in writing to the Owner's Representative for approval 10 (ten) days prior to bid date. The Contractor shall be responsible for assuring the items and equipment substituted for those shown on the Drawings will physically fit in the space allocated.
- E. Fire stopping material shall be 3M Fire Seal Caulking, or approved substitution.
- F. All terminals and enclosures shall be marked for 75° C operation or conductor size shall be increased as required at no cost to the Owner.
- G. Steel Pipe Wall Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends. Comply with NECA 1.

- H. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work and roof manufacturer's requirements.
- I. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
- J. Provide sleeves and chases where conduits pass through rated floors and walls, fire stopped in accordance with UL Listed assembly.
- K. When boring, cutting or drilling structural wood or wall members, drill only in locations as approved by the Owner.
- L. Immediately prior to final inspection, the Contractor shall make a final cleanup of dirt and refuse resulting from his Work and shall assist in keeping the premises clean at all times.
- M. Immediately prior to final inspection, the Contractor shall clean all material and equipment installed under this Contract. Dirt, dust, plaster, stains and foreign matter shall be removed from all surfaces. Damaged finishes shall be touched up and restored to their original Condition.
- N. Mechanism of all equipment shall be checked, adjusted and tested for proper operation. Protective devices and parts shall be checked and tested for specified and required application and adjusted as required to produce the intended performance.

2.03 GROUNDING SYSTEMS:

- A. The neutral conductor for each system shall be grounded in accordance with the National Electrical Code using ¾" diameter copper ground rods, 10 feet in length, in a tripod formation. The conduit system and service entrance equipment shall be bonded to the grounding conductors in an approved manner. All equipment, motors, conduit and other electrical items shall be grounded properly to prevent accidental shock to operators or other persons. All PVC conduit runs shall have grounding conductor installed per code.
- B. Ground all equipment and other apparatus to metallic cold water main (if pipe is metal and direct buried for a minimum of 10 foot outside the building) and to independent grounding electrode (minimum 20 foot of steel reinforcing bar buried within the foundation or footing) with 1/0 AWG minimum as shown on the Drawings, using ground clamps manufactured by Burndy or T&B, and approved by the Owner. Bond all grounds in accordance to NEC 2014.
- C. Bond all water piping systems per local codes. Do not bond to gas piping systems within the building, only on the exterior of buildings.
- D. Install a ground conductor in all feeder conduits connecting main switchboards, distribution panels, branch circuit panels, and all major pieces of mechanical equipment whether or not called for on the Drawings.
- E. Use ground rods if water mains or piping are not metallic, or if isolation couplings have been used.
 - 1. Make meg ground tests to measure ground resistance, and provide not more than 5 ohms resistance, adding ground rods as required to achieve that level.

2. Make ground rods accessible for inspection and testing.
- F. Provide exothermic connections with Erico/Cadweld or approved substitutes.

2.04 HANGERS AND SUPPORTS:

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
- B. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- C. Channel Dimensions: Selected for applicable load criteria.
- D. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- E. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 1. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 2. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 3. Toggle Bolts: All-steel springhead type.
 4. Hanger Rods: Threaded steel.
- H. Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- I. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter. Wire-ties and zip-ties shall not be an acceptable means of support to structure(s).
- J. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- K. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- L. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- M. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- N. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2.05 CONDUCTORS AND CABLES:

- A. Service Entrance Conductors:
1. For line voltages, provide 600 V THHN insulated copper or aluminum wire with UL Label, listing, and color coded for voltage.
- B. Conductors:
1. For line voltages, provide 600 V insulated copper wire and cable, with UL Label, listing, and color coded for voltage.
 2. Use type THHN/THWN color coded for voltage at interior, type THHN/THWN-2 for exterior.
 3. For wire No. 10 and smaller, provide solid wire: for wire larger than No. 10, provide stranded wire.
 4. Conductors No. 8 and larger, provide insulating bushings or insulating sleeves.
 5. Use only copper wires and cables.
- C. No. 12 AWG THHN conductors and larger for all branch circuits, protected by 20 amp circuit breakers. Where so indicated on the Drawings, by actual load, or by the N.E.C., use larger wires to limit voltage drops.
- D. The number of wires in a conduit is indicated on the Drawings by circuit numbers on the conduit homeruns, except:
- E. Wire Sizes:
1. Increase wire sizes to next largest AWG size for:
 - a) 120 volt circuits exceeding 150 feet in circuit length.
 - b) 208 volt circuits exceeding 200 feet in circuit length.
 2. Wire sizes shall be increased for the above conditions whether shown on the Drawings or not.
- F. Use identified (white) neutrals and colored-coded phase wires for all branch circuit wiring.

