Project Manual
of the Material and Labor Required for Construction of

Pittsburg Youth Development Center

HVAC Equipment Replacement
1001 Stoneman Ave.
Pittsburg, CA 94565

Owner:
Pittsburg Unified School District
2000 Railroad Avenue
Pittsburg, CA 94565

Engineer:
McCracken & Woodman, Inc.
Job No. 1717

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SECTION 22 00 00

PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions, Supplementary Conditions, and Division 1 General Requirements apply to the work specified in this Section.

1.2 SUMMARY

A. All materials and operations for a complete and operating plumbing and drainage system, including, but not necessarily limited to, the following:
   1. Demolition of certain plumbing equipment and piping.
   2. Natural gas piping including connection to existing piping.
   3. Condensate drain piping.
   4. Connection to mechanical equipment.

1.3 RELATED WORK

A. Electrical Systems, Section 26 00 00.

B. Heating, Ventilating and Air Conditioning Systems, Section 23 00 00.

1.4 GENERAL REQUIREMENTS

A. Verification of conditions:
   1. Prior to installation of plumbing work, Contractor shall inspect all surfaces to receive said work and arrange with the General Contractor for the satisfactory correction of all defects in workmanship and/or material that could interfere with the work specified herein.
   2. Installation of any plumbing work or materials on any surface shall constitute acceptance by the Contractor of such surfaces as being in proper condition to receive herein specified materials.

B. Examination of site: Examine site prior to bidding. Compare it with drawings and specifications. Check conditions and take measurements, which may affect work. No allowance shall subsequently be made for any extra expense due to failure to make such examination.

C. Manufacturer’s directions: Follow manufacturer's directions covering points not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over drawings and specifications. Where these are in conflict with drawings and specifications, notify Engineer for clarifications before installing the work.

D. Codes: Work and materials shall be in full accordance with all applicable local or state ordinances, California Building Code, California Plumbing Code, National Fire Protection Association, State of California Safety Orders, and State Fire Marshal.

Whenever drawings and specifications require larger sizes or higher standards than are required by regulations, drawings and specifications govern. Whenever drawings or specifications require something, which will violate regulations, regulations govern. No extra charge will be paid for furnishing items required by regulations but not specified or shown on drawings.

E. Cooperation with other trades: Schedule work and cooperate with other divisions to avoid delays, interferences and unnecessary work, conforming to construction schedule, making installation when and where required. A special effort shall be made to coordinate with the Mechanical Contractor so as not to block installation of the mechanical systems. The clearances above ceilings on this project are limited and the ductwork and piping are to have the highest priority. All plumbing work is to be coordinated with the Mechanical Contractor such that the ductwork and piping can be installed in the locations shown on the mechanical drawings. If installed work is later found to interfere with work of other divisions, make all necessary changes at Contractor's expense.

F. Licenses, permits, services, and fees: Secure and pay for all licenses required to begin, perform, and complete work.

G. Quietness of operation: Adjust, repair, or replace any equipment producing objectionable noise or vibration in any occupied areas of building, including providing additional brackets, bracing, etc., to prevent objectionable noise or vibration.

1.5 SUBMITTALS

A. General:
1. Refer also to Division 1 for additional submittal requirements.
2. When specific names are used in connection with materials, they are used as standards only, but this implies no right to use other materials or methods unless approved by the Engineer.
3. Decision of the Engineer shall govern as to what materials are acceptable substitutions. Burden of proof as to equality of any proposed fixtures, material, or equipment shall be upon the Contractor. Petition in favor of proposed substitute materials shall be made directly by the Contractor. If any tests are necessary to determine quality of proposed items, such tests shall be made at the expense of the Contractor by an unbiased laboratory satisfactory to the Engineer.
4. Submit shop drawings and material list in six (6) copies. Submit material list and shop drawings after official award of contract. Obtain approval of the Engineer before installation. Shop drawings shall be submitted for all materials, equipment, and controls.
5. Check shop drawings and submittals before forwarding to Engineer and ascertain that submittals meet all requirements of drawings and specifications and conform to structural space conditions.
6. Shop drawings also shall be prepared for modifications to architectural, electrical, and mechanical work required by proposed materials - i.e., relocation of drains, revised electrical circuits, relocation of penetrations, etc.
7. Installation of any approved substituted equipment is the Contractor's responsibility and any changes required to work included under other sections for installation of approved substituted equipment must be made to the satisfaction

of the Engineer and without any additional cost. Approval by Engineer of substituted equipment and/or dimension drawings does not waive these requirements.

8. Review of drawings and materials submitted for approval shall not be construed as a complete check or constitute a waiver of the requirements of the drawings and specifications. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided and to effect necessary rearrangement or construction of other work. Contractor agrees that shop drawing submittals processed by the Engineer do not become contract documents and are not change orders; that the purpose of the shop drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his work and to permit the Engineer to monitor the Contractor's progress and understanding of the design. If deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents are discovered either prior to or after the shop drawing submittals are processed by the Engineer, the Contractor agrees that the contract documents shall control and shall be followed.
9. Submittal lists shall include the identifying marks assigned to the items. Give name of manufacturer, brand name, and catalog number of each item. Submit complete list at one time with items arranged and identified in numerical sequence within each section and article specifications. Listing items "as specified" without both make and model or type designation is not acceptable, except as noted. Only pipe and fittings not specified by brand names may be listed "as specified" without manufacturer's name, provided proposed materials comply with specification requirements.
10. Descriptive Data: Submit six (6) copies of complete description information and performance data covering equipment that is specified but for which catalog plate numbers, brand names, or specific models have not been used.
11. Submittal of substitutions shall be limited to one proposal for each type or kind of item, unless otherwise permitted by the Engineer.

1.6 DRAWINGS, SPECIFICATIONS, AND COORDINATION OF WORK

A. Drawings are essentially diagrammatic. Size and locations of equipment are generally shown to scale. Make use of data in all Contract Documents, and verify this information against field conditions.

B. The drawings indicate the required size and point of termination of ductwork, pipes, and equipment. Install pipe with all necessary offsets and fittings to conform to the structure, avoid obstructions, preserve headroom, maintain required accessibility, and satisfy the requirements of the governing codes and the standards of good practice.

C. The architectural and structural drawings and specifications take precedence over the mechanical drawings in the representation of the general construction work. Refer to the drawings, specifications, and review shop drawings for all work in order to coordinate plumbing work with the other work of the project.

D. Where changes in indicated locations or arrangements are necessary due to conditions in building construction, interference with work in other divisions, or conflict in location,

make changes at no cost to the Owner. Deviations, offsets, rises or drops in piping that may be necessary, whether shown or not, shall be made at no expense to Owner.

E. Bring discrepancies between different drawings, between drawings and actual field conditions, or between drawings and specifications promptly to the attention of the Engineer for decision, and stop all work on affected areas subject to resolution of the conflict.

1.7 MATERIALS AND WORKMANSHIP

A. All materials and equipment to be new and in perfect condition. Materials or equipment for similar uses are to be of same type and manufacturer.

B. Workmanship shall be of best standard practice of the trade.

1.8 PROTECTION OF EQUIPMENT

A. The Contractor shall be responsible for damage to any of the work of this section until final acceptance. Cover all openings, apparatus, equipment, and appliances both before and after being set in place to prevent misuse or disfigurement of the apparatus, equipment, or appliances.

1.9 OPENINGS

A. The Contractor shall cooperate with other trades in providing information for openings required in walls, floors, and roof for pipe and equipment.

B. The Contractor shall pay all extra costs for cutting of openings as a result of incorrect, delayed, or neglected information.

C. Make absolutely watertight any openings through waterproofed construction caused by the penetration of piping and in a manner approved by the Engineer.

