SECTION 15855/DUCTWORK ACCESSORIES

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

1.4 Refer to other Division-15 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.5 Codes and Standards:

1.5.1 SMACNA Compliance: Comply with applicable portions of both SMACNA "HVAC Duct Construction Standards, Metal and Flexible" and "Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems".

1.5.2 UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".

1.5.3 NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.6 Approval Submittals:

1.6.1 Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions as follows:

1.6.1.1 Low pressure manual dampers

1.6.1.2 Control dampers

1.6.1.3 Fire dampers

1.6.1.4 Duct access doors

1.6.1.5 Flexible connections

1.6.2 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists for fire dampers. Include this data, product data, and a copy of approval submittals in O&M manual.

2 PRODUCTS

2.1 Dampers:

2.1.1 Low Pressure Manual Dampers: Provide 16 gauge dampers of single-blade type (12" maximum blade width) or multiblade type. Damper blades to be gang-operated from a single shaft with nylon or ball bearings on each end. Provide indexed locking quadrant. Parallel or opposed blade style is acceptable. Provide 2" standoff on locking quadrant for externally insulated duct.

2.1.2 Control Dampers: Provide dampers with parallel blades for 2-position control or opposed blades for modulating control. Construct blades of 16-ga. steel. Provide heavy-duty molded self-lubricating nylon bearings and 1/2" diameter steel axles spaced on 9" centers. Provide sponge rubber or felt blade edges. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16-ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up. Actuators (motors) are provided by control contractor.

2.1.3 Acceptable Manufacturers: Subject to compliance with requirements, provide dampers by Air Balance, American Warming & Ventilating, Arrow Louver and Damper, Penn Ventilator Co., Ruskin Mfg. Co., or Greenheck.

2.2 Fire Dampers:

2.2.1 Fire Dampers: Provide curtain type fire dampers, UL classified and labeled per UL 555, of types and sizes indicated. Construct casings and blades of galvanized steel. Damper shall not restrict duct free area when open. Dampers shall be rated for dynamic closure under flow and pressure. Provide sleeves and mounting angles. Provide fusible link rated at 160 to 165° F unless otherwise indicated. Provide damper with positive lock in closed position. All dampers shall be spring activated. Basis of design:

1-1/2 HR: Ruskin IBD2 - Style B for rectangular, Style CR for round, Style CO for oval.

1-1/2 HR: Ruskin IBDT for transfer grilles in narrow partitions.

3 HR: Ruskin IBD23 - Style B for rectangular, Style CR for round, Style CO for oval.

2.2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide fire dampers by Air Balance, Inc., American Warning & Ventilating, Arrow Louver and Damper, Penn Ventilator Co., Ruskin Mfg. Co., or Greenheck.

2.3 Turning Vanes: Provide manufactured or fabricated single wall turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.4 Duct Access Doors:

2.4.1 General: Provide duct access doors of size indicated, or as required for duty indicated.

2.4.2 Construction: Construct of same or greater gauge as ductwork served. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

2.4.3 Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by Air Balance, Inc., Duro Dyne Corp., Ruskin Mfg. Co., or Ventfabrics, Inc.

2.5 Flexible Connections:

2.5.1 General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.5.2 Acceptable Manufacturers: Subject to compliance with requirments, provide products by one of the following: Duro Dyne Corp., Flexaust (The) Co., or Ventfabrics, Inc.

3 EXECUTION

3.1 Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Ductwork Accessories:

3.2.1 Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

3.2.2 Install balancing dampers at all main ducts adjacent to units in return air, outside air and where indicated.

3.2.3 Install control dampers in the outside air duct and return air duct for each air handling unit. Damper operators provided by control contractor.

3.2.4 Install turning vanes in square or rectangular 90° elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

3.2.5 Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Install at fire dampers and smoke detectors. Opening size shall be per NFPA 90A for servicing fire dampers and smoke detectors. Provide label with 1-1/2" letters to indicate location of fire protection devices.

3.2.6 Install flexible connections in ductwork such that the clear length of the connector is approximately two inches. Provide thrust restraints as required. Flexible material shall not be so slack as to take a definite concave or convex shape during fan operation.

3.2.7 Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.2.8 Install fire dampers within fire walls and floors at locations shown on the mechanical drawings. Install in strict accordance with the manufacturer's printed instructions, NFPA 90A, and UL 555. Basis of design installation is detailed on the drawings.

3.3 Fire Dampers: Notify Engineer at least 24 hours in advance of ceiling installation or chase closure so that complete fire damper installation can be observed. A copy of the manufacturer's printed installation instructions shall be available at the site.

3.4 Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

3.5 Adjusting And Cleaning:

3.5.1 Adjusting: Adjust ductwork accessories for proper settings. Install fusible links in fire dampers and adjust for proper action.

3.5.2 Final positioning of manual dampers is specified in Division-15 section "Testing, Adjusting, and Balancing". However, the system shall be left functional with all dampers open or throttled.

3.5.3 Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5.4 Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION

SECTION 15860/GRILLES, REGISTERS AND CEILING DIFFUSERS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

1.4 Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets and for balancing of air outlets and inlets; not work of this section.

