OFFICE OF THE PURCHASING AGENT

TOWN OF ARLINGTON
730 Massachusetts Avenue
Arlington, MA 02476

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DATE: November 9, 2017

TO ALL BIDDERS

BID NO. 17-57

SUBJECT: 23 Maple Street Kitchen Renovation

ADDENDUM NO. 1

TO WHOM IT MAY CONCERN:

With reference to the bid request relative to the above subject, please note the following:

BID DEADLINE EXTENDED: NOVEMBER 30, 2017, 11:00 AM

ATTACHED SPECIFICATION SECTIONS (3) OMITTED FROM BID DOCUMENT

ADDENDUM MUST BE ACKNOWLEDGED WITH BID SUBMISSION.

All other terms, conditions and specifications remain unchanged.

Very truly yours,

Town of Arlington

Domenic R. Lanzillotti
Purchasing Officer

SECTION 15400 -PLUMBING (Filed Sub-Bid NOT Required)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Examine all drawings and all other Sections of the Specifications for requirements therein affecting the work of this Section.

1.02 SCOPE OF WORK

A. Provide all labor, tools, and materials necessary for complete installation and proper operation of plumbing work whether or not specifically mentioned or indicated on plans, but which are usually provided or essential for proper operation of each system as outlined below. Provide all labor, tools and materials necessary for complete demolition of existing fixtures and systems as indicated on the drawings. All existing sanitary piping impacted by the scope of work shall be rodded from the point of new connection to its connection in the street.

B. The work includes, but does not necessarily consist of in its entirety, the following
1. Sanitary drain, waste and vent system.
2. Domestic water supply system.
3. Plumbing fixtures and trim as required by code and as indicated on the drawings.
4. Insulation of piping.
5. Access panels (furnishing only). Access panels shall be gypsum faced and keyed.
6. Cleaning and testing.
7. Selected demolition work of plumbing systems.
8. Other work indicated on the drawings and specifications

1.02 RELATED WORK IN OTHER SECTIONS

A. The following items shall be furnished or performed under other Sections of these Specifications:
1. Cutting and patching of walls, ceilings and floors.
2. Installation of access panels.
3. Fixture accessories.

1.03 INTERPRETATION OF DRAWINGS

A. All work shown on the plans is intended to be approximately correct to scale, but figured dimensions and detailed drawings are to be followed in every case. The drawings shall be taken in a sense as diagrammatic. Sizes of pipes and methods of running them are shown

but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered.

B. Locations shown on the plans are approximate. It is the intent that equipment shall be in accord with the general and detail drawings of the construction proper. All measurements must be taken at the building and in coordination with all existing conditions.

C. Confer with all other trades relative to location of all apparatus and equipment to be installed and select location so as not to conflict with work of others. Any apparent conflict shall be referred immediately to the Construction Superintendent for contractor coordination and to prevent delay in installation of work.

1.04 COOPERATION WITH OTHER TRADES

A. Perform plumbing work so that the progress of the rest of the work shall not be delayed or interfered with. Material and apparatus shall be installed as fast as conditions of the building will permit and must be installed promptly.

B. Check with General Contractor, as to location of pipes, ducts, lights and apparatus, and install Plumbing in such a manner as to avoid interference with other trades.

1.05 MATERIAL AND EQUIPMENT

A. All material shall be new and of the best quality. Where no specific make of material is mentioned, any first class product of a reputable manufacturer may be used provided it conforms to the drawings and specifications and has the approval of the Engineer.

B. Materials and equipment offered or approved equal shall be equal to those specified in type, size, quality, capacity, space requirements, and power requirements. The request for each substitution must be accompanied by complete specifications of the materials or equipment offered, together with drawings or samples where necessary, to properly appraise the materials and equipment. No equipment or material shall be used unless approved for use in the State of Massachusetts and by the Architect.

1.06 GUARANTEE

A. The Plumbing Contractor shall guarantee to make good all faults and defects in the plumbing system due to defective or improper materials or workmanship that may appear within one year from the date of final acceptance of the work, and make all repairs, replacements, and changes within the guarantee period which are required to put the systems in proper operation and condition, without cost to the Owner.

1.07 PROTECTION AND CLEANING

A. Protect all materials, fixtures and fittings from loss or damage, and all pipe openings from obstruction and blockage, throughout the construction. Heavy jute inserted type paper shall be taped securely for complete covering and protection of fixtures and equipment.

B. All dirt and debris resulting from the plumbing work shall be thoroughly taken up and disposed in dumpsters provided at the site. Clean and polish all fixtures, fittings, exposed trim and equipment to leave for inspection and use in the best possible condition.

1.08 PUTTING EQUIPMENT IN OPERATION

A. All mechanical equipment installed in connection with plumbing work shall be put in operation in the presence of duly authorized representatives of the Owner, instructions shall be given to the Owner's employee appointed to familiarize himself with the systems and equipment. Four copies of the operating manual, parts list, and bulletins shall be delivered to the Owner.

1.09 MISCELLANEOUS IRON AND STEEL

A. Provide steel supports and hangers as specified or as required to fully support piping, pumps, tanks, or other equipment. All shall be done in compliance with local code and manufacturers recommendations.

B. All work shall be cut, assembled, welded, and finished by skilled mechanics. All shop fabricated iron and steel work shall be cleaned and dried and given a shop coat of paint on all surfaces and in all openings.

1.10 REGULATIONS, FEES AND PERMITS

A. All materials and the installation thereof shall conform to the requirements of the State Building Code, all State and local laws, rules and regulations and codes pertaining thereto and all applicable Sections of the State Plumbing Code. Where documents exceed code requirements, the documents and specifications shall govern construction.

B. The Plumbing Contractor shall give the proper authorities all required notices or information relating to work in his charge, and obtain all official licenses, permits and certificates.

1.11 RECORD DRAWINGS

A. Maintain at the job site at all times a complete set of black line prints and mark accurately, clearly and completely the actual installations in accordance with the requirements of this Section. At the completion of the contract, prepare at no extra cost a set of reproducible record drawings and submit to the Architect. Refer to Division 01 for details of procedure of record drawings.

1.12 SUBMITTALS

A. Submit shop drawings or descriptive literature giving performance data, physical size, wiring diagrams, configuration, capacity, material, for all items under this Section, including the following:

1. Plumbing fixtures and trim.
2. Hangers and supports.
3. Drains, valves
4. Pipe insulation.

1.13 INSPECTION OF SITE

A. This Contractor shall, prior to submitting his bid, review all drawings and visit the site and inspect all conditions affecting the proposed work. Failure to visit the site and misinterpretation of the drawings and specifications resulting there from shall be entirely the responsibility of the bidder. No claims based on lack of knowledge or difficulties resulting from same shall be allowed.

1.14 COORDINATION DRAWINGS

A. Coordinate use of project space and sequence of installation of plumbing, HVAC, and electrical work.

B. Allow cutting of structural elements only in locations and by methods approved by the architect.

C. Prepare coordination drawings for areas such as plumbing chases, corridor ceiling space, common area ceiling space, showing ductwork, piping, lights or any other potential obstruction located in the ceiling.

PART 2 - PRODUCTS

2.01 HANGERS AND SUPPORTS

A. Furnish and install all hangers and supports and al steel framework required for the support of various systems. All piping shall be supported from the building structure by means of approved hangers as manufactured by Carpenter-Patterson, Grinnell Co., Fee & Mason, or approved equal.

B. Horizontal piping shall be hung with adjustable wrought iron or malleable iron pipe hangers, spaced as follows:

PIPE SIZE	COPPER	STEEL	ROD SIZE
3/4" to 1"	6 ft.	8 ft.	3/8"
1-1/4" to 2"	8 ft.	10 ft.	3/8"
2-1/2" to 4"	10 ft.	14 ft.	1/2"

C. Cast iron soil pipe shall be supported at 5-foot intervals at hub. Copper tube straps may be used on water lines up to 1" for wood joist construction only. Bands or rings supporting copper tubing shall be heavily copper plated.

D. Hangers shall be located not more than 4' from elbow or 10' on screwed piping. Hangers for piping sizes 4" and smaller shall be Carpenter Patterson No. 1A Band Type, Grinnell Co., Fee & Mason, or approved equal black steel with hanger rods with machine threads. For copper tubing, the hangers shall be copperized. Hangers for piping larger than 4" shall be adjustable clevis wrought iron or malleable iron.

E. Chain, strap, perforated bar or wire hangers will not be approved. Approved gang hangers may be used in lieu of separate hangers on pipes running parallel to each other and close together. Where used for copper tubing, the gang hangers shall have copper saddles.

2.02 CROSS CONNECTIONS

A. No piping shall be installed in a manner to permit back siphonage or any flow of polluted water or other liquid into water service or distribution piping under any conditions.

B. Air gaps, receptor type drains, approved backflow preventors and approved vacuum breaking devices shall be provided as required by State and local codes and ordinances. Piping to inlets below fixture overflow shall have vacuum breakers of make, design, size and location approved by the Inspector of Plumbing. Breakers shall not be concealed. Breakers shall be full size of pipe and shall be Beaco, Chicago, Watts, or approved equal.

2.03 VALVES

A. The entire plumbing installation shall be provided with valves located to permit easy operation, replacement and repair. Valves shall be the product of one manufacturer except as noted. Jenkins Brothers, Hammond, Walworth, Nibco, Apollo, or approved equal. All valves shall be ball valves. All valves used shall be rated for domestic water service.

B. Valves shall be bronze except as otherwise specified. Valves on each hot water recirculation branch line shall be combination balancing and stop type, all bronze, or ball valves.

C. Ball valves: Cast bronze, two-piece body, ASTM B-584 bronze trim, soldered ends, 125 PSI WSP.

D. Check valves: Horizontal swing, renewable seats & disc, bronze disc, soldered ends, 125 PSI WSP, ASTM B-62.

2.04 UNIONS AND FLANGES

A. Unions and flanges shall be furnished and installed at all pieces of equipment to allow for easy removal and dismantling of piping systems will be allowed for removal of equipment. Unions shall be the product of Hammond Co., Jamesbury, Hancock, or approved equal.