1.10 CLEAN-UP

A. Thoroughly clean all parts of the apparatus and equipment. Exposed parts which are to be painted shall be thoroughly cleaned and all grease and oil spots removed with cleaning solvent.

B. Remove all debris and surplus equipment and leave installation in perfect condition ready for use.

1.11 CONSTRUCTION REVIEW

A. All services rendered by the Engineer or any of his consultants consist of professional opinions and recommendations made in accordance with generally accepted engineering practice.

B. Under no circumstances is it the intent of the Engineer or any of his consultants to directly control the physical activities of the Contractor or the Contractor's workmen in the accomplishment of work on this project.

C. The presence of the field representative of the Engineer or any of his consultants at the site is to provide to the Owner and/or Engineer an additional source of professional advice, opinions, and recommendations based upon the field representative's observations.

1.12 SAFETY

A. In accordance with generally accepted construction practices, the Contractor will be solely and completely responsible for conditions on the jobsite, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours.

B. Construction review by the Engineer or any of his consultants is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction take out extra space site or at any other location.

1.13 OPERATING INSTRUCTIONS

A. Upon completion of work, the Contractor shall place a competent person in charge who will operate the system and instruct the Owner’s representative in all details of the operation and maintenance of the plumbing system.

B. The Contractor shall carefully prepare four (4) descriptive booklets of the entire plumbing systems and a full description of the operation and maintenance of each piece of equipment.

C. Operating instruction manuals are to include names, addresses, and telephone numbers for the following: project name, Owner, General Contractor, Plumbing SubContractor, and equipment manufacturer’s (including local representatives).

1.14 GUARANTEE

A. The Contractor shall furnish a written guarantee to the Owner that the new materials, equipment, and installation are new, free from mechanical defects, noiseless, and are in perfect operating condition.

B. The Contractor shall guarantee to replace and repair at his own expense any and all unsatisfactory and defective work and items to the satisfaction of the Owner for a period of one (1) year after systems have been accepted by the Engineer and are put to beneficial use.

C. The Contractor shall also furnish the Owner with all manufacturer's written guarantees of materials and equipment.

1.15 RECORD DRAWINGS

A. Record drawings are to include all changes made during construction from the design drawings. The record drawings are to show the changes as mark-ups on the design drawings. Shop drawings prepared as CAD drawings will not be accepted as record drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Condensate drain piping:
   1. Type M copper tubing ANSI H23.1 with wrought copper sweat fittings ANSI B16.22 joined with lead free solder.

B. Natural gas piping:
   1. Above grade: Schedule 40 black steel pipe ANSI B125.2 and 150 PSI black malleable iron screwed fittings ANSI B16.3 for piping 2" and smaller and seamless welded joint 2-1/2" and larger. Pipe and fittings outside of the buildings are to be galvanized. Wrap below grade piping per AWWA HOC 203.

C. Unions and flanges:
   1. Steel pipe unions: Malleable iron ground joint pattern with brass to iron seats, 150 psi.
   2. Steel pipe flanges: ANSI B16.C, 150 psi forged steel welding type with flat face.
   3. Copper tubing unions: 150 psi ground joint cast bronze unions with sweat connections.
   4. Copper tubing flanges: ANSI B16.24, bronze, 150 psi to match standard ASA 150 psi steel flanges with flat face.
   5. Flange gaskets: Crane Co Cranite, 1/16" full face sheet packing, 150 psi. Coat gaskets with thread lubricant before installation.

D. Dielectric protection:
   1. Location: For connection between dissimilar metals in the piping systems to control corrosion caused by galvanic or electrolytic action. No dielectric unions allowed.
   2. Listing: Victaulic Style 47, Lochinvar V-line, Waterway or equal.
      a. Dielectric couplings: Threaded for sizes 2 inches and smaller, grooved or flanged for 2-1/2 inches and larger.

E. Thread lubricant for steel pipe: Armite Joint Seal Compound No. 250.

F. Valves: Shall be a product of single manufacturer, Red-White, NIBCO, Milwaukee or equal.
   1. Ball valves (natural gas): #5044F, Brass Body, 600 psi, full port.
   2. Valves shall be same size as line in which they are installed. No valve shall be installed with stem pointed below horizontal.

G. Pipe sleeves: Adjus-To-Crete 24 ga., electrogalvanized sheet metal adjustable sleeve, or equal.

H. Seismic bracing: Conform to SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems, Second Edition, 1998.

I. Escutcheon plates: For pipes passing through finished ceilings, walls, and floors in conspicuous locations, use chromium-plated steel floor and ceiling plates with set screw or other approved means of holding securely in place.

PART 3 - EXECUTION

3.1 GENERAL

A. Support exposed and concealed piping on specified hangers properly spaced and set to allow piping to adjust for temperature change expansion and contraction. Evenly space and support piping in parallel.

B. Coordinate with other trades to provide continuous support channel for all pipes and conduit in exposed locations.

C. Conceal piping in ceilings, furred walls, partitions and pipe spaces, except where noted otherwise. Provide maximum head room and run piping to maintain proper clearance for piping runs beforehand and with other divisions to insure clearance. Where work of other divisions prevents installation of piping shown on drawings, reroute piping as directed by Engineer at no extra cost to Owner.

D. Install exposed piping parallel to or at right angles with building walls.

E. No valve, piece of equipment, or trim shall support the weight of any pipe. Install valves, traps, cleanouts, etc., in accessible locations.

F. Install piping free from traps and air pockets.

G. Wherever changes in sizes of piping occur, use reducing fittings.

H. Install unions adjacent to threaded valves, equipment, and at other points where required for disassembly.

I. Provide sleeves wherever pipes run through walls, slabs, beams, footings, and floors large enough for passage of pipe and/or pipe insulation. Sufficiently size sleeves to allow for contraction and expansion of pipe. Pack sleeves with approved packing material. Pack sleeves in walls and slabs below grade and through exterior walls above grade with waterproof mastic or grout.

J. Where sleeves are missed or misplaced during canning, core holes with rotary diamond tooth core drills.

K. Fit exposed pipes, which pass through walls, ceilings, or floors in finished rooms and conspicuous locations with escutcheon plates.

L. Install insulating unions or flanges at ferrous and nonferrous piping connections.

M. Minimum bury for exterior piping: 30" below finish grade, except as otherwise noted or determined by invert elevations.

3.2 PIPE HANGERS, SUPPORTS, AND BRACES

A. Piping at completion of job shall be rigid and immobile. Install additional pipe supports, brackets, and hangers as required to accomplish a rigid and immobile piping system.

B. Double wrap copper pipe with heavy vinyl tape where pipe comes in contact with ferrous materials.

3.3 CLEANING

A. Thoroughly clean exterior and interior of piping, equipment, and materials before systems are put in operation. Remove paint, concrete, plaster, and other foreign materials. Clean valve handles and stems of any paint, dirt, or other foreign materials. Clean drains of dirt and debris. Remove shipping paper from cleanout covers and polish. Remove and clean out dirt and debris from pipe spaces, including wire and blocking.

3.4 TESTING

A. Condensate drain piping: Test with minimum height of stand pipe 10'-0". Test duration to be a minimum of four (4) hours.

B. Gas piping: Test with air under pressure of 100 psi for a minimum test duration of four (4) hours.

C. If systems are tested in sections, include connection to previously tested section. Final pressures at end of test period shall be no more nor less than that caused by expansion or contraction of test medium due to temperature changes. Apply tests for a minimum period of four (4) hours or as required by local codes or agencies having jurisdiction. Where testing pressures are higher than rated pressure for equipment, or special trim, remove and bypass item with temporary piping for purposes of test.

D. Testing shall be done in the presence of the Owner's representatives.

3.5 PIPING IDENTIFICATION

A. Installation:

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

C. Plastic nameplates: Install with corrosive-resistant mechanical fasteners or adhesive.

D. Plastic pipe markers: Install in accordance with manufacturer's instructions. Maximum spacing is to be twenty (20) feet on center.