- G. Make splices electrically and mechanically secure with pressure-type. Push-in connectors shall not be allowed.
 - 1. For wires size 10 AWG and smaller, provide NSI twist-on connectors.
 - 2. For wires size 8 AWG and larger, provide NSI Polaris insulated connectors.
- H. Tape all joints with rubber tape 1-1/2 times the thickness of the conductor insulation, then cover with the friction tape or the vinyl-plastic electrical tape specified above.

2.06 RACEWAYS AND BOXES:

A. Raceways and Fittings:

- 1. Provide electrical metallic tubing, with set type screw fittings, for all conduit concealed in the walls, above accessible ceilings, or exposed in work areas, except in freezer and or loading dock areas where galvanized conduit shall be provided.
- 2. Provide minimum 3/4" raceway for power circuits and 1" raceways for low-voltage communication cables.
- 3. Schedule 40 PVC conduit for feeder to utility service entrance outside the building and feeders under floor slab and underground electrical site work.
- 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
- 5. MC Cable or FMC is allowed in limited uses: Lighting whips, interior partition walls, and millwork. MC Cable is NOT allowed for homerun branch circuits.
- 6. Surface mounted raceways on existing walls shall be 3/4" maximum. Provide 1/2" raceways for thermostat, HVAC sensors and control circuits anchored to wall system by approved method.
- 7. Use LFMC conduit for short motor connections, or where subject to vibration.
- 8. Where conduit is concealed in interior walls or above the ceiling provide EMT.
- 9. Where conduit is exposed in work areas, provide EMT with compression fittings.
- 10. Adjust raceway sizes required for derating and ambient temperatures.
- 11. Provide necessary sleeves and chases where conduits pass through floors and walls, and provide other necessary openings and spaces, arranging to prevent unnecessary cutting.
- 12. Provide LFMC for expansion joints between two structures and entering/exiting enclosures where movement can occur.
- 13. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651.
- 14. Securely and rigidly support conduits to super structure throughout the Work.
- 15. Underground conduit installations where open trenching occurs and accessible to public, shall require barriers and warning tape per OSHA guidelines.

B. Boxes:

- 1. For floor boxes with convenience outlets, provide Hubbell No. B2537, with S3925 cover, with combination 3/4" and 1-1/8" plug and S3079 scrub-proof carpet flange.
- 2. Floor boxes: Provide type RFB4 series with (4) independent compartments, stamped steel and shallow steel for concrete 2 7/16" depths. Coverplates shall be scrub-proof with carpet in-lay and easy open handle. Activate all compartments with TPS approved wiring devices.
- 3. Interior recessed/surface, provide 4" square by 2-1/8" deep ganged boxes with mudplates and stainless steel covers.
- 4. Exterior recessed/surface, 4" square by 2-1/8" deep provide weatherproof boxes, while-in-use and gasketed covers.

5. Communication outlets, provide 4" square boxes by 2-1/8" deep with multiple activation device cover. Route 1" conduit to accessible ceiling cavity with end bushings and nylon pull string.
6. Pull boxes, NEMA rated for the environment, sized per conductor fill. Screw on covers. Steel, finished inside and out with manufacturer standard enamel with 3/4" minimum knockouts.
7. Junction boxes may not be installed back-to-back in walls and partitions. Consult with Owner for proper separation of boxes (typically, 12" in non-rated walls, 24" in rated walls).
8. Securely and rigidly support boxes to super structure throughout the Work.

2.07 LIGHTING CONTROL DEVICES:

- A. Occupancy Sensors and Presence Detection:
 1. Ceiling mounted in Classrooms: STEINEL: 64470 IR QUATTRO HD COM2-24.
 2. Ceiling mounted in Corridors: STEINEL: 64560 US HALLWAY COM2-24.
 3. Ceiling mounted in Restrooms: STEINEL: 64700 DT QUATTRO COM1-24.
- B. Wall Dimmers/Occupancy/Vacancy Sensors:
 1. LEVITON: DS710-10Z, Locations may vary, final by Owner.
- C. Photocells: Integral with egress exterior fixtures.
- D. Provide and install time clocks for automatic operation of lighting and equipment loads in accordance with the Time Clock Schedule shown on the Drawings, and as follows:
 1. Equipment Control:
 2. Tork W-220-L, SPST, reserve power, 40 AMP contacts, NEMA 1 surface mounted enclosure.
 3. Lighting Control:
 4. Tork 7200ZL, DPST, reserve power, 40 AMP contacts, astronomic dial, NEMA 1 surface mounted enclosure.
 5. Photocell:
 6. Tork 2101, SPST, 2000 Watt rating, 120 Volt.