2.05 VALVE TAGS AND PIPE MARKING

A. All valves to groups of fixtures shall have laminated plastic tags attached to stem of each valve. Each tag shall be stamped clearly with large letters and numbers to designate the valve number and the service. A printed or typewritten list or schedule of all valves shall be made which shall give the number, service and location of each valve. The above list shall be mounted in fused plastic in a location directed by the Architect. All valve numbers shall correspond to numbers indicated for valves on the record drawings,

B. All piping except sanitary and vent shall be marked with Seton “Set Mark” or approved equal pipemarkers showing the direction of flow and pipe service after pipe is insulated and/or painted.

C. Identify non-potable water by firmly attached metal tags as required by State Plumbing Code bearing the legend WATER UNSAFE and attached to pipes at intervals of not more than 25‘.

2.06 SLEEVES

A. Approved sleeves for the passage of all piping through foundation walls, floors and partition walls shall be furnished by the Plumbing Contractor and set into the construction by the trade involved.

B. Sleeves for passage of pipes through waterproofed walls or floors, and through foundation walls below grade shall be approved castings with collar or fin for embedding in the construction, or wrought iron pipe sleeve with welded fin (assembly galvanized), or cast iron with brazed fin. Pipes shall be lead caulked in sleeves and the whole installation made watertight.

C. Sleeves through masonry walls shall be Schedule 40 steel pipe. Sleeves through non-bearing walls shall be galvanized metal, 24 gauge.

D. Sleeves through concrete floors shall have anchoring rings or lugs to hold sleeve in floor construction. Install top of sleeve 3/4" above finish floor.

E. Sleeves shall be at least two sizes larger than the pipe accommodated and sized to permit continuous insulation on pipes with at least 1/4" clearance.

F. Sleeves shall have spaces between pipe and sleeve sealed with a polysulfide sealant.

G. Escutcheons shall be installed around all exposed pipe passing through finished floor, wall or ceiling. Escutcheons shall be chrome plated, secured in place by set screw or clips.

2.07 ACCESS PANELS

A. Furnish all access panels for walls and where required. Coordinate the access panel location as well as provide a scaled drawing of locations to the General Contractor for coordination and approval prior to installation. The same scaled drawing shall be submitted to the Architect prior to installation. Piping shall be laid out in such a manner as to minimize the number of access panels required. Access panels shall be fire rated where required. Make: Ventlock, Knapp, J.R. Smith, or approved equal. Minimum size: 12" x 12" key latch. All access panels shall be purchases and provided by Plumber and installed by General contractor. All access panels in ceiling shall be recessed to accept gypsum board.

B. Provide access panels for all cleanouts, valves, shock absorbers, control valves, pressure reducers, air arrestors, and any other concealed accessories requiring access.

2.08 CLEANOUTS, COVERS AND FRAMES

A. Floor cleanout: Duco cast iron with tapered cleanout plug. Adjustable scoriated polished bronze top for concrete finished floors: recess type top for tile or terrazzo floors. Make: J.R. Smith Fig. 4020 Series, or equal Zurn, Josam, or approved equal.

B. Wall cleanout: Cleanout plugs concealed in walls shall be made accessible with chrome plated bronze round or square frame and cover secured with slotted screws. Make: J.R. Smith Fig. 4720, Zurn, Josam, or approved equal.

2.09 INSULATING FITTINGS

A. Furnish and install patented type dielectric fittings or couplings, Epco, Vallett, Watts or approved equal in pipe systems wherever dissimilar metals are joined.

B. Dielectric fittings shall not be concealed within walls or ceilings.

2.10 INSULATION

A. All insulation when installed shall have composite fire and smoke hazard ratings as tested by Procedure ASTM-E-84, NFPA-255, and UL-723, not exceeding a flame spread of 25 and smoke developed of 50, as approved under NFPA and NBFU Pamphlet #90A and #90B standards.

B. Insulation material and application shall be in accordance with State Building Code / NFPA.

C. Cold Water: Piping shall be insulated with 1/2" thick fiberglass insulation with factory applied all-service jacket secured in place with self sealing laps. Fittings shall be insulated with premolded PVC fitting covers secured in place with stainless steel tacks.

D. Hot Water and Existing Storm Drain: Piping shall be insulated with 1" thick fiberglass pipe insulation with factory-applied all-service jacket secured in place with outward clinching staples. Fittings shall be insulated with premolded PVC fittings, covers secured in place with stainless steel tacks.

E. Piping insulation materials as manufactured by Johns Mansville, Owens-Corning, Knauf or Certain Teed, or approved equal.

2.11 PIPE, FITTINGS AND FABRICATION

A. All piping materials for the various systems specified under this Section shall conform to the standards listed below, (Refer to System Materials for type of pipe to be used.)

1. Buried Pipe: Bell and spigot with mechanical push-on joints and resilient gaskets, cast iron, service weight; both pipe and fittings products of one manufacturer: Combustion Engineering, Central Foundry,Russell, Alabama Foundry, Charlotte Foundry, or approved equal. Piping shall be coated with asphaltum or coal tar pitch inside and outside.
2. Above Ground Pipe - Sanitary and Storm Drain: Hubless cast iron, service weight, ASTM-A-74, manufactured and installed in accordance with C.I.S.P.I. Standards and as approved by the State Plumbing Code.
3. Type “L” (above ground) and “K” (below ground) copper tubing (hard temper), ASTM-B-88, used with cast brass or wrought copper solder fittings. Drain & vent pipe (for drain & vent 2" and smaller only) shall use drainage patter fittings.

B. Piping Joints

1. Joints in cast iron bell and spigot piping shall be caulked and made gas and watertight, firmly packed with picked oakum to a depth of 1-1/2", and secured with pouring of molten virgin lead or shall be made with mechanical push on type joints made with resilient gaskets as approved by the State Plumbing Code.
2. Joints for hubless cast iron pipe and fittings shall be made with double lamp retainer sleeve and neoprene gasket as manufactured by MG, Dresser, Clamp-All, or approved equal. and approved by the State Plumbing Code and local plumbing Inspector.
3. Joints in copper tubing shall be properly fluxed with non-corrosive, lead free flux and made with lead free 95-5 solder. Joints for Type “K” copper below ground shall be made using silver solder or flared ends or other method approved by the State Plumbing Code.
4. Joints between copper tubing and cast iron soil pipe shall be made with cast iron, bronze or brass adapters for leading into bell and soil pipe.

5. Joints on cast iron water pipe shall be made with cast iron Dresser, Smith-Blair, Adams, Victaulic, or approved equal coupling.

C. Systems Materials

1. Sanitary and System
   a. Buried piping: Service weight cast iron, bell & spigot, neoprene gasket.
   b. Above ground: Hubless cast iron, service weight, for pipe sizes larger than 2". Sizes 2" and under shall be type "L" DWV copper with drainage pattern fittings. Urinal waste shall be cast iron with lead and oakum caulked joints.
2. Water System
   a. Service main: (Existing)
   b. Interior piping: Type "L" copper for all above ground piping. Type "K" for all below ground piping.

2.12 PLUMBING FIXTURES

A. Provide fixtures with traps, valves, waste fittings and all parts necessary for final connection. Color of fixtures shall be white unless otherwise noted. Provide additional support to suit the construction as required for lavatory hangers and all wall-mounted accessories. Furnish and set all hangers, supports, brackets, for the proper installation of all fixtures or equipment requiring support. Supports shall be in accordance with recommendations of the manufacturers of the fixtures, and where built in to partitions or walls, shall be set as the wall progresses. This Section shall be held responsible for the stability of all fixtures and furnishing all chair carriers or other materials necessary to accomplish this. Exact mounting height shall be determined in full compliance with code and as indicated on the contract drawings by the Architect.

B. The SPECIFICATIONS indicate manufacturer, model, type, capabilities and ratings of equipment for this project. Performance, capacities, and any other statistical data, shall be interpreted as the minimum requirements.

C. The manufacturer's names and models indicated represent a standard of materials, appearance, finishes, performance and are not intended to specify a particular manufacturer. Listing of a specific manufacturer does not constitute a final acceptance.

D. The following is a list of manufacturers:

FIXTURE	MANUFACTURER	REMARKS
P-4 Kitchen Sink (Stainless Steel) Double Basin 20 Gauge Stainless Steel	Sink shall be by Elkay model LRADQ331955 with single hole drilling. Faucet shall be Symmons model S-2640 with pull down spray in chrome finish. Acceptable alternative manufacturers shall be Just, American Standard and Kohler.	20 GA, insert, stainless steel crumb-cup strainer, 1-1/2" cast brass side outlet P-trap for dish washer connection with ground joint fittings, angle supplies and stops, three hole punched. Provide ½" hot water service stop for connection to dish washer. Garbage disposer shall be similar to Insinkerator Badger 5 furnished and installed by the plumbing contractor. Acceptable alternative manufacturers shall be Kitchen Aid and Moen.
P-5 Wash Machine Box	Symmons "Laundry-Mate" model W-602-X Acceptable alternative manufacturers shall be Oatey and Sioux Chief	Provide service stops and recessed installation with cover plate

PART 3 - EXECUTION

3.01 SERVICES AND SYSTEMS

A. Water System

1. Piping shall be run parallel with the lines of the building; well supported from the structure; free from pockets and sags; pitched to drain points; and installed with pipe expansion loops, mechanical expansion joints, pipe guides, offsets and anchors to adequately care for thermal expansion.
2. Piping shall be installed to provide not less than 3/4" spacing from finished covering to other covering or surfaces of other obstruction.
3. All piping shall be protected from water hammer or shocks by approved water hammer arrestors, Air cushion shall be provided at tops of risers, and mechanical arrestors at all quick closing or solenoid valve equipped apparatus.,
4. Valves shall be installed as indicated on riser diagrams on branches leaving mains, at branches to large groups of fixtures and at single fixtures when trim does not include stops.