E. Valves: Identify valves in main and branch piping with tags.

F. All exposed piping and piping above accessible ceilings shall be neatly identified spaced not more than twenty (20) feet on center.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions, Supplementary Conditions, and Division 1 General Requirements apply to the work specified in section.

1.2 SUMMARY

A. The work shall consist of furnishing all labor, material, and equipment required to complete the installation of the heating, ventilating, and air conditioning (HVAC) systems as indicated on the drawings and described herein, including all incidental work necessary to make it complete and satisfactory and ready for operation. Work shall include, but not be limited to, the following principal items:
   1. Demolition of certain HVAC equipment and related accessories.
   2. Air conditioning unit.
   3. Heating and ventilating units.
   4. Miscellaneous, including instruments, sleeves, flashings, tags and markings, and all accessories and items necessary for a complete installation.
   5. Testing and adjusting all system components.
   6. Testing and balancing of all air systems.
   7. Complete control systems including:
      a. Thermostats.
      b. Sensors.
      c. Low voltage wiring.
      d. Coordination with other trades to ensure required work is completed.
      e. Check-out and commissioning of control systems to verify sequences of operation are in accordance with the drawings.

1.3 RELATED WORK

A. Plumbing Systems, Section 22 00 00.

B. Electrical Systems, Section 26 00 00.

1.4 GENERAL REQUIREMENTS

A. Verification of conditions: Prior to installation of HVAC work, inspect all surfaces to receive said work and arrange for the satisfactory correction of all defects in workmanship and/or material that could interfere with the work specified herein. Installation of any HVAC work or materials on any surface shall constitute acceptance of such surfaces as being in proper condition to receive herein specified materials.

B. Codes: Work and materials shall be in full accordance with all applicable local or state ordinances, California Building Code, California Mechanical Code, National Fire

Protection Association, State of California Safety Orders, and State Fire Marshal. Whenever drawings and specifications require larger sizes or higher standards than are required by regulations, drawings and specifications govern. Whenever drawings or specifications require something, which will violate regulations, regulations govern. No extra charge will be paid for furnishing items required by regulations but not specified or shown on drawings.

C. Reference standards: Published specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to work of this Section where cited below:

1. Air Moving and Conditioning Association (AMCA).
2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
3. American Society of Mechanical Engineers (ASME).
4. American Society of Plumbing Engineers (ASPE).
5. Associated Air Balance Council (AABC).
6. National Electrical Manufacturers Association (NEMA).
7. National Fire Protection Association (NFPA).
8. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
9. California Building Code (CBC).
10. State of California - OSHA.
11. California Mechanical Code (CMC).
12. The State of California Codes and Safety Orders.
13. 2016 California Building Energy Efficiency Standards (Title 24).
14. State Fire Marshal requirements (SFM).
15. Air Conditioning and Refrigeration Institute (ARI).
16. State of California Environmental Quality Act.
17. American Society of Testing and Materials (ASTM).
18. Underwriters Laboratories (UL).
19. Occupational Safety and Health Act (OSHA).
20. National Bureau of Standards (NBS).
21. American National Standards Institute (ANSI).
22. AMCA Standard 99: Standards Handbook.
23. AMCA/ANSI Standard 204: Balance Quality and Vibration Levels for Fans.
24. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings.
25. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans.
26. AMCA Standard 500:Test Methods for Louvers, Dampers and Shutters.
27. ARI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil.
28. ANSI/ASHRAE 15: Safety Code for Mechanical Refrigeration.
29. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
30. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
31. ASME Section VIII: Unified Pressure Vessel Code.
32. UL Standard 1995: Heating and Cooling Equipment.
33. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
34. ASHRAE Standard 62.1-2013: Ventilation for Acceptable Indoor Air Quality.

35. ANSI/ASHRAE Standard 55-2013: Thermal Environmental Conditions for Human Occupancy.

D. Materials and workmanship:
   1. All materials and equipment to be new and in perfect condition. Materials or equipment for similar uses are to be of same type and manufacturer.
   2. Workmanship shall be of best standard practice of the trade.

E. Protection of equipment: The Contractor shall be responsible for any damage to any of the work of this section until final acceptance. Cover all duct, pipe and equipment openings, and cover all apparatus, equipment, and appliances both before and after being set in place to prevent misuse or disfigurement of the apparatus, equipment, or appliances.

F. Openings:
   1. Cooperate with other trades in providing information as to openings required in walls, floors, and roof for ducts and equipment.
   2. Pay all extra costs for cutting of openings as a result of incorrect, delayed, or neglected information.
   3. Make absolutely watertight any openings through waterproofed construction caused by the penetration of ductwork or piping, in a manner approved by the Engineer.

G. Cleanup:
   1. Thoroughly clean all parts of the apparatus and equipment. Exposed parts, which are to be painted shall be thoroughly cleaned of cement, plaster, and other materials, and all grease and oil spots removed with cleaning solvent.
   2. Inside of all pipes, ducts, etc., shall be flushed or cleaned before being placed in operation, and all strainers shall be cleaned after operational tests.
   3. Remove all debris and surplus equipment and leave installation in perfect condition ready for use.

H. Construction review:
   1. All services rendered by the Engineer or any of his consultants consist of professional opinions and recommendations made in accordance with generally accepted engineering practice.
   2. Under no circumstances is it the intent of the Engineer or any of his consultants to directly control the physical activities of the Contractor or the Contractor's workmen in the accomplishment of the work.
   3. The presence of the field representative of the Engineer or any of his consultants at the site is to provide to the Owner and/or Engineer an additional source of professional advice, opinions, and recommendations based upon the field representative's observations.

I. Safety:
   1. In accordance with generally accepted construction practices, the Contractor will be solely and completely responsible for conditions on the project site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited by normal working hours.

2. Construction review by the Engineer or any of his consultants is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the project site or at any other location.

J. Welder's qualifications:
1. All welding must be performed by registered welders qualified to perform welding operations in accordance with ASME Code Standards.

1.5 SUBMITTALS

A. Refer also to Division 1 for additional submittal requirements.

B. When specific names are used in connection with materials, they are used as standards only, but this does not imply the right to use other materials or methods unless approved by the Engineer.

C. Decision of the Engineer shall govern as to what materials are acceptable substitutions. Burden of proof as to equality of any proposed fixtures, material, or equipment shall be upon the Contractor. Petition in favor of proposed substitute materials shall be made directly by the Contractor. If any tests are necessary to determine equality of proposed items, such tests shall be made at the expense of the Contractor by an unbiased laboratory satisfactory to the Engineer.

D. Submit shop drawings and material list in six (6) copies. Submit material list and shop drawings after official award of contract. Obtain approval of the Engineer before installation. Shop drawings shall be submitted for all materials, equipment, and controls.

E. Check shop drawings and submittals before forwarding to Engineer and ascertain that submittals meet all requirements of drawings and specifications and conform to structural conditions available.

F. Shop drawings also shall be prepared for modifications to architectural, structural, plumbing, electrical, and mechanical work required by proposed materials - i.e., relocation of drains, revised electrical circuits, relocation of penetrations, etc.

G. Installation of any approved substituted equipment is the Contractor's responsibility, and any changes required to work included under other sections for installation of approved substituted equipment must be made to the satisfaction of the Engineer and without any additional cost. Approval by Engineer of substituted equipment and/or dimension drawings does not waive these requirements.