2.08 SWITCHBOARDS:

- A. Main Switchboard:
 1. Switchboards shall be as manufactured by Cutler-Hammer or equal.
 2. Switchboard enclosures shall be front access/front and rear aligned, Panel mounted branch devices, UL Listed for the environment rated for 65kA and capable of 35kA lowest breaker interrupt rating. Barriers between adjacent switchboard sections.
 3. Factory-applied gray finish over rust-inhibiting primer on treated metal surface.
 4. Phase, Neutral and Ground Bus: Hard drawn copper of 98 percent conductivity.
 5. 800-Amps and larger: Depth shall be 18" minimum, 30" maximum.
 6. Pull Box on Top of Switchboard with adequate ventilation to match ratings.
 7. Load terminals for future circuit-breaker positions at full-ampere rating of position.
 8. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends. 100% Neutral buses.
 9. Install switchboards on 6" concrete base, #3000 PSI, place and secure anchorage devices and install anchor bolts to elevations for proper attachment to switchboards.
 10. Install filler plates in unused spaces.

11. Separate Metering: Compartment and section with front hinged door, for metering and current transformers: IEEE C57.13; 5 A, 60Hz, dry-type.
12. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - a) Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - 1) Phase Currents, Each Phase: Plus or minus 1 percent.
 - 2) Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - 3) Frequency: Plus or minus 0.5 percent.
 - 4) Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - b) Capable to interface with Owner's Building Management Systems.
13. Surge-Suppression Device: Integral in separate compartment, Type 1.
14. Warrantee Period: Five years from date of Substantial Completion.

B. Disconnecting and Overcurrent Protective Devices:

1. Service Entrance Label: 65kA.
2. Molded-Case Circuit Breaker (MCCB), 80% rated, comply with UL 489, with series-connected rating to meet available fault currents.
3. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger. Magnetic trip element with front-mounted, field-adjustable trip setting.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Kitchen Areas and similar inaccessible outlet locations: Single to three-pole configurations with Class A ground-fault protection for personnel rated at 6-mA trip. Provide shunt-trip for circuit breakers serving under exhaust hoods.

C. Where existing facility switchboard(s) or main switches are instructed to remain by Owner that require current-limiting fuses:

1. For above 600 Amps, provide Class L "Hi-Cap" manufactured by Bussman.
2. For below 600 Amps, as shown for short circuit duty, provide Class RK-1 time delay, "Limitron", or Class RK-5 "Low Peak", or Class RK-9 "Fusetron", manufactured by Bussman, or equal manufacture by Gould-Shawmut.
3. At switches provide a micarta nameplate with white lettering on a red background, reading WARNING, REPLACE ONLY WITH CURRENT-LIMITING FUSES AS ORIGINALLY INSTALLED.
4. Provide 100% spare fuses with spare fuse cabinet installed in the main electric room.

2.09 PANELBOARDS:

A. Panelboards and Retrofit Panelboards: NEMA PB 1.

1. Cutler-Hammer Type "Pow-R-Line" or Owner approved equal. Commercial Grade.
2. Retrofit panelboards shall be Cutler-Hammer Pow-R-Line or equal. Commercial.
3. Provide same construction as by the Manufacturer of the main switchboard.
4. Phase, Neutral and Ground Bus: Hard drawn copper of 98 percent conductivity.
5. Main and Neutral Lugs: Mechanical type. Lugs for two section panels shall be sub-feed lugs for "main lug only" panels, and through-feed lugs for panels with main circuit breakers sized for rated frame.
6. Enclosures:
 - a) Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b) Outdoor Locations: NEMA 250, Type 3R:

- c) Kitchen and Wash-Down Areas: NEMA 250, Type 4X S.S.
- 7. Cabinets, flush or surface mounted as indicated. Top and/or Bottom Entry.
- 8. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- 9. Gutters: Same gage and finish of panel enclosure; integral with body.
- 10. Directory Card: Inside panelboard door, mounted in metal frame with transparent cover.
- 11. Doors shall be as required, accurately fitted with catch-lock and two (2) keys. All front keys alike.
- 12. Panel boards shall be rated for the voltage, 3 phase, 4 wire, solid neutral, UL 489 and rated 250 or 600 volts. Mains shall terminate in cable lugs or main circuit breaker with lugs of sufficient size to accommodate wires feeding panel compartment.
- 13. Bolt-on circuit breakers.
- 14. Equipment Ground Bus: Adequate for feeder and branch circuit equipment ground conductors. Bonded to box.
- 15. Disconnecting and Overcurrent Protective Devices (OCPDs):
 - a) Tandem and mini-circuit breakers shall NOT be used.
 - b) Multipole breakers shall have common trip.
 - c) Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1) Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2) Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 3) GFCI Circuit Breakers: Single- thru three-pole configurations with Class A ground-fault protection (6-mA trip).
 - 4) Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Shunt-trip: 120-V trip energized from separate circuit for equipment under exhaust hoods.
 - 3. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in "on" or "off" position.
 - 4. Handle Clamp: Loose attachment, for holding circuit-breaker handle in "on" or "off" position.
- 16. Provision for Future Devices: Equipment with mounting brackets, bus connections, and necessary appurtenances for the OCPD ampere ratings indicated for future installation of devices.

2.10 WIRING DEVICES:

- 1. UL Listed and labeled as defined in NFPA 70.
- 2. Receptacles shall be Tamper Resistant below 5-1/2 feet.
- 3. Color of wiring devices shall match existing facility devices or per Owners requirements. Color of isolated ground receptacles to be orange. Coordinate with Owner for final color of all devices.
- 4. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596:
 - a) Bryant, Hubbell, Arrow-Hart: No. 5242
 - b) Leviton: No. 5362
 - c) Or equal
- 5. Ground-Fault circuit interrupter type receptacles shall be side wired feed-thru, Hubbell No. GF5352-I, or equal.

6. Clock outlets (simplex) shall be 120V, Leviton Cat. No. 689 or equal, cover plate to match existing facility installations.
7. Toggle Switches: Comply with NEMA WD 1, UL 20, and FS W-S-896. Commercial-industrial type, 20 amp, 120/277 V AC, from the following tabulation:

		<u>Single Pole:</u>	<u>Two Pole:</u>	<u>Three Way:</u>	<u>Four Way:</u>
(a)	Bryant	4901	4902	4903	4904
(b)	Hubbell	1221	1222	1223	1224
(c)	Arrow-Hart	1991	1992	1223	1994
(d)	Leviton	1221-2	1222-2	1223-2	1224

8. Cover plates for flush mounted receptacles and switches:
 - a) Mechanical, utility, kitchen and Exterior: provide 0.040" stainless steel cover plates in all areas and all devices.
 - b) Office and classroom areas: Provide 0.040" stainless steel cover plates. Plastic cover plates matching the wiring devices specified for millwork.
 - c) Where wiring devices are grouped, set in gangs with one cover plate.
 - d) Where wiring devices are noted to be weatherproof, provide cast cover, gasketed & hinged, while-in-use rated.
 - e) Use jumbo size plates, 302 stainless steel for outlets installed in masonry walls or as specified by Owner and existing facility standard installation.
9. Manual motor starter: Square D "Class 2510" for 120V, 1ph motors.

2.11 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

A. LED TROFFER - MANUFACTURERS

1. Pre-Approved Manufacturers Listed: Products of firms regularly engaged in the manufacture of recessed LED lighting fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years. The manufacturer of the lighting fixtures shall comply with the provisions of the appropriate code and standards. All fixtures shall be pretested before shipping. Provisions for a single fixture shipped to the project site shall become property of the Owner to test and evaluate the construction meets or exceeds the original fixture approved by the Owner and listed in the fixture schedule.
2. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
3. Codes: Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
4. UL or CSA US Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL 8750 or others as they may be applicable. A listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

5. Luminaire Flat Panel Edge Lit shall be DLC Premium Certified (Design Lights Consortium).
6. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
7. Base Bid Manufacturers: Are listed on fixture schedule and specification. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards and photometric distribution set by the specified product.
8. Alternate Manufacturers: Identification by means of manufacturers names and catalog numbers is to establish basic features, quality and performance standards. Any substitutions must meet or exceed these standards. The three listed manufacturers are pre-approved Owner's standard fixtures and substitution request may not be allowed prior to bid.