5. Final connections shall be made to all fixtures, appliances, or equipment with plumbing connections whether furnished by this contractor or by others,
6. Sterilization: Before any use of water system is made for domestic purposes, sterilize the entire water distribution system. Contractor to provide water testing reports after water has been sterilized.
7. Water piping shall be covered as specified except where chrome plated piping is used or other notation is made.

B. Drainage Systems

1. The interior drainage systems shall be constructed using materials as specified and/or indicated.
2. Provide properly trapped and vented waste connections to fixtures, floor drains, and special equipment.
3. Drain piping shall be uniformly pitched to conform to local and state code requirements. In the absence of invert elevations check contract drawings and verify location, size, and elevation of all existing sanitary piping before proceeding with installation.
4. Cleanouts shall be installed at the base of all stacks, beyond running traps, at changes in direction of more than 45 degrees, at not over 50' intervals in horizontal runs. Cleanout tees shall not be used where it is possible to use a straight tee.
5. Traps of material and design approved by local or state plumbing inspector shall be furnished and installed by the Plumbing Contractor for all equipment and appliances. All traps shall have bottom cleanouts where access can be provided.
6. Carefully inspect for damaged materials. Run piping as shown on the drawings, making changes in direction with long sweep 1/8 and/or 1/16 bends. Make connections to horizontal lines with Y's and 1/8 bends. Connections to stacks may be with sanitary T-fittings.
7. Clamps on hubless cast iron type joints shall be tightened to not less than 48 pounds of torque. A calibrated preset torque wrench supplied by pipe manufacturers shall be used.
8. Hubless type joints suspended more than 18" below the floor slab shall be provided with sway bracing.

3.02 TESTING

A. Testing of all systems shall be done at the expense of the plumbing contractor and with equipment furnished by him. Testing shall be done in the presence of duly authorized inspectors and the Owner's representative with 48 hour notice given these authorities. All systems shall be repaired and retested until requirements are met, without additional expense to the Owner

B. Sanitary and vent piping shall be tested by plugging where leaving the building at outlets on the system; filling the system by section and proving tight, without addition of water

for one hour's duration. Systems tested by sections shall be proved tight for one hour or by similar test required by the inspector of plumbing. Install necessary test plugs in stacks during installation.

C. Interior water piping shall be tested at a water pressure of 150 psi for one hour.

3.03 STERILIZATION

A. The entire potable water distribution system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine, and shall be introduced into the system for a period of time during which all valves and faucets shall remain open chlorine solution shall be flushed from the system with clean water until the residual chlorine content is no greater than 0.2 parts per million. Contractor to provide water testing reports after water has been sterilized.

3.04 DEMOLITION

A. Demolition performed by this contractor shall include all existing sanitary and water piping. Cap pipes back at active lines. Disposal of the removed materials shall be by general contractor. The plumbing contractor shall remove and store all demolition materials for removal from site by general contractor.

3.05 COMPLETION

A. Provide properly executed certificate of inspection from authorities having jurisdiction.

B. Instruct such persons as the Owner designates in the proper operation and maintenance of the systems and their parts. Submit to the Architect a letter naming the person or persons so instructed and the dates of such instruction.

C. Prepare and deliver literature showing operating, service and replacement data for all equipment which will require periodic maintenance or replacement.
   1. Verify that project record documents are complete as specified under submittals and Record Documents.

END OF SECTION 15400

SECTION 15500 - HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.01 GENERAL

A. The "Owner-Contractor Agreement for Public Building Construction or Renovation", together with all Amendments and Supplements as hereinbefore listed, shall apply and are hereby made a part of this section of the Specifications.

B. The sections of these specifications entitled "Special Conditions", "Minimum Wage Determination", and Division 1, "General Requirements" shall apply and are hereby made a part of this section of the Specifications.

C. Examine all Drawings and all other Sections of the Specifications for requirements and provisions affecting the work of this Section.

D. The Contractor shall examine all Drawings and all Sections of the Specifications and shall be responsible for all work included. The Contractor shall be DCAM certified for heating, ventilation and air conditioning work.

1.02 LOCATION

A. The Work of this Contract shall be performed at the Town of Arlington, 23 Maple Street, Arlington, MA.

1.03 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary to provide complete heating, ventilating and air conditioning systems and general contracting work, as shown on the Drawings and as specified herein.

B. Furnish all labor and materials to perform demolition work as shown on the Drawings, as required for the installation of new work, and as specified hereinafter.

1.04 DESCRIPTION OF WORK

A. Work included, but not limited to: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Exhaust Fans, each type
2. Ductwork and accessories

1.05 CODES, ORDINANCES, AND PERMITS

A. Installation of systems and equipment provided under this section shall be done in strict accordance with Massachusetts Department of Public Safety Codes, Massachusetts Department of Environmental Protection, Massachusetts State Building Code and Town of Arlington Regulations having jurisdiction.

B. All work, where applicable, shall conform to NFPA codes and all material shall be U.L. approved.

C. All electrical apparatus furnished under this section shall be approved by the U.L. and shall be so labeled or listed where such is applicable. Where custom-built equipment is specified and the U.L. label or listing is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by U.L. where such is applicable to the component.

D. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from authorities having jurisdiction. Deliver certificates of inspection to Engineer. No work shall be covered before examination and approval by Engineer, inspectors, and authorities having jurisdiction. Replace imperfect or condemned work conforming to requirements, satisfactory to Engineer, and without extra cost to the Owner. If work is covered before due inspection and approval, the installing contractors shall pay costs of uncovering and reinstalling the covering, whether it meets contract requirements or not.

1.06 RECORD DRAWINGS

A. Refer to DIVISION 1 of the Specifications for record drawings and procedures to be provided under this section.

1.07 CLEANING

A. During the progress of the work, clean up and remove all oil, grease and other debris. At completion, clean all equipment, piping and duct systems and leave all work in perfect operating condition.

1.08 COORDINATION AND RESPONSIBILITY

A. The structure and its appurtenances, clearances and the related services, such as plumbing, heating, ventilation and electric service have been planned to be legal, adequate and suitable for the installation of equipment specified under this section. The Owner will not assume any increase in cost caused by differing requirements peculiar to a particular make or type of equipment, and any incidental cost shall be borne by the Contractor. The Contractor shall be responsible for the proper location of his required sleeves, chases, inserts, etc., and see that they are set in the forms before the concrete is

poured. The Contractor shall be responsible for the work and equipment furnished and installed until the completion and final acceptance of this contract, and shall replace any work which may be damaged, lost or stolen, without additional cost to the Owner.

1.09 PROTECTION OF MATERIALS, WORK, AND GROUNDS

A. Materials, fixtures and equipment shall be properly protected and all pipe and duct openings shall be temporarily closed so as to prevent obstruction and damage.

B. Protect and preserve all materials, supplies and equipment of every description and all work performed. Protect all existing equipment and property of any kind from damage during the operations. Damage shall be repaired or replaced promptly by the Contractor at his expense.

1.10 DRAWINGS

A. It is the intention of the Specifications and Drawings to call for finished work, tested and ready for operation. Any apparatus, appliance, material or work not shown on the Drawings, but mentioned in the Specifications or vice-versa, or any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be provided by the Contractor without additional expense to the Owner.

B. The Drawings are generally diagrammatic. The locations of all items that are not definitely fixed by dimensions are approximate only. The exact locations must be determined at the project and shall have the approval of the Engineer before being installed. The Contractor shall follow Drawings, including his shop drawings, in laying out work and shall check the Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions. Where space conditions appear inadequate, notify the Engineer before proceeding with the installation. The Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Size of ducts and pipes and methods of running them are shown, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered. To carry out the true intent and purpose of the Drawings, all necessary parts to make complete approved working systems ready for use, shall be furnished without extra charge. All work shall be installed in such a manner as to avoid being unsightly.

D. All measurements shall be taken at the building by the Contractor, prior to purchasing and installing the equipment and piping.

1.11 SHOP DRAWINGS

A. Provide six (6) sets of shop drawings for the following in accordance with Division 1:

1. Fans, each type

2. Ductwork and Accessories

1.12 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Submit operation and maintenance data complete with at least the following:

1. Table of Contents:

2. Introduction:

a. Explanation of manual and its use

b. Description of all systems

3. Plant Operation:

a. Operating instructions for all apparatus.

4. Maintenance

a. Maintenance and lubricating chart: Furnish three sets of charts indicating equipment tag number, location of equipment, equipment service, greasing and lubricating requirements, lubricants and intervals of lubrication.

b. Recommended list of spare parts: Furnish two typed sets of instructions for ordering spare parts with sectional views of the fittings or equipment showing parts numbered or labeled to facilitate ordering replacements, including a list with itemized prices of those parts recommended to be kept on hand as spares, as well as the name and address of where they may be obtained.

5. Manufacturer's Literature:

a. Fans, each type

1.13 UNDERWRITERS' LABEL AND LISTING

A. All electrical apparatus furnished under this Section shall be approved by the UL and shall be labeled or listed where such is applicable. Where custom-built equipment is specified and the UL label or listing is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by UL where such is applicable to the component.

1.14 CUTTING AND PATCHING

A. All cutting and patching necessary for the proper installation of work to be performed under this Section and subsections shall be performed by the Contractor.

B. All work shall be fully coordinated with all phases of construction, in order to minimize the requirements for cutting and patching.

C. The Contractor shall form all chases or openings for the installation of his own or any other Contractor's or Subcontractor's work, or shall cut the same in existing work and shall see that all sleeves or forms are in the work and properly set in ample time to prevent delays. He shall see that all such chases, openings, and sleeves are located accurately and are of the proper size and shape and shall consult with the Engineer and the Contractors or subcontractors concerned in reference to this work. In so doing, he shall confine the cutting to the smallest extent possible consistent with the work to be done. In no case shall piers or structural members be cut without the approval of the Engineer.

D. The Contractor shall carefully fit around, close up, repair, patch, and point around the work specified herein to the entire satisfaction of the Engineer.