H. Review of drawings and materials submitted for approval shall not be construed as a complete check or constitute a waiver of the requirements of the drawings and specifications but will indicate that the material submitted is acceptable in quality, utility, and capacity. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided and to effect necessary rearrangement or construction of other work. Contractor agrees that shop drawing submittals processed by the Engineer do not become contract documents and are not change orders; that the purpose of the shop drawing review is to establish a reporting procedure and is

intended for the Contractor's convenience in organizing his work and to permit the Engineer to monitor the Contractor's progress and understanding of the design. If deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents are discovered either prior to or after the shop drawing submittals are processed by the Engineer, the Contractor agrees that the contract documents shall control and shall be followed.

I. Submittal lists shall include the identifying marks assigned to the items. Give name of manufacturer, brand name, and catalog number of each item. Submit complete list at one time with items arranged and identified in numerical sequence within each section and article of the specifications. Listing items "as specified" without both make and model or type designation is not acceptable except pipe and pipe fittings not specified by brand names, which may be listed "as specified" without manufacturer's name, provided proposed materials comply with specification requirements.

J. Descriptive Data: Submit complete description, information, and performance data covering equipment which is specified but for which catalog plate numbers, brand names, or specific models have not been used. Include fan performance curves for all equipment with fans and for each individual fan submitted.

K. Submittal of substitutions shall be limited to one (1) proposal for each type or kind of item, unless otherwise permitted by the Engineer.

1.6 DRAWINGS, SPECIFICATIONS, AND COORDINATION OF WORK

A. Drawings are essentially diagrammatic. Size and locations of equipment are generally shown to scale. Make use of data in all contract documents, and verify this information against field conditions.

B. The drawings indicate the required size and point of termination of ductwork, pipes, and equipment. Install pipe with all necessary offsets and fittings to conform to the structure, avoid obstructions, preserve headroom, maintain required accessibility, and satisfy the requirements of the governing codes and the standards of good practice.

C. Where changes in indicated locations or arrangements are necessary due to conditions in building construction, rearrangement of equipment, or conflict in location, make such changes at no cost to the Owner, provided that the change is ordered before pipe ductwork and/or equipment is installed and that the length of run is not revised by more than 5 percent of the indicated run.

D. Bring discrepancies between different drawings, between drawings and actual field conditions, or between drawings and specifications promptly to the attention of the Engineer for decision, and stop all work on affected areas subject to resolution of the conflict.

1.7 OPERATING INSTRUCTIONS

A. Comply with the requirements of Division 1 – General Requirements.

B. Upon completion of the work, the Contractor shall place a competent person in charge who will operate the system and instruct the Owner's representatives in all details of the operation and maintenance of each piece of equipment and each system.

C. The Contractor shall carefully prepare four (4) descriptive binders of the entire HVAC system and a full description of the operation and maintenance of each piece of equipment. The binders shall have tabs indicating each type of equipment with sub-dividers indicating the equipment symbol shown on the drawings. An index shall be provided with page numbers for each type of equipment and each piece of equipment. The binders shall be well organized to provide easy reference.

D. Operating instruction manuals are to include names, addresses, and telephone numbers for the following: project name, Owner, Mechanical Contractor, and equipment manufacturers (including local representatives).

1.8 GUARANTEE

A. The Contractor shall furnish a written guarantee to the Owner that the materials, equipment, and installation are new, free from mechanical defects, noiseless, and are in perfect operating condition.

B. The Contractor shall guarantee to replace and repair at his own expense any and all unsatisfactory and defective work and items to the satisfaction of the Owner for a period of at least one (1) year after start-up and air balance are complete, the air balance report has been submitted and approved and the HVAC systems are put to beneficial use.

C. The Contractor shall also furnish to the Owner all manufacturer's written guarantees of materials and equipment.

1.9 RECORD DRAWINGS

A. Record drawings are to include all changes made during construction from the design drawings. The record drawings are to show the changes as mark-ups on the design drawings. Shop drawings prepared as CAD drawings will not be accepted as record drawings.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Air conditioning unit:
   1. Completely packaged, high efficiency, self-contained, fully charged, gas-electric unit, weatherproofed, suitable for outdoor installation. Unit to be ARI certified, AGA approved and U.L. listed. Unit shall meet the requirements of the current Titel 24 Energy Standard Requirements.
   2. Carrier 48HC or equal as scheduled on the drawings. Verify that the total cooling capacity, sensible cooling capacity, heating capacity, and blower capacity meet or exceed those of the Carrier unit scheduled.

3. A complete unit, factory assembled, precharged, and ready for operation except for external service connections. Unit shall be internally prewired including contacts, relays, compressor short cycle and low voltage protections overload protection control wiring to terminate block. Crankcase heater, low ambient control to 35°F and fully modulating enthalpy controlled economizer cycle.
4. Unit shall be one hundred (100) percent factory run tested before shipping.
5. Unit shall meet or exceed the EER rating scheduled on the drawings.
6. Provide factory five (5) year refrigeration compressor warranty.
7. Provide all options and accessories as scheduled on drawings.

B. Heating and ventilating units:
1. Heating and ventilating units shall be Reznor model RPB outdoor, power vented, gas fired, packaged duct furnace/blower units.
2. Each heating and ventilating unit shall be derated to the gas input and output as shown on the drawings.
3. Heating and ventilating units are to be a direct replacement for the existing heating and ventilating units and are to be suitable for mounting on the existing roof curbs.
4. Provide all options and accessories as scheduled on the drawings.

2.2 SYSTEMS

A. Supports and anchors:
1. Supports and anchors are to be as shown on the drawings. If supports and anchors are not shown on the drawings the following applies:
2. Flashing:
a. Follow the roof manufacturer's recommendations for all roof penetrations, curbs, platforms, and sleepers.
3. Sleeves:
a. Sleeves for pipes through nonfire rated floors: Form with 18 gauge galvanized steel.
b. Sleeves for pipes through nonfire rated beams, walls, footings, and potentially wet floors: Form with steel pipe or 18 gauge, 1.2 mm thick galvanized steel.
c. Sleeves for pipes through fire rated and fire resistive floors and walls, and fireproofing: Prefabricated fire rated sleeves, including seals, UL Listed.
d. Sleeves for round ductwork: Form with galvanized steel.
e. Sleeves for rectangular ductwork: Form with galvanized steel or wood.
f. Stuffing fire stopping insulation: Glass fiber type, noncombustible.
g. Caulk: Acrylic sealant.

B. Vibration isolation:
1. Refer to the drawings for vibration isolation requirements.
2. Vibration isolation is to be Mason Industries or equal.

C. Mechanical identification:
1. Equipment and damper identification shall be manufactured by Marking Services, Incorporated or equal.
2. Materials:
a. Color: Unless specified otherwise, conform with ANSI/ASME A13.1.

b. Plastic nameplates: Laminated 3-layer plastic with engraved black 2 inch letters on light contrasting background color.