B. LED LUMINAIRE SOURCE REQUIREMENTS

1. LED's shall be manufactured by, Nichia, Cree, Samsung or Osram.
2. Lumen Output – minimum initial lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-90-degree zone - as measured by IESNA Standard LM-79-08 in an accredited lab. Exact tested lumen output shall be clearly noted on the shop drawings.
3. Type 2x4: 40 Watt, Efficacy (lm/W) >123 @ 5000K for ceilings up to 10'-0".
4. Type 2x4: 48 Watt, Efficacy (lm/W) >124 @ 5000K for ceilings 10'-1" to 12'-0".
5. Type 2x2: 30 Watt, Efficacy (lm/W) >121 @ 5000K for ceilings up to 10'-0".
6. Type 2x2: 40 Watt, Efficacy (lm/W) >119 @ 5000K for ceilings 10'-1" to 12'-0".
7. 4-Ft Strip: 45 Watt, Efficacy (lm/W) >128 @ 5000K.
8. Recessed Fixtures: Comply with NEMA LE 4.
9. Retain CRI and CCT in first subparagraph below for projects that require the same CRI and CCT values across all product types. If different product types require different CRI or CCT values, remove CRI and CCT values from this article and insert under each product type used in the Project. Note that each product type may have a different minimum CRI or CCT requirement.
10. Rated lamp life of 50,000 hours. Lumen output shall not decrease by more than 20% over the minimum operational life of 50,000 hours.
11. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
12. LED Boards shall be suitable for field maintenance or replacement with plug-in connectors at power supply/drive.
13. Light Color/Quality:
14. Correlated Color temperature (CCT) range as per specification, luminaire sources and 5000K shall be correlated to chromaticity as defined by the absolute (X, Y) coordinates on the 2- D CIE chromaticity chart.
15. The color rendition index (CRI) shall be 82 or greater.
16. Chromaticity shift over 6,000 hours shall be <0.007 change in delta-u'v' average as demonstrated data set in IESNA LM-80-08 report.
17. Lumen Maintenance Factor: >0.84 at 25°C, 50,000 hours and reported in TM-21 L70 Lifetime >60,000 hours.
18. Binning: Per ANSI, 3-step MacAdam ellipse with abilities to produce uniform color across copious quantities of fixtures.

C. LED LUMINAIRE POWER SUPPLY AND DRIVE REQUIREMENTS

1. Driver: Instant start. 120 – 277 Volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 85% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
2. Flat Panel Edge-lit LED: The electronics/power supply enclosure shall be external to the SSL luminaire and be accessible per UL requirements.

3. Dimming: Driver shall be suitable for full-range dimming. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output with a smooth shut off function. Dimming shall be controlled by a 0-10V signal. Signal wires shall be 22 AWG solid copper minimum.
4. Compatible with Leviton dimming device(s): DS710-10Z or equal.
5. Electrical Characteristics:
6. Power Factor: >0.93.
7. Input Power: 120-277V, 50/60 Hz.
8. Total Harmonic Distortion (THD): <20%.
9. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.
10. Material Usage: Drivers shall be (ROHS)-compliant.
11. Warranty: Five (5) years.

D. LED FLAT PANEL CONSTRUCTION

1. Frame: LED strips mounted on edges enclosed in solid extruded aluminum frame, painted after formed with UV-stabilized acrylic optical lens with a full aluminum back. Construction seals conditioned air from the plenum or non-conditioned air. Housing shall be designed rigid to eliminate warping or bending for level installation. Frame corners conformed for seamless appearance.
2. Optical Lens/Diffusers:
3. Retain "Acrylic" Subparagraph below if acrylic options in "Diffusers and Globes" Paragraph above are retained.
4. Acrylic: One hundred percent virgin UV-stabilized acrylic (PMMA) optical panel, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
5. Retain "Glass" Subparagraph below if glass options in "Diffusers and Globes" Paragraph above are retained.
6. Retain "Lens Thickness" Subparagraph below for all diffuser and globe types.
7. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply) and integral controls as per this specification.
8. Each luminaire shall be designed to operate at an average operating temperature -4°F to 104°F.
9. Humidity: 20% – 85% RH, Lighting Facts.
10. Luminaire housing to have no visible welding, screws, springs, hooks, rivets, bare LED's or plastic supports in viewing angles at floor to ceiling placement.
11. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply and circuit board for the luminaire shall be fundamental to the unit.
12. Driver disconnect shall be provided where required to comply with codes.
13. Finish: Polyester white powder coat painted with 92% high-reflective paint after fabrication.
14. Integral Grid Clips required on recessed mounted luminaires along with integral tie wire mounting points. Compatible with standard 15/16" and 9/16" T-Bar ceilings.
15. Luminaire to have air removal capability where specified.
16. Any questions shall be directed to Randy Ramsey in the Bond office of TPS. Office: 918-746-6131 or E-mail: ramsera@tulsaschools.org
17. NOTE: As new technologies become available this specification will be changed. Do not assume you have the latest spec, ask for the most recent revised specification from Tulsa Public Schools bond office.