E. The Contractor shall fill and patch all openings or holes left in the existing structures by the removal of existing equipment by himself, his subcontractors or other filed subcontractors.

F. All of this work shall be carefully done by workmen competent to do such work and with the proper and smallest tools applicable.

G. Any cost caused by defective or ill-timed work shall be borne by the contractor responsible therefore.

1.15 GUARANTEE

A. The Contractor shall guarantee, in writing, all work and all materials provided under this Section 15500, in accordance with the provisions of the printed form of Contract and the General Conditions.

1.16 ELECTRICAL

A. All electrical apparatus and controls furnished as a part of this Section shall conform to applicable requirements under DIVISION 16 - ELECTRICAL.

B. All motors furnished under this Section shall be furnished by the manufacturer of the equipment served, shall be premium efficiency type for inverter duty and shall be mounted and aligned so as to run free and true. Each motor shall be built to conform to

the latest applicable NEMA, ANSI and IEEE standards for the type and duty of service it is to perform.

C. Each motor shall be designed to operate on 60 Hz, and each shall be expressly wound for the voltage specified. Each motor shall operate satisfactorily at rated load and frequency with a voltage variation no greater than plus or minus 10% of voltage specified. Dual voltage 208/220 motors will not be accepted.

D. All motors shall be provided with adequate starting and protective equipment as specified and each shall have a terminal box of adequate size to accommodate the required conduit and wires.

E. Motor controllers shall be equipped with all poles, auxiliary contacts and other devices necessary to permit the interlocking and control sequences required. Controller operating coils shall be generally designed for 120 volt operation, and 3 phase motors shall be provided with thermal overload protection in all phases.

F. The Contractor shall furnish all magnetic starters for each and every motor furnished under this section of the specification, except where otherwise indicated. All starters for motors over 10 HP shall be solid state with reduced inrush design. The maximum allowable inrush shall be 2.5 times running load amperage. All starters for fractional HP motors shall be provided with manufacturer's standard motor starter.

G. The Contractor shall furnish and install all low voltage and/or line voltage control wiring for the mechanical equipment. All wiring shall be preformed by a licensed electrician.

1.17 VERIFYING EXISTING CONDITIONS

A. Before commencing any work under this section, verify all governing dimensions and examine all adjoining work on which this work is in any way associated or connected. Failure to visit the jobsite will in no way relieve the Contractor from installing the work according to the intent of these specifications and at no additional cost to the Owner.

B. Each bidder shall visit the site and inspect conditions affecting the proposed work. Failure to do so and misinterpretation of the Plans and Specifications resulting therefrom shall be entirely the responsibility of the bidder.

C. Each bidder shall make note of the existing conditions affecting hauling, rigging, transportation, installation, etc., in connection with his work and shall make all provisions for transportation of all materials and equipment.

D. Where field conditions require, the Contractor shall arrange for equipment to be shipped to the job, dismantled and assembled in place.

E. Remove walls, window assemblies/glass and floor structures where necessary to install and remove equipment as shown. The Contractor shall reinstall such displaced structures to their original condition.

1.18 STANDARDS

A. The latest published issue of the standards, recommendations, or requirements of the following listed societies, associations, or institutes in effect at the date of Contract are part of this Specification. These shall be considered as minimum requirements; specific requirements of this specification and/or associated drawings shall have precedence. In case of conflict between published requirements, the Owner's representative shall determine which is to be followed.

1.	AMCA	Air Moving and Conditioning Association
2.	ANSI	American National Standards Institute
3.	ASHRAE	American Society for Heating, Refrigerating, and Air Conditioning Engineers
4.	ASME	American Society of Mechanical Engineers
5.	ASTM	American Society for Testing and Materials
6.	FIA	Factory Insurance Association
7.	IEEE	Institute of Electrical and Electronic Engineers
8.	MCAA	Mechanical Contractors Association of America
9.	NEMA	National Electrical Manufacturers Association
10.	NFPA	National Fire Protection Association
11.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
12.	UL	Underwriters' Laboratories, Inc.
13.	OSHA	Occupational Safety and Health Act
14.	NEC	National Electric Code

1.19 COOPERATION WITH OTHER TRADES

A. The work shall be so performed that the progress of the entire building construction, including all other trades, shall not be delayed or interfered with. Materials and apparatus shall be installed as fast as conditions permit and must be installed promptly when and as desired.

B. Confer with all other trades relative to location of all apparatus and equipment to be installed and select locations so as not to conflict with work of other Sections. Any conflicts shall be referred immediately to the Engineer for decision to prevent delay in installation of work. All work and materials placed in violation of this clause shall be readjusted to the Engineer's satisfaction, at no expense to the Owner.

C. Where work of this section will be installed in close proximity to work of other sections or where there is evidence that the work of this section will interfere with work of other sections, assist in working out space conditions to make satisfactory adjustment. If so directed, prepare and submit for approval 3/8" scale or larger working drawings and sections, clearly showing how this work is to be installed in relation to the work of other sections. If the work of this section is installed before coordinating with other trades or so as to cause interference with work of other trades, make changes necessary to protect conditions without extra charge.

1.20 WORKING CONDITIONS AND SAFETY

A. Whereas the building may be occupied during the construction period, it is of utmost importance that the occupant's safety and the building's normal process be maintained. The Contractor shall not disrupt the normal operations of the building and shall be required to cease work during occupied hours if, in the opinion of the Owner, the work creates a disruption to the building's occupants. The Contractor will then be required to perform such disruptive work during non-occupied hours.

1.21 FINAL ACCEPTANCE

A. Final acceptance of Ownership of the HVAC system installed within this scope of work shall be contingent on passing a satisfactory system pressure test, mechanical performance test and cooling and heating function test to determine that the system will perform according to the contract requirements. The above tests shall be witnessed by the Engineer and the Owner; acceptance will only be granted in writing by the Owner after receipt of certification from the Engineer and Commissioning Agent that the design criteria have been met.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. Furnish all sheet metal work and accessories specified herein for laundry exhaust ductwork, kitchen hood exhaust ductwork, and exhaust air ductwork.

1. All ducts shall be constructed galvanized steel, low pressure ductwork (2" w.c. pressure class) and installed in accordance with the latest edition of SMACNA.
2. Seal all low-pressure duct joints (Class B). Excess sealant must be removed immediately to provide a neat appearance.
3. Duct sizes shall be 6" for ceiling mount exhaust fan, 7" for kitchen hood and 4" for clothes dryer; approximately 10 lineal feet of ductwork including elbows and full duct size wall vents with backdraft damper (color as selected by the architect).
4. Wall vents shall terminate a minimum of 3'-0" from operable building openings.

B. Clothes Dryer Exhaust: The ductwork used to exhaust air from clothes dryers shall be galvanized sheet metal. The duct shall be installed per manufactures recommendation and the state/local codes. The ductwork shall be pitched to the outdoors.

C. All ducts shall be constructed in accordance with the Duct Manual.

D. Duct joints shall be constructed in accordance with the Duct Manual.

E. Duct seams shall be constructed in accordance with the Duct Manual.

F. Duct reinforcement shall be per the Duct Manual.

G. Fittings and special installations shall be constructed in accordance with the Duct Manual.

H. Flexible connections at exhaust fan shall be 4" wide connections, in accordance with the Duct Manual, constructed of Ventglass heavy glass fabric double coated with neoprene and shall be as manufactured by Vent Fabrics, Inc. Flexible connections shall meet the requirements of the National Board of Fire Underwriters. Exterior flexible connections shall be weather tight.

I. Hangers and supporting systems shall be in accordance with the Duct Manual.

2.02 EXHAUST FANS

A. Ceiling Mount Exhaust Fan

1. Ventilation fan shall be low sone ceiling mount rated for continuous run. Fan shall be ENERGY STAR® rated and certified by the Home Ventilating Institute (HVI). Evaluated by Underwriters Laboratories and conform to both UL and cUL safety standards. Fan shall be controlled by motion sensor.

2. Motor/Blower

   a. Enclosed DC brushless motor technology rated for continuous run.
   b. Fan ventilation rates shall be manually adjustable for 50-80-110 CFM.
   c. Power rating shall be 120 volts and 60Hz.

d. Fan shall be UL listed for tub/shower enclosure when used with a GFCI protected circuit and used in insulated ceiling (TYPE I.C.).
e. Fan equipped with a thermal cutoff fuse.
f. Removable, permanently lubricated, plug-in motor.

3. Housing

a. Rust proof paint, galvanized steel body.
b. Integrated dual 6" diameter duct adapter.
c. Built-in metal flange provides blocking for penetrations through drywall as an Air Barrier, and assists with the decrease in leakage in the Building Envelope during blower door testing.
d. Built-in backdraft damper.
e. Articulating and expandable installation bracket up to 24".

4. Grille

a. Attractive design using Poly Pro material.
b. Attached directly to housing with torsion springs.

5. Power Consumption

a. Power Consumption shall be no greater than 3.5/5.5/9.8 watts at 0.1 w.g. and 15.1/15.3/11.5 watts at 0.25 w.g. ENERGY STAR® rated with efficiency of no less than 15.1/15.3/11.5 CFM/watt at 0.1 w.g. and 8.1/8.4/7.2 CFM/watt at 0.25 w.g.

6. Plug 'N Play™ Modules

a. Provide Motion Sensor

B. Rotating Ceiling Fan

1. Manufacturers: Casablanca WISP 59152, Minka Aire, Hunter or Approved Equal.

2. Ceiling Fan: 52" Pewter/Bronze ceiling fan with integrated light kit with cased white glass, 18W dimmable LED bulb, direct drive silent performance motor, three positioning mounting system for standard/angled/low ceiling mounting and operating controls.

PART 3 - EXECUTION

3.01 HOISTING, SCAFFOLDING, STAGING AND PLANKING

A. Provide, set up and maintain al required derricks, hoisting machinery, scaffolding, staging and planking. Perform all hoisting required to complete the work of this section as indicated and specified.