D. Testing, adjusting, and balancing:
1. Scope includes but is not limited to:
a. Testing, adjustment, and balancing of air systems.
b. Measurement of final operating condition of HVAC systems.
2. References:
a. AABC: National standards for field measurement and instrumentation, total system balance.
b. ASHRAE: Systems handbook: Testing, adjusting, and balancing.
c. NEBB: Procedural standards for testing, balancing, and adjusting of environmental systems.
3. Submittals:
a. Submit name of adjusting and balancing agency for approval.
b. Pre-construction plan
1) The Testing, Adjusting and Balancing Contractor is to submit a plan at least two (2) weeks prior to the commencement of testing, adjusting and balancing work which includes the following:
a) A complete set of report forms intended for use on the project, with all data filled in except for the field readings. Forms to be project specific.
b) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
c) Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certs to be included.
d) A narrative of any project specific and/or non-standard testing, adjusting and balancing procedures to be used, and the equipment or systems they apply to.
c. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.
4. Report forms:
a. Submit reports on AABC National Standards for Total System Balance or NEBB forms.
b. Forms shall include the following information:
1) Title page:
a) Company name
b) Company address
c) Company telephone number
d) Project name
e) Project location
f) Project engineer
g) Project engineer
h) Project Contractor
i) Project altitude

2) Instrument list:
   a) Instrument
   b) Manufacturer
   c) Model
   d) Serial number
   e) Range
   f) Calibration date
3) Air moving equipment:
   a) Location
   b) Manufacturer
   c) Model
   d) Air flow, specified and actual
   e) Return air flow, specified and actual
   f) Outside air flow. specified and actual
   g) Total static pressure (total external), specified and actual
   h) Inlet pressure
   i) Discharge pressure
   j) Fan RPM
4) Electric motors:
   a) Manufacturer
   b) HP/BHP
   c) Phase, voltage, amperage; nameplate, actual, no load.
   d) RPM
   e) Service factor
   f) Starter size, rating, heater elements
5) V-belt drive:
   a) Identification/location
   b) Required driven RPM
   c) Driven sheave, diameter and RPM
   d) Belt, size, and quantity
   e) Motor sheave, diameter, and RPM
   f) Center to center distance, maximum, minimum, and actual
6) Air conditioning unit data:
   a) Manufacturer
   b) Identification/number
   c) Location
   d) Model
   e) Design external static pressure
   f) Actual external static pressure
   g) Design supply and return air flow
   h) Actual supply and return air flow
   i) Design inlet static pressure
   j) Actual inlet static pressure
   k) Design discharge static pressure
   l) Actual discharge static pressure
   m) Filter type
   n) Filter static pressure drop
   o) Design outside air quantity
   p) Actual outside air quantity
   q) Actual outside air temperature

r) Actual mixed air temperature, heating and cooling
s) Actual supply air temperature, heating and cooling

7) Air conditioning unit power exhaust data:
a) Manufacturer
b) Location
c) Model
d) Design external static pressure
e) Actual external static pressure
f) Design exhaust airflow - maximum
g) Actual exhaust airflow - maximum

8) Heating and ventilating unit data:
a) Manufacturer
b) Identification/number
c) Location
d) Model
e) Design external static pressure
f) Actual external static pressure
g) Design supply and return air flow
h) Actual supply and return air flow
i) Design discharge static pressure
j) Actual discharge static pressure
k) Design outside air quantity
l) Actual outside air quantity
m) Filter type
n) Filter static pressure drop
o) Supply air and outside temperature, heatingmode

5. Air balance tolerances:
a. Air balance shall be made with least possible friction.
b. Allowances shall be made for air filter resistance at the time of the tests. The main air supplies shall be at design air quantity with pressure drop across the air filter bank at simulated dirty condition.
c. Air balance tolerances:
1) Supply air: The room air supply shall be plus 10%, minus 0% from the design air quantity for rooms with an air supply of under 1000 cfm and plus or minus 5% where the air supply is 1000 cfm or more. In rooms with multiple supply outlets, the air supplied shall be within plus 5%, minus 0% of the design air quantity.
2) Return air: The main air returns shall be plus 10%, minus 0% from the design air quantity for rooms with an air return of under 1000 cfm and plus or minus 5% where the air return is 1000 cfm or more. In rooms with multiple return inlets, the air returned shall be within plus 5%, minus 0% of the design air quantity.
3) Outside air: The outside air setting is to be plus 5%, minus 5% from the design air quantity.

6. Quality assurance:
a. Agency shall be company specializing in the adjusting and balancing of systems specified with a minimum of 3 years experience. Perform work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing, and Adjusting Supervisor.

b. Total system balance shall be performed in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance, ASHRAE Systems Handbook, or NEBB Procedural Standards for Testing, Balancing, and Adjusting of Environmental Systems.
c. Schedule and sequence work to ensure completion of work before substantial completion of Project.

7. Schedule and sequence work to ensure completion of work before substantial completion of project.
8. Agencies: The following agencies are acceptable for this Project: National Air Balance, Mechanical Environmental Systems (MESA), or equal.
9. Examination:
   a. Before commencing work, verify that systems are complete and operable. Ensure the following:
      1) Equipment is operable and in a safe and normal condition.
      2) Control systems are installed complete and operable.
      3) Proper thermal overload protection is in place for electrical equipment.
      4) Final filters are clean and in place. If required, install temporary media in addition to final filters.
      5) Duct systems are clean of debris.
      6) Correct fan rotation.
      7) Coil fins have been cleaned and combed.
      8) Report any defects or deficiencies noted during performance of service to the Engineer.
      9) Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
      10) If, for design reasons, system cannot be properly balanced, report as soon as observed.
      11) Beginning of work means acceptance of existing conditions.
10. Preparation:
    a. Provide instruments required for testing, adjusting, and balancing operations.
    b. Provide additional balancing devices as required.
11. Adjusting:
    a. Recorded data shall represent actually measured or observed condition.
    b. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
    c. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
    d. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
    e. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Representative.
12. Air system procedure:
    a. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at all locations.
    b. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

c. Measure air quantities at air inlets and outlets.
d. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
e. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
f. Vary total system air quantities by adjustment of fan speeds. Install drive changes as required. Vary branch air quantities by damper regulation.
g. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
h. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
i. Adjust outside air automatic dampers, outside air and return air dampers for design conditions.
j. Measure temperature conditions across outside air and return air dampers to check leakage.

PART 3 - EXECUTION

3.1 GENERAL

A. For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workmen who are properly qualified for the work they perform. All installers are to be completely familiar with the manufacturer's current recommended methods of installation and shall so execute.

3.2 EQUIPMENT

A. All equipment is to be installed to meet the manufacturer's installation instructions, guidelines, and recommendations.

3.3 MECHANICAL IDENTIFICATION

A. Installation:
1. Degrease and clean surfaces to receive adhesive for identification materials.
2. Plastic nameplates: Install with corrosive-resistant mechanical fasteners or adhesive.
3. Equipment: Identify all equipment with plastic nameplates.

3.4 SUPPORTS AND ANCHORS

A. Equipment bases and supports:
1. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

B. Flashing:
1. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, and roofs in accordance with roofing manufacturer's recommendations.

2. Provide acoustical lead flashing around ducts penetrating building wall from roof-mounted equipment. Flashing to be installed in accordance with manufacturer's instructions for sound control.

C. Sleeves:
1. Install steel escutcheons at interior and exterior surfaces.

3.5 SYSTEM TEST AND STARTUP

A. Check the installation and connection requirements for conformance with the manufacturer's installation instructions for each piece of equipment.

B. Perform the step-by-step checkout and startup procedures for each piece of equipment in accordance with the manufacturer's startup instructions.

C. The Mechanical Contractor is to coordinate the efforts of the Test and Balance Contractor to ensure that all systems are tested and performing as intended.

D. Make all necessary control and system adjustments and operate the system in its final configuration for a period of ten (10) working days for the purpose of proving satisfactory performance. During this period, instruct such persons as Owner may designate in proper operation, care, and maintenance of the systems.

END OF SECTION

SECTION 26 00 00

ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working electrical installation, as shown on the drawings or described in these Specifications. The work shall include materials, appliances and apparatus not specifically mentioned herein or noted on the drawings as being furnished and installed under another section.

B. Work Included:
1. Service and connections to motors and equipment furnished under other divisions.
2. Overcurrent protective devices.
3. Grounding.
4. Incidental work and materials involved in installing the electrical equipment including, but not limited to, rigging, support hardware, temporary lighting and carpentry.
5. Fire-stopping.
6. Compliance with all applicable codes.
7. Testing.
8. Seismic bracing and structural calculations for anchoring and bracing of installed equipment.
9. Project record drawings.
10. Electrical permit(s).

1.2 RELATED SECTIONS

A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete, finished and workmanlike installation.