E. RECESSED LED DOWNLIGHTS

1. An approved manufacturer same as LED troffers or equal. 4000K minimum.
2. Housing finish to be white unless otherwise specified
3. Must be able to accept an actual lensed R-30 LED, with Edison medium base.

F. LED HIGH-BAY

1. Housing: Low copper, corrosion resistant, die cast aluminum.
2. Optics/Lens: High transmittance opaque glass lens sealed (IP66) with silicone gasket. Narrow, medium and wide distribution types. Optically opaque plastic lens factory installed to diffuse source intensity.
3. LED Source: High power LED source, with performance of 135 lumens per Watt.
4. LED source color: 3000K-5000K, CRI >80.
5. LED Drivers: UL/CSA recognized component to meet UL8750 & EN61347.
6. Light beam spread: 120° wide beam.
7. Finish: High-gloss black powder coated heat-radiative coating, anti-corrosion, anti-UV paint.
8. Mounting: Beam clamp, ceiling, hook and stem mount availability.
9. Input Power: 120-277V, 50/60 Hz.
10. Total Harmonic Distortion (THD): <20%.
11. Dimming: Driver shall be suitable for full-range dimming. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 10% of rated lumen output with a smooth shut off function. Dimming shall be controlled by a 0-10V signal. Signal wires shall be 22 AWG solid copper minimum. Compatible with Leviton dimming device(s): DS710-10Z or equal.
12. Operating Temperature: -30°C to +55°C ambient.
13. Material Usage: Drivers shall be (ROHS)-compliant.
14. Warranty: Five (5) years.

G. EXIT SIGNS:

1. Comply with LM80 and with authorities having jurisdiction for sign colors and lettering size, and with be LED illuminated
2. Internally Lighted Signs: As follows:
3. Lamps for AC Operations: Light-emitting diodes, 50,000 hours minimum rated lamp life
4. Self-Powered Exit Signs (Battery Type) Integral automatic charger in a self-contained power pack.
5. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty
6. Charger: Fully automatic, solid-state type with sealed transfer relay.
7. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80 percent of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

H. EMERGENCY LIGHTING UNITS:

1. Self-contained units Comply with UL 924/LM 80. Units include the following features:
 - a. Battery: Sealed, maintenance-free nickel - cadmium type with minimum 10-year nominal life and special warranty.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level when normal voltage is restored, relay disconnects lamps and batter is automatically recharged and floated on charger.

I. EMERGENCY LED POWER SUPPLY UNIT:

1. Self-contained, modular, battery-inverter unit factory mounted within fixture body-comply with UL 924/LM 80.
2. Test Switch and light-emitting diode indicate light: Visible and accessible without opening fixture or entering ceiling space.
3. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamp, and battery is automatically recharged and floated on charger.
6. Do not support from sub-purlins of panelized roof systems.

2.12 ENCLOSED SWITCHES AND CIRCUIT BREAKERS:

- A. Provide safety switches of heavy-duty type, horsepower rated, quick-make and quick-break design, externally operated with provision for padlocking in "OFF" position, fusible or non-fusible as shown on the Drawings. Cartridge to accommodate Class R fuses.
- B. Provide enclosures clearly marked for maximum voltage, current, and horsepower rating, and:
 1. Indoor: NEMA type 1
 2. Outdoor: NEMA type 3R, rain tight
 3. Kitchen: NEMA type 4x
- C. For switches having dual ratings (higher rating when used with dual-element fuses), provide ratings indicated on a metal plate riveted or otherwise, or permanently fastened to the enclosure.
- D. For switches serving equipment with multiple motors, switches shall be fused as indicated on the equipment nameplate.