B. Scaffolding is to have solid backs and flows to prevent dropping material therefrom to the floors or ground.

C. All items of existing work indicated to be removed or are necessary to remove to permit proper installation of new work to be taken down and be immediately removed from the premises.

3.02 DEMOLITION

A. The existing facility will continue to operate during all phases of the demolition work and subsequent construction. No interruption of the systems will be permitted without prior approval of the Owner.

B. Perform all demolition while ensuring minimum interference with adjacent occupied areas.

C. Where sections of a system are to be removed and the system serves other areas of the building that are outside the scope of the work, perform the following:

1. Coordinate the temporary shut down of the system with the Owner's representative.

2. Install supports in the remaining active sections of the system as required by the removal of nearby supports associated with the demolition.

3. Isolate the system.

4. Cap the remaining system section, leaving the remainder of the system active.

D. Provide temporary shoring or bracing during the demolition work to prevent movement, settlement, or collapse of the system or adjacent systems due to the work.

E. Promptly repair any damage caused to adjacent facilities or areas that are designated to remain at no additional cost to the Owner.

F. Equipment:

1. Coordinate with all Contractors and Subcontractors to provide disconnection prior to equipment removal.

2. Remove equipment by unfastening at the supports or attachments. Then remove the attachments from the building, leaving no component of the original installation.

3. The Owner shall have the option to choose to take possession of the equipment or not. If the Owner chooses not to take possession of the equipment, the Contractor shall remove and dispose of the equipment in accordance with the paragraph below.

4. Exercise care with equipment that is to be relocated or turned over to the Owner, examine the equipment before removal in the presence of the Owner's representative to determine its condition. Make a record of any marks, etc. by a photograph or videotape acknowledged by the Owner's representative.

5. Install relocated equipment to ensure no damage.

6. Equipment to be turned over to the Owner: Deliver to an on-site location designated by the Owner, and obtain acknowledgment of receipt in good condition the following equipment.

G. All equipment, etc., not turned over to the Owner shall be put into the dumpsters; become the property of the Contractor, and shall be removed from the site by the Contractor.

H. Remove existing equipment and appurtenances as indicated on demolition plans and as required to install the new systems.

3.03 GENERAL

A. Install all items specified under PART 2 - PRODUCTS, according to the applicable manufacturer's recommendations and shop drawings, the details shown on the Drawings and as specified under this section. Provide all required hangers and supports.

B. Equipment base mounted on concrete or masonry slabs, pads and piers, or mounted on stands, gratings, platforms, or other, shall not be set in any manner, except on the finished and permanent support.

C. Support of equipment on studs, or other means, and the placing or building of the supporting slab, pad, pier, stand, grating, or other "to the equipment", is prohibited.

3.04 EQUIPMENT

A. All equipment shall be installed in strict accordance with manufacturer's written installation instructions.

3.05 VIBRATION ABSORPTION

A. All equipment and piping shall operate without objectionable or unusual noise or vibration, as judged by the Engineer.

B. Rotating equipment shall be fitted with such vibration-absorbing facilities as will be required to limit the transmission of vibration to the building and to the attached piping and breaching. The facilities shall be generally designed to limit this transmission to a maximum of 2%, but a greater amount will be allowed if it does not prove objectionable. The facilities shall also be designed to limit equipment floor loadings to 500 lb/sq. ft. or less. If, in order to accomplish this, the equipment requires the job installation of isolation mountings, inertia blocks, special hangers or other arrangements, these shall be carefully and specifically selected for each piece of equipment.

C. Motor driven equipment shall have the motor, equipment and drive mounted on a common base. Hollow bed plates shall be grouted with a rich cement mortar.

3.06 MISCELLANEOUS IRON AND STEEL

A. Provide steel supports and hangers required to support pipe, ductwork, and other equipment or materials. Submit details of steel supports and method of fabrication for approval.

B. All work shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets, and framework shall be properly sized and strongly constructed.

C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be by experienced metal working mechanics. Members shall be straight and true and accurately fitted. Scale, rust, and burrs shall be removed. Welded joints shall be ground smooth where exposed. Drilling, cutting and fitting shall be done as required to properly install the work and accommodate the work of other trades as directed by them.

D. Members shall be generally welded, except that bolting may be used for field assembly where welding would be impractical. Welders shall be skilled.

E. All shop-fabricated iron and steel work shall be cleaned and dried and given a shop coat of paint on all surfaces and in all openings and crevices.

3.07 BALANCING, ADJUSTING, OPERATING, AND INSTRUCTIONS

A. The HVAC contractor shall engage the services of an independent firm to perform testing, adjusting and balancing of the HVAC systems. The HVAC contractor shall submit to the owner at least three (3) qualified firms for the owner's review and acceptance in accordance with Division I, start up and adjusting.

B. Engage a balancing company to adjust, balance, and operate the heating, ventilating and air-conditioning system and thoroughly instruct the Owner's personnel in all phases of care and operation of the systems. The Balancing Company shall be certified by Associated Air Balance Council or by the National Environmental Balancing Bureau.

C. The Balancing Company will not perform air systems balancing until after the systems have been cleaned and treated by the Contractor.

D. The Contractor as a part of this contract shall provide all materials, labor, and service of all contractors for fulfillment of air and water balancing of all systems. The Balancing Company shall inform Contractor of all requirements ahead of time.

E. All equipment shall be operated and adjusted and all air systems shall be adjusted and balanced, readings taken and recorded on an approved form submitted to the Engineer for approval, readjusted and rebalanced in accordance with the Engineer's review comments and resubmitted.

F. The Balancing Company shall provide all instruments and accessories required to perform the tests.

G. The Contractor shall obtain from the manufacturer of each piece of equipment, five (5) copies of lubrication, operating and maintenance data sheets and control system drawings. He shall prepare five (5) complete sets of written coordinating operating and maintenance instructions into complete operating and maintenance manuals.

END OF SECTION 15500

SECTION 16100 –ELECTRICAL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The GENERAL REQUIREMENTS, DIVISION 1, and PROCUREMENT AND CONTRACTING REQUIREMENTS, DIVISION 0, are hereby made a part of this Specification Section.

B. Examine all Drawings and all Sections of the Specifications for requirements therein affecting the work and this Section. The exact scope of work of this Sub-bidder cannot be determined without a thorough review of all specification sections and other contract documents.

1.02 SCOPE OF WORK

A. Conditions of the Contract and Division 1, General Requirements, apply to work of this Section. Where Paragraphs of this Section conflict with similar paragraphs of Division 1, requirements of this Section shall prevail.

B. Examine Drawings and other Sections of Specifications for requirements that affect work of this Section.

C. As used in this Section, “provide” means “furnish and install” and “HVAC” means “Heating, Ventilating and Air Conditioning” and “POS” means “Provided Under Other Sections”. “Furnish” means “to purchase and deliver to the project site complete with every necessary appurtenance and support,” and “Install” means “to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.” “EC” refers to this Electrical Contractor. “GC” refers to General Contractor.

D. Perform work and provide material and equipment as shown on Drawings and as specified or indicated in this Section of the Specifications. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation. Drawings and Specifications form complimentary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation. Remove all debris caused by contractors’ work.

E. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract. It is not intended to specify or to show every offset, fitting or component; however, Contract Documents require components and materials whether or not indicated or specified as necessary to make the installation complete and operational.

F. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and federal government, and other authorities that have lawful jurisdiction.

G. Give notices, file plans, obtain permits and licenses, pay fees and obtain necessary approvals from authorities that have jurisdiction. All backcharges from the Utility shall be paid for by the Owner.

H. As work progresses and for duration of Contract, maintain complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately, including work installed as a modification or addition to the original design.

I. Work shall include, but shall not be limited to, the following:

1. Motor connections and controls.
2. Circuit breakers, and associated feeders. Reuse of existing panelboards.
3. Safety disconnect switches (fused or unfused).
4. Fuses.
5. Lighting fixtures.
6. Conduit and raceways.
7. Wire and cable.
8. Branch circuit wiring.
9. Selective electrical demolition.
10. Wiring devices and plates.
11. Pull boxes and cable troughs.
12. Grounding.
13. Supervision and approval.
14. Electrical connections to HVAC Kitchen and Plumbing equipment, and other equipment provided under other Sections or by Owner.
15. Nameplates, labels and tags.
16. Testing.
17. Operating and maintenance instructions and manuals.

1.03 EXAMINATION OF SITE AND DOCUMENTS

A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's failure to familiarize themselves with the

Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

B. Pre-Bid Conference: Bidders are strongly encouraged to attend the Pre-Bid conference; refer to Advertisement for Bids for time and date.

1.04 CONTRACT DOCUMENTS

A. Work to be performed under this Section is shown on the Architectural Drawings.

B. Electrical Contractor shall refer to Architectural. Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated.

C. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

D. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

E. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

F. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

1.05 DISCREPANCIES IN DOCUMENTS

A. Address questions regarding drawings to Architect in writing before award of contract; otherwise, Architect's interpretation of meaning and intent of drawings shall be final.

1.06 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for

additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.07 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work in strict accordance with the rules, regulations, standards, codes, ordinances, and laws of local, state and federal governments and other authorities having legal jurisdiction over the site.

B. Underwriters' Laboratories (UL) shall list material and equipment.

C. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction.

1.08 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee work in writing for one year from date of final acceptance. Repair or replace defective materials or installation at no cost to Owner. Correct damage caused in making necessary repairs and replacements under guarantee at no cost to Owner.

B. Submit guarantee to Architect before final payment.

C. Statement of guarantee requirements shall not be interpreted to limit Owner's rights under law and this contract.

1.09 RECORD DRAWINGS

A. Maintain record drawings on site. Record set must be complete and current and available for inspection when requisitions for payment are submitted.

1.10 SUBMITTALS

A. Refer to Section 01300 of submittal procedures.

B. Material and equipment requiring Shop Drawing and Product Data submittal shall include but shall not be limited to:

1. Circuit breakers.
2. Safety disconnect switches (fused or unfused).
3. Fuses.
4. Lighting fixtures.
5. Conduit and raceways.
6. Wire and cable.
7. Branch circuit wiring.
8. Wiring devices and plates.
9. Sleeving.