B. Perform the following work, in accordance with the appropriate sections of the specifications as necessary to furnish a complete, working electrical installation.
1. Moisture protection: Include sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations through walls, and roofs. All leaks caused by this contractor's work shall be repaired at no additional cost to the owner.
2. Miscellaneous metal work: Include fittings, brackets, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panel etc.
3. Mechanical Equipment: Provide power wiring, fused disconnect switches and electrical connections for all mechanical equipment. Refer to the mechanical drawings for additional requirements. All electrical power (including 120V control power) and interfacing relays and other devices shown on those drawings as

being furnished by the electrical contractor shall be included in the pricing. Provide roof receptacles as required by code. Roof receptacles shall be ground fault with built-in test and reset.

4. Equipment furnished under other contracts requiring electrical power and connections: Information regarding power and control connections is shown on the electrical drawings. It is the contractor's responsibility to obtain a set of vendor's installation drawings and coordinate the details of the electrical installation with them.

1.3 DEFINITIONS

Furnish: Purchase and deliver to jobsite in new condition.
Install: Receive and store at jobsite until required; place, secure and connect; provide appurtenances.
Provide: Furnish and install as defined above.
Section: Refers to a section of these specifications.
NEC: National Electrical Code.
NETA: International Electrical Testing Association.
Contractor: Electrical Contractor.
Commissioning: Complete system testing and debugging. After commissioning the system under test shall be fully operational and ready to turn over to the owner.

1.4 SEISMIC BRACING

A. All major electrical components including, but not limited to, conduit racks and panel board shall be anchored and braced to conform to the International Building Code.

1.5 QUALITY ASSURANCE

A. Materials and Systems:
   1. Labels: Provide materials listed and labeled by Underwriters' Laboratories or testing firm acceptable to authority having jurisdiction, where listing service is normally provided for product.
   2. Materials:
      a. Provide new and ship to jobsite in original manufacturer's containers or bundles. Materials and equipment for which tests have been established by Underwriters Laboratories, Inc. shall bear its label of approval or the label of an OSHA approved nationally recognized testing laboratory [NRTL].
      b. The materials to be furnished shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to material specified, and shall be the manufacturer's latest standard design that complies with the Specification requirements.

B. Workmanship: Arrange work to as required for a coordinated installation.

C. Code Compliance: Comply with applicable codes, laws, rules, regulations, and standards of applicable code-enforcing authorities.

D. References and Standards: All materials and equipment shall comply with all applicable standards and requirements of the standards listed below. Nothing in the

Drawings or Specifications shall be construed to permit Work not conforming to applicable laws, ordinances, rules, regulations. It is not the intent of Drawings or Specifications to repeat requirements of codes except where necessary for completeness or clarity.

1. Underwriters' Laboratories, Inc. (UL).
2. American National Standards Institute (ANSI).
3. Institute of Electrical and Electronics Engineers (IEEE).
4. National Electrical Code (NEC) (as currently adopted by the AHJ).
5. International Building Code (IBC).
6. Standard for Electrical Safety in the Work Place (NFPA-70E, 2009 Edition).
7. National Electrical Manufacturer's Association (NEMA).
8. National Fire Protection Association (NFPA).
9. NETA Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
10. State of California Energy Regulations.

E. If the Drawings or Specifications are not clear, the Subcontractor shall issue a Request for Information (RFI) for an interpretation and decision prior to proceeding with the Work.

F. Manufacturer's Directions: Follow manufacturer's directions for specific equipment installation requirements. Manufacturer's directions do not take precedence over the drawings and specifications and where these are in conflict notify the Architect for clarification prior to proceeding with the work.

G. Protection of Equipment:

1. Care shall be exercised during construction to avoid damage to equipment. Equipment shall be protected from dust and moisture prior to and during construction.
2. Where required or directed, construct temporary protection for equipment and installations so as to protect same from dust and debris caused by construction.
3. The Subcontractor shall repair by spray or brush painting, after properly preparing the surface, scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used.
4. Failure of the Subcontractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

H. Qualifications and License Requirements:

1. The subcontractor performing electrical construction work on the project shall have an Electrical Construction License from the State of California.
2. The Subcontractor performing electrical construction work shall have sufficient experience in this type of construction.
3. Certified electricians shall have evidence of certification in their possession at all times. Non-certified personnel shall perform electrical work under the continuous supervision of a certified electrician.

1.6 SUBMITTALS

A. A complete list of materials and equipment proposed shall be submitted for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog

number, type or class, rating, capacity, size, etc.

B. Submittals shall include, but not be limited to, manufacturer's product literature, dimensioned drawings, one-line drawings and performance data as necessary to verify compliance to specification requirements.

C. Submit product information for supplied products for approval.
1. Overcurrent protection devices.
2. Fused disconnect switches.
3. Conduits.
4. Conductors.

1.7 SUBSTITUTION

A. The manufacturer's equipment described on the drawings and listed first in the specification is the basis of the design. Where manufacturers of generally comparable products are listed, these are substitute items subject to proof of acceptability.

B. No resubmittal of substitute items shall be allowed. If a substitute item is rejected, the contractor shall provide the specified item.

C. Installation of approved substituted equipment is the Subcontractor's responsibility, and changes required to work included under other divisions for installations of approved substituted equipment must be made to the satisfaction of the Architect-Engineer and without change in contract price. Approval by the Architect-Engineer of substituted equipment and/or dimension drawings does not waive these requirements.

1.8 SUPERVISION

A. The contractor shall personally or through an authorized and competent representative constantly supervise the work from beginning to completion and, within reason, keep the same workmen and foreman on the project throughout the project duration.

1.9 PROTECTION

A. Keep conduits, junction boxes and outlet boxes and other openings closed to prevent entry of foreign matter; cover fixtures, equipment and apparatus; protect against dirt, paint, water, chemical, or mechanical damage before and during construction period. Restore to original condition any fixture, apparatus, or equipment damaged prior to final acceptance, including restoration of damaged shop coats of paint, before final acceptance. Protect bright finished surfaces and similar items until in service. No rust or damage will be permitted.

1.10 SITE INVESTIGATION

A. The contractor acknowledges that he has investigated and satisfied himself as to the conditions affecting his work including reviewing the site electrical drawings. No allowance shall be subsequently made for any extra expense incurred due to failure or neglect to determine conditions affecting the work.

1.11 WARRANTY OF CONSTRUCTION

A. The contractor warrants that the work performed under this contract conforms to the contract requirements and is free of any defects of equipment, materials or design furnished, or workmanship by the contractor of any of his subcontractors or suppliers.

B. Such warranty shall continue for a period of one year from the date of final acceptance of the work. Under this warranty the contractor shall remedy, at his own expense, any such failure or defect in the system.

C. Manufacturer's guarantees or warranties still in effect shall be given to the owner at the expiration of the guarantee period specified above.

1.12 SAFETY AND INDEMNITY

A. The contractor shall be responsible for implementing, maintaining and supervising all necessary safety precautions which will insure against injury to persons or damage to property as a result of any of his work, tools or equipment on or off the project, before, during or after normal working hours. No drawing review, construction review or any other act or services rendered by the owner, engineer, their employees or consultants shall be construed to approve or judge upon the adequacy of the contractor's safety measures.

B. The contractor shall hold harmless, indemnify and defend the owner, engineer, their employees and consultants from any and all liability claims, losses or damage arising or alleged to arise from the performance of the work described herein, but not including the sole negligence of the owner, engineer, their employees or consultants.

1.13 PROJECT RECORD DRAWINGS

A. Prepare complete record drawings showing actual installed locations and sizes of equipment, fixtures, devices, feeders, branch circuits and empty conduit runs and a complete and accurate single-line diagram of the electrical work as installed.