2.13 ENCLOSED CONTROLLERS:

- A. General: Provide Cutler-Hammer or equal, of the sizes and types needed for the operations shown on the Drawings, specified herein, and otherwise required for the facility and with the following attributes:
 1. Comply with pertinent requirements of NEMA and NEC.
 2. Include required accessory items.
 3. Lockable handle to "OFF" position for combination starters.
 4. Horsepower rated, with interchangeable thermal overloads and with double-break contacts capable of interrupting 10 times the rated motor current.
 5. Normally reset without entering the starter enclosure.
 6. Equipped with overloads in each ungrounded leg.
 7. Equipped with integral phase loss protection.
 8. In finished areas where conduit is concealed, switches shall be flush mounted.
- B. Manual Starters:

1. For both single-phase and three-phase starters, provide units that open all ungrounded conductors simultaneously.
2. For single-phase starters, provide units of tumbler switch type that clearly indicate ON, OFF, and TRIPPED positions. Switches shall have built-in thermal overload protection for reach ungrounded conductor. Switches shall be Square D class 2510 or equal.
3. For three-phase starters, provide pushbutton operated units with START-STOP-RESET button on the enclosure cover. Provide handle guards for padlocking in the "OFF" position.

C. Magnetic Starters:

1. Provide units with operating coils designed to operate on line voltage or any other auxiliary voltage shown on the Drawings.
2. For starters with line voltage operating coils, provide built-in under-voltage release.
3. Provide units with the accessories and auxiliary contacts needed for automatic or remote operation as shown on the Drawings.

D. Combination Starters:

1. Provide units complying with requirements for magnetic starters and, in addition, with a fused switch on the same enclosure.
2. Provide circuit protection to comply with NEC requirements for the motor being operated.

E. Lock-out/Tag-out Requirements: Per Owners requirements.

PART 3 FINAL PAYMENT

3.01 TESTING AND INSPECTION:

- A. Provide personnel and equipment, make required tests, and secure approvals from the Owner and governmental agencies having jurisdiction.
- B. Make written notice to the Owner adequately in advance of each of the following stages of construction:
 1. In the underground condition prior to placing concrete floor slab, when all associated electrical Work is in place.
 2. When all rough-in is complete, but not covered.
 3. At completion of the Work of this Section.
 4. Inspect grounding and bonding system and connections for proper installation.
 5. Use suitable test instrument to measure resistance to ground system. Test in accordance with test instrument manufacturer's specified fall-of potential method.
- C. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance, remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.
- D. In the Owner's Presence:
 1. Test all parts of the electrical system and prove that all such items provided under this Section function electrically in the required manner.

2. Measure voltages between phases and between phase wires and neutrals, and report these voltages to the Owner.
 3. Immediately submit to the Owner a report of maximum and minimum voltages, and a copy of the recording volt-meter chart.
- E. Adjust and set all time clocks in accordance with Owner's instructions.

3.02 PROJECT COMPLETION:

- A. Upon completion of the Work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type cleaner recommended by the Manufacturer of the item being cleaned.
- B. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual required to be submitted under Article 1.05 of this Section of these Specifications.

END OF SECTION

"General Decision Number: OK20220053 09/02/2022

Superseded General Decision Number: OK20210053

State: Oklahoma

Construction Type: Building
Building Construction -does not include residential construction consisting of single family homes and apartments up to and including 4 stories. (Including building projects on industrial sites and treatment plants)

County: Tulsa County in Oklahoma.

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	<ul style="list-style-type: none">Executive Order 14026 generally applies to the contract.The contractor must pay all covered workers at least \$15.00 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2022.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	<ul style="list-style-type: none">Executive Order 13658 generally applies to the contract.The contractor must pay all covered workers at least \$11.25 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on

that contract in 2022.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Modification Number	Publication Date	Rates	Fringes
0	01/07/2022		
1	02/18/2022		
2	02/25/2022		
3	06/17/2022		
4	08/05/2022		
5	08/26/2022		
6	09/02/2022		
BROK0005-004 06/01/2022			
BRICKLAYER.....		\$ 26.42	12.49

ELEC0584-006 06/01/2021			
ELECTRICIAN (Excludes Low Voltage Wiring and Installation of Alarms and Sound and Communication Systems).....			
		\$ 32.38	7%+10.15

ELEV0083-003 01/01/2022			
ELEVATOR MECHANIC.....			
		\$ 44.93	36.885+a+b

PAID HOLIDAYS:

a. New Year's Day, Memorial Day, Independence Day, Labor Day,

Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving, and Christmas Day.