10. Pull boxes and cable troughs.
11. Fire alarm System devices.

1.11 RELATED WORK IN OTHER SECTIONS

A. The following work is not included in this Section.

1. Furnishing of starters, VFD's and disconnects that are being furnished by Section 230000.
2. Motors will be furnished and set in place under other Sections.
3. Telephone and data system, wire, cable, equipment and instruments.
4. Automatic temperature control wiring except as noted on Drawings.
5. Staging, scaffolding, ladders, chutes and other construction aids.

1.12 SEQUENCING

A. Coordinate work of this Filed Subcontract with that of other trades, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

B. Do not order or deliver any materials until all submittals, required in the listed Specification Sections included as part of this Filed Subcontract, have been received and approved by the Architect.

C. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Architect in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Rigid metallic conduit shall be zinc-coated steel that conforms to industry standards, by Allied Tube and Conduit, Republic Steel, Wheatland Tube or approved equal.

B. Electrical metallic tubing (EMT) shall be zinc-coated steel that conforms to industry standards, by Republic Steel, Allied Tube and Conduit, Triangle/PWC or approved equal.

C. Wireways shall be sheet steel with hinged spring-latched covers, galvanized or painted to protect against corrosion. Provide necessary bends, couplings, connectors and other appurtenances. Interior parts shall be smooth and free of sharp edges and burrs. Wireways shall be by Square D or approved equal.

D. Flexible metallic conduit shall be galvanized, spiral wrapped metallic conduit (Greenfield) or liquid-tight flexible metallic conduit as specified for specific equipment.

E. Conduit expansion fittings shall be threaded hot-dipped galvanized malleable iron with internal bonding assembly by O.Z./Gedney or approved equal.

F. Conduit fire seat fittings shall have heat-activated intumescent material for fire rating equal to or higher than that of floor or wall by O.Z./Gedney or approved equal.

G. Provide water-tight gland sealing assemblies with pressure bushings as required for penetrations.

H. Provide threaded malleable iron or steel connectors and couplings with insulated throats; manufactured elbows; locknuts; and plastic or bakelite bushings at terminations, as necessary. Couplings and connectors shall be gland and ring compression or stainless steel multiple point locking or steel concrete-tight set screw. Compression couplings and connectors shall form positive ground. Set-screw connectors and couplings shall have wall thickness equal to conduit, case-hardened, hex-head screws and separate ground wire. Bushings for rigid steel conduit and connectors for EMT shall have insulating inserts that meet requirements of UL 514 flame test.

2.02 OUTLET BOXES

A. Outlet boxes on concealed work shall be at least 4 inches square or octagonal, galvanized pressed steel with plaster rings as required. Outlet boxes for exposed conduit work shall be cast aluminum alloy with cast aluminum alloy covers.

B. Where installed in plaster, boxes shall be fitted with galvanized steel plaster covers of required depth to finish flush with finished wall or ceiling.

C. Switch boxes, receptacle boxes and other outlet boxes shall be standard 4 inches square with plaster rings or gang covers as required.

D. Outlet boxes shall be by Steel City Electric Company, Appleton Electric Company, National Electric Products Company or approved equal.

E. Outlet boxes for various systems and components shall be as required by manufacturer.

F. Waterproof boxes shall be Condulet Cast Boxes with water-proof devices and covers. Provide hot-dipped galvanized corrosion-resistant epoxy enamel finish or PVC-coated products, where noted on Drawings.

G. Provide screw-joint outlet boxes, with gasketed weatherproof covers in exterior locations, where exposed to moisture, at kitchen and cafeteria equipment with or next to water or steam connections, and where indicated as weatherproof on Drawings.

H. Provide only enough conduit openings to accommodate conduits at individual location. Each box shall be large enough to accommodate number and sizes of conduits, wires and splices to meet NEC requirements, but shall be at least size shown or specified.

Necessary volume shall be obtained by using boxes of proper dimensions. Box depths greater than 2-1/8 inches shall not be used to obtain necessary volume, but may be used with Architect's approval to facilitate installation. Standard concrete boxes may be 6 inches deep where necessary to permit entrance of conduits into sides of boxes without interference with reinforcing bars. Octagonal hung ceiling boxes with suspension bars may be 3-1/2 inches deep. Rectangular boxes for inter-connection of branch circuit conduits may be 2-1/2 inches deep.

2.03 JUNCTION BOXES, PULL BOXES AND CABLE TROUGHS

A. Provide code gauge galvanized steel junction and pull boxes for conduit 1-1/4 inches trade size and larger, where indicated and as necessary to facilitate installation, of required dimensions, with accessible, removable screw-on covers. Provide junction and pull boxes in special sizes and shapes determined in field where necessary.

B. Junction box covers shall be accessible. Do not install junction boxes above suspended ceilings except where ceiling is removable or where access panel is provided.

C. Sheet metal pull boxes shall be supported adequately to maintain shape. Larger boxes shall have structural steel bracing welded into rigid assembly formed adequately to maintain alignment in shipment and installation. Secure covers with corrosion-resistant screws or bolts.

1. Pull boxes exposed to rain or in wet locations shall be weatherproof.
2. Pull boxes used with aluminum conduit shall be metal compatible with aluminum.
3. Provide clamps, grids and other appurtenances to secure cables. No cable shall be unsupported for more than 30 inches.
4. No pull box shall be within 2 feet of another.
5. Provided sealed, cast-alloy, hazardous-location boxes with sealing fittings in garages and other areas in which flammable gases or vapors may be present to prevent transmission of gases or vapors through conduits.
6. Pull boxes connected to concealed conduits shall be mounted with covers flush with finished wall or ceiling. No aluminum pull box shall be embedded in concrete.

D. Provide cable troughs of special shapes, design and construction required to install, support and enclose feeder cable throughout indicated routing. Troughs shall be as specified above for junction and pull boxes, with reinforcing, insulating supports and clamping for cable installation. Cables shall be continuous throughout troughs, and shall be racked in distributed phase groupings arranged with phase cables surrounding neutral conductors.

2.04 WIRE AND CABLE (600 V INSULATION)

A. Provide single-conductor, annealed copper wire and cable with insulation rated 600 V, of sizes specified and scheduled on Drawings, by General Electric, Rome, Okonite or approved equal, for secondary service, feeders, branch and system wiring. Wire insulated for 300 V may be used where voltage is less than 100 V, if isolated from higher voltages. Wire sizes shown and specified are American Wire Gauge for copper.

B. Armored cable shall be Type MC 600 V copper with full-sized insulated ground conductor, in accordance with NEC Article 330. Minimum size shall be #12 AWG unless specified otherwise.

C. Wire #8 and larger shall be stranded; #10 and smaller shall be solid. Wire and cable shall have THWN-THHN or XHHW insulation.

D. Motor control circuits and signal wiring may be #14 if NEC requirements are met. Branch circuits longer than 75' feet for 120 V and 175 feet for 277 V shall be at least #10 from panel to last outlet.

E. Wiring within light fixtures and other high-temperature equipment shall have 150 ºC insulation as required by NEC.

2.05 FEEDER IDENTIFICATION

A. Provide nonferrous identifying tags or pressure-sensitive labels for cables, feeders, and power circuits in pull boxes, manholes and switchboard rooms, at cable termination and in other locations.

B. Tags or labels shall be stamped or printed to correspond with markings on Drawings or marked so that feeder or cable may be identified readily. If suspended tags are provided, attach with 1/32 inch diameter nylon 55-pound test monofilament line or slip-free plastic cable lacing unit.

2.06 COLOR CODING

A. Color code secondary service, feeders and branch circuit conductors as follows:

208/120 Volts	Phase
Black	A
Red	B
Blue	C
White	Neutral
Green	Ground

B. Colors shall be factory-applied entire length of conductors by one of the following methods except as noted and limited below:

1. solid color compound,
2. solid color coating,
3. colored stripping (2 stripes 180 degrees apart),
4. colored bands or hash marks with maximum spacing of 18 inches,
5. colored fibrous covering, or
6. surface printing every 12 inches, maximum spacing of 18 inches.

C. Branch circuit conductors #12 and #10 shall have solid color compound, solid color coating. Neutrals and equipment grounds shall have solid compound or solid color coating (white, gray and green), except that neutrals with colored stripe shall be used where required by NEC. Conductors #8 and larger with stripes, bands or hash marks shall have background color other than white, green and gray.

D. Solid color coating, stripes, bands or hash marks shall be strongly adherent paint or dye, sufficiently wide and clear to be readily distinguishable after installation.

E. Alternative field-applied color coding methods may be used for wire #10 or larger, with color code specified in Subparagraph A:

1. Apply 3/4 inches colored pressure-sensitive plastic tape in half overlapping turns for 6 inches from all terminal points and in boxes in which splices or taps are made. Apply last two laps of tape with no tension. Do not cover cable identification markings.
2. Identify with nylon, self-extinguishing, self-locking colored cable ties. Ties shall accommodate wire sizes 1/16 inches through 1-3/4 inches in diameter and shall not be less than 0.18 inches wide. Minimum tensile strength shall be at least 50 lbs. Temperature range shall be -65 ºF to +350 ºF. Provide three ties to each wire at each terminal point starting 3 inches from terminal and spaced 3 inches apart and three ties to each wire in boxes where splices or taps are made with special tool or pliers, and cut off excess.

2.07 WIRE PULLING EQUIPMENT

A. Provide polyethylene ropes for pulling wire.

B. Provide fish wires in telephone conduits and other empty conduit systems required, without splices and with ample exposed lengths at each end.

C. Provide wire pulling lubricants that meet applicable UL requirements as necessary.

2.08 CABLE SUPPORTS AND BOXES

A. Provide cable supports and boxes for vertical feeders as required by NEC. Boxes shall be 10 gauge steel plates fastened to angle iron frame with removable covers secured with brass machine screws.