B. Project record drawings shall be prepared in AutoCAD R2010 or later version format.

C. Submit a compact disk (with all electronic files) to the owner.

1.14 TEMPORARY FACILITIES

A. Provide all required temporary facilities for proper performance of the contract. All such temporary facilities shall be located where directed and maintained in a safe and sanitary condition at all times until completion of the contract; then removed from the site and disposed of as directed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All the materials shall be new, of the quality herein specified, free from defects and listed by the Underwriter's Laboratories for the purpose for which they are used. Materials shall be of uniform type and make throughout the building.

2.2 CONDUIT:

A. Rigid Steel Conduit:
1. Conduit, Rigid steel: Full weight, threaded, hot-dip galvanized, inside enameled, conforming to ANSI C80.1.
2. Three piece couplings: Electroplated, cast malleable iron. Efcor 165 Series. OZ/Gedney 4-50 series or approved equal.
3. Insulated Grounding Bushings: Threaded cast malleable iron body with insulated throat and steel “lay-in” ground lug with compression screw. OZ/Gedney BLG series. Thomas& Betts 3870 series or approved equal.
4. Insulated Metallic Bushings: Threaded cast malleable, iron body with plastic insulated throat rated 150 degrees C, OZ/Gedney tupe B, Thomas & Betts 1222 series or approved equal.

B. Electrical Metallic Tubing (EMT):
1. Conduit: Shall be formed of cold rolled strip steel, electrical resistance welded continuously along the longitudinal seam and hot dip galvanized after fabrication. Conduit shall conform to ANSI C80.3 specifications and shall meet UL requirements.
2. Couplings: Electroplated, steel, set-screw type, UL listed concrete tight in dry locations; electroplated, steel, watertight compression type (with compression ring), UL listed concrete tight in damp and wet locations. Efcor or approved equal.
3. Connectors: Electroplated, steel, set-screw type, UL listed concrete tight with insulated plastic throat, 150 degree C temperature rated; electroplated, steel, watertight compression type (with compression ring), UL listed concrete tight with insulated plastic throat, 150 degree C temperature rated in damp and wet locations. Efcor or approved equal.

C. Rigid Non-metallic Conduit (PVC):
1. Rigid Polyvinylchloride conduit, schedule 40, conforming to NEMA TC2, latest edition. UL listed for exposed and direct-burial applications and for 90 degree C conductor insulation.
2. Fittings: Couplings, adapters, transition fittings, etc., shall be molded PVC, slip on, solvent weld type.
3. Manufacturer: Carlon Type 40 – heavy wall rigid PV-duit or approved equal.

D. Liquid tight Flexible Metallic Conduit:
1. Conduit: Anaconda Type UA, Coleman Type UXTL or approved equal.
2. Fittings: Connector body and gland nut shall be of cadmium plated cast malleable iron, with tapered, male, threaded hub; insulated throat and neoprene "O" ring gasket recessed into the face of the stop nut. The clamping gland shall be of molded nylon with an integral brass push-in ferrule.

2.3 OUTLET AND PULL BOXES

A. Dry Locations: Galvanized, one-piece, pressed steel; Steel City, Raco, Efcor.

B. Pull Boxes: Fabricated from Code-gauge galvanized steel, painted grey.

2.4 WIRE AND CABLE

A. Deliver to the site in unbroken containers or reels, all secondary cable single conductors, 600 volt rating, with UL label.

B. All conductors shall be copper; Minimum size is #12.

C. Conductors #6 and smaller shall be color coded.

B. Wire type shall be XHHW, 90 degrees C, for feeders, type THWN, 90 degrees C, for branch circuits in dry locations and type RHH, THHN or THWN, 90 degrees C, for wire installed in fixtures raceways.

C. Color coding shall be in accordance with the requirements of the local inspection authorities.

2.5 WIRE TERMINATIONS AND SPLICING DEVICES

A. Splices in wires and cables #10 and smaller shall be made with approved type solderless connectors, Scotchlok or equal. In no case shall insulation of joint be of less insulation value than corresponding insulation of the wires.

B. Wire splicing devices shall be mechanical set-screw type with flexible insulating cover, captive pressure screws and self-closing openings. They shall be UL 486B listed for 600V and shall be rated for copper conductors. Ilsco “Nimbus” or equal.

2.6 HANGERS AND SUPPORTS:

A. Construction channel: 14 gauge, plated steel, Superstrut, Unistrut.

B. General: Properly support all material, equipment and apparatus.

C. Concrete Inserts: No. 452 or C-302 for new construction. Phillips Red Head or self-drilled anchors.

D. Exposed Metallic Conduits: Support at intervals of not more than 10'.

E. Conduit Supports: Pipe clamps with inserts for concrete, machine screws for metal surfaces and wood screws for wood construction or suitable trapeze supports.

F. Miscellaneous Steel: Provide miscellaneous steel members, beams, brackets, etc., for support of work in this Division unless specifically included in other Divisions.

2.7 OVECURRENT PROTECTION DEVICES

A. Molded Case Branch and Feeder Circuit Breakers:
1. Breakers shall be molded case, bolt-on, trip indicating, thermal magnetic type ambient temperature compensated.
2. Circuit breakers shall have interrupting capacity not less than shown on the drawings, or if not shown, not less than 14,000 RMS symmetrical amps for 480

volt systems and 10,000 RMS symmetrical amps for 208 volt systems. Series ratings may be used to obtain ratings between feeder and branch circuit breakers only.

3. Covers shall be sealed on non-interchangeable trip breakers to prevent tampering. Circuit breaker ratings shall be clearly visible after installation, or engraved nameplates shall be provided stating the rating. All ferrous parts shall be plated to minimize corrosion.
4. Breakers shall have toggle, quick-make and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against over-current conditions in the circuit. Trip position of the breakers shall be clearly indicated by operating handles moving to a center position.
5. Each pole of the circuit breakers shall have a thermal magnetic trip element, each pole being individually calibrated. Multiple breakers shall have s single handle to open and close all contact simultaneously in both manual operation and under automatic tripping. Interpole barriers shall be provided inside the breaker to prevent any phase-to-phase flash over. Each pole of the breakers shall have means of arc extinction.
6. Circuit breaker frame 250A and larger shall be provided with adjustable instantaneous.
7. Circuit breakers shall have UL label and shall conform to the requirements of the National Electrical Manufacturers' Association Publication AB-1-1975.
8. Fuses: All power fuses shall be current limiting type. Unless otherwise shown on the plans, types of fuses shall be Shawmut or equal class RK-1 Rejection type fuses.

2.8 DISCONNECT SWITCHES:

A. Switches shall be NEMA heavy duty type with dead front construction with provisions for fuses and for padlocking the handle in the off position.

B. Switches shall have a quick-make quick-break, position indicating, operating handle and mechanism and a dual cover interlock to prevent unauthorized opening of the switch door in the "ON" position.

Manufacturer: Square D, Eaton, General Electric or approved equal.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. All workmanship shall be of highest quality, done by persons especially skilled at assigned tasks, and shall result in neat installation consistent with best practices of trades.

B. Install work uniform, level and plumb in relationship to lines of building. Do not install any exposed diagonal, or otherwise irregular work unless approved by the County representative.

3.2 COORDINATION WITH OTHER TRADES:

A. The contract drawings are diagrammatic and indicate the approximate location of outlets and materials unless dimensions are shown. follow the drawings as closely as possible.

B. Examine the contract drawings to logically locate work in coordination with construction features such as beams, furring, door swings, ducts, and pipes.

3.3 CUTTING AND PATCHING:

A The electrical contractor shall obtain approval before performing any cutting or patching of concrete, steel, masonry, or wood structure in the buildings

3.4 CONDUIT

A. Conduits shall be installed in a workmanlike manner and shall conform to best of modern practice. All conduits shall be installed with code radius bends. Where more than two 90 degree bends are required, pull boxes shall be installed. Conduits shall be tightly corked and shall be otherwise well protected during construction. All branch circuit conduits shall be blown out and swabbed before wires are pulled. All conduit ends shall be reamed after cutting. A heavy nylon cord shall be installed in all empty conduits or ducts.