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years' service.

* ENG10627-020 06/01/2022

POWER EQUIPMENT OPERATOR:

	Rates	Fringes
Group 1.....	\$ 34.15	15.70
Group 2.....	\$ 32.45	15.70
Group 3.....	\$ 31.90	15.70
Group 4.....	\$ 31.10	15.70
Group 8.....	\$ 26.05	15.70
Group10.....	\$ 24.60	15.70

POWER EQUIPMENT OPERATOR

GROUP 1: All Crane Type Equipment 200 ton and larger and including 400 ton capacity cranes. All Tower Cranes.

GROUP 2: All Crane Type Equipment 100 ton capacity and larger cranes, and less than 200 ton capacity.

GROUP 3: All Crane Type Equipment 50 ton capacity and larger cranes, and less than 100 ton capacity. Crane Equipment (as rated by mfg.) 3 cu. yd. and over Guy derrick Whirley Power Driven Hole Digger (with 30' and longer mast).

GROUP 4: CRANES with Boom Incl. Jib less than 100 ft and less than 3 cu. Yd.; Overhead Monorail Crane

GROUP 8: FORK-LIFT

GROUP 10: OILER; SEMI-TRAILER TRUCK DRIVER

IRON0584-025 06/01/2022

	Rates	Fringes
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IRONWORKER (Ornamental, Reinforcing and Structural).....	\$ 28.00	16.00
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PLUM0430-010 07/01/2021

	Rates	Fringes
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PLUMBER (Excludes HVAC Pipe and Unit Installation).....	\$ 32.85	14.08
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PLUM0430-019 10/01/2020		
HVAC MECHANIC (Installation of HVAC Unit Only, Excludes Installation of HVAC Pipe and Duct).....	\$ 32.25	13.98
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PLUM0430-020 07/01/2021		
PIPEFITTER (Including HVAC Pipe Installation, excluding HVAC Unit Installation).....	\$ 32.85	14.08
-----	-----	-----
ROOF0143-001 07/01/2022		
ROOFER.....	\$ 24.00	9.30
-----	-----	-----
SHEE0270-006 06/01/2020		
SHEET METAL WORKER (HVAC Duct Installation Only).....	\$ 35.49	14.60
-----	-----	-----
* SUOK2012-033 07/30/2012		
CARPENTER (Drywall Hanging Only).....	\$ 15.08	1.21
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CARPENTER, Excludes Drywall Hanging, and Form Work.....	\$ 14.96 **	1.55
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CAULKER.....	\$ 20.00	1.61
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CEMENT MASON/CONCRETE FINISHER...	\$ 13.72 **	1.27
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DRYWALL FINISHER/TAPER.....	\$ 13.00 **	0.00

ELECTRICIAN (Alarm Installation).....	\$ 19.48	3.34
ELECTRICIAN (Low Voltage Wiring).....	\$ 20.65	3.06
ELECTRICIAN (Sound and Communications Systems Installation).....	\$ 21.11	2.47
FORM WORKER.....	\$ 12.69 **	0.38
LABORER: Common or General.....	\$ 12.44 **	2.71
LABORER: Mason Tender - Brick...\$	12.43 **	0.00
LABORER: Mason Tender - Cement/Concrete.....\$	13.00 **	1.91
LABORER: Pipelayer.....\$	12.39 **	0.00
OPERATOR: Asphalt Paver.....\$	16.25	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....\$	16.96	4.22
OPERATOR: Bulldozer.....\$	21.07	2.48
OPERATOR: Grader/Blade.....\$	14.28 **	1.70
OPERATOR: Loader (Front End)....\$	16.18	0.00
PAINTER: Brush, Roller and Spray, Excludes Drywall Finishing/Taping.....\$	12.22 **	0.00
SHEET METAL WORKER, Excludes HVAC Duct Installation.....\$	22.11	4.93
SPRINKLER FITTER (Fire Sprinklers).....\$	21.86	1.19
TRUCK DRIVER: Dump and Flatbed Truck.....\$	11.00 **	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$15.00) or 13658 (\$11.25). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or

""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. Example: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of

each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material,

etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"