B. Provide split wedge cable supports with clamps for cable without metallic sheath. Provide basket weave or approved equal cable supports approved by cable manufacturer for cable with metallic sheath. Supports shall be by O.Z./Gedney or approved equal.

2.09 WIRING DEVICES

A. Provide wiring devices by single manufacturer. Arrow-Hart (Division of Crouse-Hinds), Leviton, Bryant, Hubbell or approved equal. Catalog designations of Arrow-Hart are specified to establish standards of quality for materials and performance.

B. Toggle Switches:

1. Single-pole shall be No. 1991, 20A., 120-277 V AC.
2. Double-pole shall be No. 1992, 20A., 120-277 V AC.
3. Three-way shall be No. 1993, 20A., 120-277 V AC.
4. Four-way shall be No. 1994, 20A., 120-277 V AC.

C. Receptacles:

1. Duplex shall be No. 5739, 125 V, 20A, 2-pole, 3 W, grounding.
2. Heavy duty receptacles shall be sized as required for intended service.
3. Duplex convenience outlets and other outlets on emergency circuits shall be red melamine, No. 5739, 125 V, 20 A, 2-pole, 3W, grounding.

2.10 WIRING DEVICE PLATES

A. Provide smooth white nylon device plates by Arrow-Hart, Bryant, Hubbell or approved equal.

B. Nameplate designations for device plates shall be engraved directly on plates and filled in.

C. Device plates for switches and receptacles connected to emergency circuits shall have engraved nameplates marked “Emergency Circuit” in ¼ inch letters, filled red.

D. Device plates shall be manufacturer of wiring devices.

E. Receptacle device plates for circuits other than 120 V, 2-wire, shall be engraved with ¼ inch letters, filled red, indicating voltage characteristics and circuit number of outlet.

F. Outlets shall be flush to surface.

G. All receptacles shall be provided with labels indicating panel board and circuit number (i.e. PIA-23).

2.11 SAFETY DISCONNECT SWITCHES

A. Provide quick-make/quick-break safety switches: Type HD, heavy duty, Class 3, Design 3, unless specified otherwise. Provide NEMA 1 or NEMA 12 enclosure for dry applications and NEMA 3R for wet. Switches shall be rated 240 or 600 V minimum as required for voltage of associated circuit and shall be rated in horsepower. Fuses shall interrupt locked rotor current of associated motor or ten times full rates load current, whichever is greater.

B. Mount switch parts on insulating bases to facilitate replacement from front of switch. Current-carrying parts shall be high-conductivity copper. Contacts shall be silver-tungsten or plated. Provide positive pressure fuse clips and switch operating mechanism suitable for continuous use at rated capacity without auxiliary springs in current path.

C. Switches shall withstand available fault current or let-through current before operating, without damage or rating change.

2.12 FUSES

A. Provide current-limiting, high-interrupting-capacity fuses for equipment provided under this and other Sections. Except as specified otherwise, provide 10% spares at least three of each size, in cabinet in main electric room. Cabinet trim shall match that of panelboard trim. Coordinate with equipment manufacturers and with work of other Sections.

B. Fuses larger than 600 A shall be Class L time delay Bussman KRP-C or approved equal. Fuses 600 A and smaller that serve motors, fusible circuit breaker panelboards and transformers shall be dual-element current limiting Class RKI or approved equal.

C. Submit specific fuse locations, types, manufacturers and ratings. Test data will be waived if fuses are products of single manufacturer and selectivity is substantiated by published catalog data. Provide data for short circuit and protection coordination study as directed.

D. Switch sizes and fuse ratings shown on Drawings and specified represent general approximate values for each motor hp delineated. Coordinate fuse values with motor switch sizes. Obtain recommended fuse rating data from fuse manufacturer. In case of discrepancy between Contract Documents and manufacturer's recommendations, manufacturer's recommendations shall govern work. Revise switch sizes to accommodate recommended fuse values and revise assembled equipment as necessary. Furnish necessary change information to equipment manufacturers. Submit changes in switch sizes to Architect for approval. Certify that motor circuits have adequate short circuit protection with fuses provided.

2.13 LIGHTING SYSTEMS

A. General:

1. Provide lighting fixtures and equipment complete, wired and assembled as specified and shown on Drawings.
2. This specification contains descriptive criteria. Where no manufacturer's name is listed as standard of quality, Architect's decision concerning the conformity of the product to Contract Documents requirements shall be final.
3. In addition to submittals requirements of Section 01 33 00, shop drawing and product data submittals shall include physical dimensions, specify types and mounting details.

    a. Equipment and materials that require product sample submittal are shown on Drawings.
    b. Submit written statement that verifies coordination of fixture mounting with ceiling systems as specified, with date of verification.

B. Lamps:

1. Provide LED modules by General Electric, Phillips or Sylvania, unless specified or shown on Drawings otherwise. Obtain most recently published performance criteria.
2. Lamps shall meet ANSI C78 requirements.
3. Guarantee lamps for 90 days after acceptance by Architect. Replace LED modules that fail during that time at no cost to Owner.
4. LED modules shall be new unless specified or shown on Drawings otherwise.
5. Do not operate lamps before final inspection by Architect except for initial testing. Initial lumen output shall not be measured before 100 hours of operation.
6. Fluorescent lamps shall be rated 3500K, 85 CRI, Low-Mercury content.

C. Luminaires:

1. General:

    a. Provide factory-wired luminaires that meet UL 57 and ANSI C81 requirements, of dimensions and in locations as shown on Drawings.
    b. Finish shall be uniform with no defects such as whirls, discoloration, sand or dust spots, cracks or chips. Steel rustproofing shall be by five-stage cleaning cycle and iron or zinc phosphate coating with rust inhibitor.
    c. Luminaires in damp or wet locations shall bear correct UL label as shown on Drawings. Luminaires in hazardous locations shall bear UL 885 and UL 1225 labels.
    d. Provide safety chains on luminaires as shown on Drawings. Chains shall support eight times luminaire weight including fixture components. Maximum distance luminaire may fall shall be 1 foot.

D. Lens Diffusers:

1. Provide lenses of at least 1/8 inch thick, 100% clear acrylic, tinted acrylic or glass as shown on Drawings. Lenses shall not be inverted unless specified otherwise.
2. Acrylic lenses shall meet or exceed Grade 8 requirements of ASTM D-788 Table 2.
3. Acrylic lens prismatic pattern 20 shall have 1/8 inch square base male cones on base parallel to lens edge. Prism height shall be at least 0.05 inch. Lens shall be KSH-20 or approved equal.

E. Louver Diffusers

1. Parabolic louver shall be at least 0.025 inch thick, semi-specular pre-anodized aluminum, as shown on Drawings.
2. Metallic louvers shall be at least 20 gauge steel.
3. Plastic louvers shall be 100% acrylic.
4. Coated plastic louvers shall be destaticized polystyrene.

PART 3 - EXECUTION

3.01 MATERIALS AND WORKMANSHIP

A. Work shall be executed in workmanlike manner and shall present neat, rectilinear and mechanical appearance when completed. Maintain maximum headroom at all times. Do not run pipes and ducts exposed unless shown exposed on drawings. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that completed installation shall operate safely and efficiently.

3.02 CONTINUITY OF SERVICES

A. Do not interrupt existing services to existing building without Owner's and Architect's approvals.

3.03 SPECIAL RESPONSIBILITIES

A. Coordinate work of this Section with work of other Sections.

1. Provide information about items furnished under this Section to be installed under other Sections, as necessary.
2. Obtain detailed information from manufacturers of equipment provided under this Section as to proper methods of installation.
3. Obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or by Owner.
4. Keep fully informed of shape, size and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.

3.04 TESTING, INSPECTION AND CLEANING

A. Test and inspect work provided under this Section as required by Contract Documents, codes, standards and authorities that have jurisdiction, to satisfaction of Architect. Notify Architect and authorities at least 48 hours before testing or inspection. Do not cover work before testing or inspection.

B. Furnish Architect with certificates of testing and inspection for electrical systems, indicating approval of authorities that have jurisdiction and conformance with requirements of Contract Documents.

C. Test wiring and connections for continuity and grounds before fixtures are connected; demonstrate insulation resistance by megger test as required. Insulation resistance between conductors and grounds for secondary distributions systems shall meet NEC requirements.

D. Verify and correct as necessary: voltages, tap settings, trip settings and phasing on equipment from secondary distribution system to points of use. Test secondary voltages at bus in main switchboard, at panelboards, and at other locations on distribution systems as necessary. Test secondary voltages under no-load and full-load conditions.

E. Test lighting fixtures with specified lamps in place for 10 hours; check fixtures in sections. Do not operate lamps other than for testing before final inspection by Architect. Replace lamps that fail within 90 days after acceptance by Architect within Contract Price.

F. Provide necessary testing equipment and testing.

G. Failure or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Replace defective material.

H. After completion of project, clean the exterior surface of equipment included in this section, including concrete residue.

3.05 NAMEPLATES

A. Provide nameplates in or on junction boxes and cabinets, and for special purpose switches, motor disconnect switches, remote control stations, starters or other controls furnished or installed under this Section. Nameplates shall designate equipment controlled and function.

B. Nameplates shall be laminated black bakelite with 1/4 inch high white recessed letters. Nameplates shall be securely attached to the equipment with galvanized screws. Adhesives or cements shall not be used.

3.06 WIRING METHODS

A. Install wire and cable in approved raceways as specified and as approved by authorities that have jurisdiction. Surface metal raceways shall not be used unless explicitly specified and shown on Drawings. Do not use surface raceways on floor. Do not use armored cable except as approved by local code for lighting and receptacle circuits in suspended ceilings and stud-wall partitions. Homeruns for lighting circuits shall be 3-phase, 4-wire run in conduit.

B. Wire from point of service connection to receptacles, lighting fixtures, devices, equipment, outlets for future extension, and other electrical apparatus as shown on Drawings. Provide slack wire for connections. Tape ends of wires and provide blank covers for outlet boxes designated for future use.