B. Conduits shall be concealed in spaces provided, unless otherwise specifically shown. If spaces are inadequate, the School representative shall be notified in time to avoid unnecessary work. All conduit runs exposed to view shall be installed parallel or at right angles to structural members, wall of lines of the buildings.

C. In long runs of conduit, provide sufficient pull boxes to facilitate pulling wires and cables. Support pull boxes from structure independent of conduit supports. Spacing of pull boxes shall not exceed 100 feet. Pull boxes are not necessarily shown on the plans.

D. Uses:
1. EMT: For feeders and power and lighting branch circuits run exposed or concealed above ceilings and in walls.
2. Rigid steel: Exterior exposed and for all turn-ups through floor slabs.
3. Liquidtight flexible metallic conduit: For all connections to air conditioning equipment and motors located in wet or damp areas.
4. PVC schedule 40: Underground for power.

E. Where conduits cross corridor walls, through electrical or mechanical room walls, they shall be neatly firestopped. Fire sealing shall be done using approved compounds and methods.

3.5 INSTALLATION OF WIRE AND CABLE

A. No wires shall be pulled into any portions of conduit system until all construction work which might damage the wire has been completed. No mechanical means shall be used to pull wires without obtaining permission from the school representative. All wires

shall be continuous from outlet to outlet, or from terminal to terminal. No splices shall be permitted in the conduit.

B. Splices in wires and cables shall be made with approved type solderless, crimped connector kits. In no case shall insulation of joint be of less insulation value than corresponding insulation of the wires.

3.6 INSTALLATION OF BOXES AND WIRING DEVICES:

A. General:
1. All outlets shall finish flush with building walls, ceilings and floors except where exposed work is called for.
2. Install raised device covers (plaster rings) on all switch and receptacle outlets installed in stud walls; or in furred or suspended, walls or ceilings. Covers shall be of a depth to suit the wall or ceiling finish.
3. Leave no unused openings in any box. Install close-up plugs as required to seal openings.
4. Exposed outlet boxes and boxes in damp location or wet locations shall be cast metal with gasketed cast metal cover plates.

B. Box Layout:
1. Outlet boxes shall be installed at the locations and elevations shown on the drawings or specified herein. Make adjustments to locations as required by structural conditions and to suit coordination requirements of other trades.
2. Through-wall boxes shall not be permitted.

C. Supports:
1. Boxes installed in metal stud walls shall be equipped with brackets designed for attaching directly to the studs or shall be mounted on heavy gauge, galvanized steel, snap-in box supports. Efcor MBS series, Steel City 5171 V series or equal.

D. Wiring Devices and Device Plates:
1. Wall mounted straight blade, U-ground receptacles shall be installed with grounding slot at the bottom for vertical orientations and with grounding slot at left for horizontal orientations.
2. Device plates shall be set with the vertical corner line plumb and with all edges of the plate in contact with the adjacent wall surfaces.

E. Blank device plates shall be installed on all outlets in which no device is required is installed.

3.8 GROUNDING

A. Except as otherwise noted, the complete electrical installation including neutral conductors, metallic conduits and raceways, boxes, cabinets and equipment shall be completely and effectively grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified.

B. An insulated, green copper ground conductor shall be installed in all power system raceways.

C. Conduit terminating in concentric knockouts at panelboards, cabinets and gutters shall have grounding bushings and bonding jumpers installed interconnecting all such conduits and the panelboards, cabinets, gutter, etc.

D. Terminate the equipment ground wires on an isolated ground bus provided in panelboards.

E. Receptacle grounding: Connect the ground wire to the receptacle ground screw and to the box using two 6" green pigtails sliced to the ground wire

3.9 TESTING AND COMMISSIONING

A Required labor, equipment and materials shall be provided to perform specified tests. Tests must be successfully completed prior to and after energizing systems. Defects which are found during tests shall be corrected at no additional charge.

B. Test all new feeders, circuits, control devices and motors for proper operation. Correct any malfunctions at no additional charge.

3.10 IDENTIFICATION AND LABELING

A. Provide plastic engraved nameplates on all major pieces of equipment including, but not limited to each feeder circuit breaker and panelboards. Nameplates shall be black with 1/2" high white letters and shall clearly indicate the device or feeder name and, in the case of panelboards, the voltage.

B. Provide a typewritten panelboard directory in each panelboard.

C. Provide black lettering (3/16" high) on clear adhesive circuit markers ("Brother" or equal) identifying panel and circuit number on each receptacle and motor circuit. Markers shall be placed on the receptacle cover plates or on the outside of disconnect switches in dry locations and on the inside of disconnect switches in damp or wet locations.

3.11 WORKMANSHIP

A. All workmanship shall be of highest quality, done by persons especially skilled at assigned tasks, and shall result in neat, clean and well done installation consistent with best practices of trades.

B. Install work uniform, level and plumb in relationship to lines of building. Do not install any exposed diagonal, or otherwise irregular work unless specifically approved by the owner's representative.

3.12 CLEANING AND PROTECTION

A. During progress of the work, keep premises reasonably free of debris, cuttings and waste material. Upon completion of work, and at other times as general contractor may

direct, remove all such debris from premises.

B. Interior of conduits and equipment shall be kept free of direct rubbish and other foreign materials during and after installation. Conduits and ducts shall be capped when work is stopped and for future use.

C. Fixtures shall be protected from dirt, moisture and mechanical damage during and after installation. Damaged fixtures shall be restored to their original condition or shall be replaced at no additional cost to the owner.

D. Upon completion of the work under this section, remove immediately all surplus materials, rubbish and equipment associated with or used in the performance of this work. Failure to perform such cleanup operations within 24 hours of notice by the general contractor shall be considered adequate grounds for having the work done by others at this contractor's expense.

3.13 PAINTING AND FINISHING

A. Equipment shall be furnished with factory or field-applied coat and finish coat of enamel. Damaged finishes shall be restored to match original.

3.14 WATERPROOF CONSTRUCTION:

A. Maintain waterproof integrity of all penetrations of materials intended to be waterproof. Flash all raceways extending through the roof with galvanized metal roof jacks and seal with approved sealants to make the flashing watertight. All leaks caused by this contractor's work shall be repaired at no additional cost to the owner.

B. Equipment or devices mounted out-of-doors or otherwise exposed to the weather shall have NEMA Type 3R or better enclosures. Such installations shall be weatherproof.

3.15 CLEAN-UP

A. Perform the work under this section so as to keep affected portions of the building and site neat, clean and orderly. Upon completion of the work under this section, remove immediately all surplus materials, rubbish and equipment associated with or used in the performance of this work. Failure to perform such cleanup operations within 24 hours of notice by the owner shall be considered adequate grounds for having the work done by others at this contractor's expense.

3.16 PROJECT CLOSEOUT

A. The contractor shall notify the owner’s representative in writing when the project is ready for final inspection for the purpose of determining the state of completion of the project. From the information gathered from this inspection, the owner’s representative will prepare a "walk-through-summary" of work to be performed, corrected, or completed before the project will be accepted. All work on the walk-thru summary shall be completed within thirty (30) calendar days by the contractor prior to final inspection.

B. Project record drawings and the operation and maintenance manuals shall be completed within 30 calendar days after the walk-through summary and shall be delivered to the owner's representative at that time. Provide four copies.

C. Provide two hours of electrical system operation instruction and review with the owner's representative at the completion of the project.

D. Submit "as-built" compact disk (with all electronic files) to the owner.

E. Final payment will not be made until the project record drawings, the operation and maintenance manuals and the "as-built" drawings are received and accepted.

END OF SECTION