C. Conductors #10 and smaller in branch circuit panelboards, signal cabinets, signal control boards, switchboards and motor control centers shall be bundled. Conductors larger than #10 in switchboards, motor control centers and pull boxes shall be cabled in individual circuits.

D. Two or more conduits installed instead of single conduit shall contain duplicate conductors, including neutrals and ground conductors where required; total capacity of duplicate conductors shall be at least equal to capacity of conductors replaced.

E. Follow homerun circuit numbers shown on Drawings to connect circuits to panelboards. Where homerun circuit numbers are not shown on Drawings, divide similar types of connected loads among phase buses so that currents are approximately equal in normal usage. Connect each branch circuit homerun with two or more circuits and common neutral to circuit breaker or switch in three-wire or four-wire branch circuit panelboard so that no two circuits are fed from same bus. Where panelboard cabinets are recessed, provide conduits with sufficient capacity for future conductors for spare branch circuit protective devices and spaces in panelboard; stub up concealed to junction box. Provide extensions above ceiling.

F. Electrical metallic tubing may be used generally, if approved by local codes, for lighting fixture and receptacle circuits, telephone, inter-communications, signal and instrumentation circuits, and for control circuits. EMT may be used generally, if approved by authorities, in masonry walls, above hung ceilings, in equipment rooms, in mechanical and electrical chases and closets, in exposed locations along ceilings or walls above normal traffic level and where not subject to accidental damage or abuse. Do not run EMT exposed below 8 feet above finished floor. Conduit below 8 feet – 0 inches AFF exposed shall be rigid steel.

G. Install connectors and couplings as recommended by manufacturers. Compression fittings shall not be used with rigid steel, intermediate metallic or aluminum conduit. Set screw fittings shall not be used with rigid aluminum conduit and shall not be used for other applications, unless specified and approved by Architect. If set-screw connectors are used, tighten to imbed screws in conduit.

H. Conduit in concrete shall be rigid steel. EMT shall not be installed underground, in slabs on grade, in wet locations, in hazardous areas, or for circuits operating at more than 600 V. Buried metallic conduit shall be rigid steel. Run conduit in slabs above bottom steel reinforcing, below top reinforcing and inside beam stirrup, wall reinforcements and column ties.

I. Rigid non-metallic conduit as specified in Part 2 of this Section may be used, if approved by local authorities, for installation in concrete slabs when installed as required by NEC and manufacturer's requirements. Penetrations from concrete slabs shall be made with rigid steel conduit and rigid steel conduit fittings only.

J. Maximum outside diameters of raceways in conduit shall be 1/3 slab thickness. No more than two ¾ inches raceways shall cross in floor slab at a single point. Submit raceway crossing locations for approval before pouring slabs and relocate at no expense to Owner as directed by Architect. Lateral spacing of parallel raceways shall be at least 6 inches on centers. Do not run conduit in slab less than 3 inches thick without express approval and direction of Architect.

K. Raceways with outside diameters larger than 1/3 slab thickness shall be run concealed in hung ceilings in finished areas, exposed in unfinished Mechanical/Electrical and storage areas, below slabs on grade.

L. Penetrate waterproof walls of structural slabs and foundation walls only where approved by Architect. Submit proposed penetration points, size openings and penetration methods to Architect for approval.

M. Provide flexible conduits for connections to electrical equipment and to equipment furnished under Divisions 15400 and 15500 that are subject to movement, vibration or misalignment; where available space dictates; and where noise transmission must be eliminated or reduced. Flexible conduit shall be liquid-tight under following conditions:

1. Exterior locations
2. Moisture or humidity-laden atmospheres
3. Corrosive atmospheres
4. Where wash-down operations are possible
5. Where seepage or dripping of oil, grease or water is possible

N. Run concealed conduit and EMT in as direct lines as possible with minimum number of bends of longest possible radius. Run exposed conduit and EMT parallel to or at right angles to building lines. Ends shall be free from dents or flattening.

O. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance to outlets. Conduit shall enter and be secured to cabinet, junction box, pull box or outlet box with locknut outside and bushing inside, or with liquid-tight, threaded, self-locking, cold-weld wedge adapter. Provide additional locknut for rigid conduit and

wrench- tighten locknut for EMT or flexible conduit where circuit voltage exceeds 250 V. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into tapped connections. Vertical conduit runs that terminate in bottoms of wall boxes or cabinets shall be protected from entrance of foreign material before installation of conductors.

P. Size rigid steel conduit, EMT and flexible metallic conduit as required by NEC except as specified or shown on Drawings otherwise. Unless shown otherwise on Drawings, telephone conduits shall be at least 1 inch.

Q. Check raceway sizes to determine that green equipment ground conductor fits in same raceway with phase and neutral conductors to meet NEC percentage of fill requirements. Increase duct, conduit, tubing and raceway sizes shown or specified as required to accommodate conductors.

R. Unless specified or shown on Drawings otherwise, install conduit and EMT concealed. Unless specified or shown otherwise, conduit and EMT may be run exposed on unfinished walls and unfurred basement ceilings and in unfinished penthouses, attics and roof spaces. Provide stand-off clips for conduits on exterior masonry walls.

S. Install conduit systems complete before drawing in conductors. Blow through and swab after plaster is finished and dry, and before conductors are installed.

T. Expansion/Deflection Fittings: Conduit buried or secured rigidly on opposite sides of building expansion joints and long runs of exposed conduit subject to stress shall have expansion fittings. Fittings shall safely deflect and expand to twice distance of structural movement.

1. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting.
2. Conduits buried in concrete shall cross building expansion joints at right angles; provide expansion fittings as required by manufacturer's instructions. Provide insulated bushings at ends of conduits.

U. Sealing Fittings: Threaded sealing fittings for rigid steel conduits shall be zinc- or cadmium-coated, cast or malleable iron; sealing fittings for aluminum conduit shall be threaded cast aluminum. Fittings that prevent passage of water vapor shall be continuous drain.

1. Install and seal fittings as required by manufacturer's recommendations. In concealed work, install fittings in flush steel box with blank cover plate.
2. Install sealing fittings at following points, and elsewhere as shown:

    a. Where conduits enter or leave hazardous areas equipped with explosion-proof lighting fixtures, switches, receptacles and other electrical devices.

b. Where conduits pass from warm to cold locations.
c. Where required by NEC.

3. Secure conduit system as required by NEC.

V. Attach pull ropes to conductors with basket-weave grips on pulling eyes. Pull cables that share conduit at same time.

W. Provide inserts, hangers, anchors and steel supports as necessary.

3.07 INSTALLATION OF LIGHT FIXTURES

A. Coordinate installation of fixtures with installation of ceiling materials and suspension systems.

B. Do not install fixtures until work of other trades that may damage fixtures is completed.

C. Investigate lighting fixture locations and supports to ensure that no interference exists with hangers, ducts, sprinklers, pipes and other equipment.

D. Provide plaster frames for fixtures recessed in gypsum board or plaster ceiling.

E. Do not suspend or support lighting fixtures or safety chains from hung ceiling conduit or duct. Support fixtures with threaded rod from structural members only.

F. Provide unistrut below ducts where fixture locations coincide with duct runs. Provide threaded rods to support unistrut.

G. Luminaires shall be compatible with flexible wiring system.

H. Where air is supplied or returned through luminaries, coordinate compatibility of fixtures with air boots and attachments.

I. Patch spray-on fireproofing damaged during installation.

J. Support surface-mounted luminaries at least two concealed points to prevent rotation.

K. Fire-rated enclosures necessary for fixture housings above ceiling will be provided under another Section.

L. Mounting height of suspended or wall-mounted luminaries shall be shown on Drawings.

M. Locate ceiling-mounted fixtures as shown on reflected ceiling plans. Locate wall- and floor-mounted fixtures as shown on Electrical Drawings.

N. Coordinate aiming of adjustable fixtures with Architect.

3.08 GROUNDING

A. Provide equipment grounding system as shown on Drawings. Equipment grounding system shall be designed so metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with electrical circuits operate continuously at ground potential and provide low impedance path for possible ground fault currents.

B. System shall meet NEC requirements, modified as shown on Drawings and as specified.

C. Provide separate green insulated equipment grounding conductor for each single or three-phase feeder and each branch circuit. Install grounding conductor in common conduit with related phase or neutral conductors, or both. Parallel feeders installed in more than one raceway shall have individual full size green insulated equipment ground conductors.

D. Determine numbers and sizes of screw terminals for equipment grounding bars in panelboards and other electrical equipment. Provide screw terminals for active circuits, spares and spaces.

E. Provide green insulated grounding conductor in same raceway with associated phase conductors, as follows:

1. From green ground terminals of receptacles to green 10-32 washer-in-head outlet box machine screw. (Receptacles with special cast boxes and factory-designed and approved ground path do not require separate ground jumper.)
2. From green 10-32 washer-in-head machine screw in ceiling outlet box or junction box through flexible metallic conduit to ground terminal in fixture.
3. From green 10-32 washer-in-head machine screw in ceiling outlet box or junction box through flexible metallic conduit to green 10-32 washer-in-head machine screw in switch outlet box in movable partitions.
4. From green 10-32 washer-in-head machine screw in junction box or disconnect switch through flexible metallic conduit to ground terminal in connection box mounted on single phase fractional horsepower motor.
5. From equipment ground bus in motor control center through conduit and flexible metallic conduit to ground terminal in connection box mounted on three-phase motor. Ground conductor motors with separate starters and disconnect devices shall originate at ground bar in panelboard and shall be bonded to each starter and disconnect device enclosure.
6. From switchgear equipment ground bus to panelboard equipment ground bus.
7. From switchgear equipment ground bar to equipment grounding bar on busway.
8. From computer area power panel ground bar for branch circuits as required by NEC. No ground conductor circuit shall exceed 3 ohms resistance to building ground system.

F. Provide green insulated grounding conductor in nonmetallic conduits or ducts unless specified otherwise.

END OF SECTION 16100