1.5 Codes and Standards:

1.5.1 ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual". Provide air outlets and inlets bearing ADC Certified Rating Seal.

1.5.2 NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 Approval Submittals:

1.6.1 Product Data: Submit manufacturer's technical product data for air outlets and inlets indicating construction, finish, and mounting details.

1.6.2 Performance Data: For each type of air outlet and inlet furnished, provide aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections and data as required.

1.7 O&M Data Submittals: Submit cleaning instructions for finishes and spare parts lists. Include this data and a copy of approval submittals in O&M manual.

2 PRODUCTS

2.1 General:

2.1.1 Except as otherwise indicated, provide manufacturer's standard grilles, registers, and ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

2.1.2 Manufacturers not listed in the following specification will not be considered for approval unless accepted by addendum prior to bid.

2.1.3 Performance: Provide grilles, registers and ceiling diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device equal to the

basis of design.

2.1.4 Ceiling and Wall Compatibility: Provide grilles, registers and diffusers with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into ceiling module or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems and walls which will contain each type of ceiling diffuser, grille, or register.

2.1.5 Appearance: All grilles and registers shall be aluminum construction and all diffusers shall be steel or aluminum construction, unless otherwise noted, with uniform matching appearance for each type of outlet. Ceiling mounted grilles and registers shall be set to be sight tight from the predominant exposure.

2.1.6 Finish: All ceiling mounted grilles, registers, and diffusers shall be finished with baked white enamel. Wall and door mounted grilles and registers shall be finished with clear anodized finish.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products by Titus, Metal Aire, Nailor or Price.

2.3 Square Ceiling Diffusers (CD-1): Provide square face, adjustable, 360 degree pattern diffusers with one-piece stamped cones, no corner joints, round necks. Provide lay-in panel as required. Provide trim ring for diffusers in hard ceilings to allow opening to be used for access. Diffusers with 24 x 24 face: Titus TMSA, Metalaire 5700 A , Price SCD. Diffusers with 12 x 12 face: Titus TMS, Metalaire 5800, Price SCD.

2.4 Return Grilles (RG-1): Provide return grilles with one set of 45 degree fixed louvers, parallel to the long dimension. Provide mounting frame for all wall and plaster ceiling installations. Titus 350 FL, Metalaire RHE and Price 630.

2.5 Exhaust Registers (ER-1): Provide exhaust registers with one set of 45 degree fixed louvers, parallel to the long dimension. Provide opposed blade damper, screwdriver operated from the face. Provide mounting frame for all wall and plaster ceiling installations. Titus 350 FL, Metalaire RHE and Price 630.

2.6 Sidewall Supply Registers (SR): Provide supply registers with two sets of individually adjustable airfoil registers, spaced at ¾", with the front set parallel to the long dimension. Provide opposed blade damper, screwdriver operated from the face. Provide mounting frame. Titus 272-FL or Metalaire 4004.

2.7 Transfer Grilles (TG): Provide transfer grilles with one set of 45 degree fixed louvers, parallel to the long dimension. Titus 350 FL, Metalaire RHE, Price 91.

2.8 Door Grilles (DG): Provide steel door grilles with vee core, fixed louvers, spaced ½", flanged frame, and telescoping auxiliary flanged frame. Provide prime coat ready for field painting. Titus T-700 or Metalaire DGDF, Price ATG.

3 EXECUTION

3.1 Coordinate installation with ceiling and light fixture installation. Locate ceiling outlets as

indicated on architectural Reflected Ceiling Plans. Unless otherwise indicated, locate ceiling outlets in the center of acoustical ceiling modules with sides parallel to the grid.

3.2 Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

3.3 Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

3.4 Set air volumes to values shown on the drawings so that the system is functional. Leave ready for test and balance contractor.

3.5 Furnish to Owner three operating keys for each type of outlet and inlet that require them; obtain receipt.

END OF SECTION

SECTION 15880/ROOF-MOUNTED AIR INTAKES AND VENTS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Approval Submittals:

1.3.1 Product Data: Submit product data sheets showing dimensions, construction, weight, ratings, and installation instructions.

1.4 O&M Data Submittals: Include a copy of approval submittals in O&M manual.

2 PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide products by Acme Engineering & Manufacturing Corp., Greenheck Corp., Loren Cook, Penn Ventilator Co., Ruskin smoke hatches, or approved AMCA labeled equal.

2.2 Intakes and Vents: Provide hooded gravity ventilators, curb-mounted, of type and capacity shown on the drawings. Construct with heavy gauge aluminum hood, housing and base. Provide steel frame. Provide factory applied three-coat epoxy finish on hood. Provide hinged hood with approved locking device for both open and closed positions. Ventilators shall be low silhouette trimline style.

2.3 Accessories:

2.3.1 Curbs: Provide 12" high, roofed-over type, prefabricated aluminum curbs with treated wood nailer and 1-1/2" fire resistant fiberglass insulation sized to match the intakes or vents. For deck slopes of 1/4" per foot and more, fabricate curbs to form level top edge.

2.3.2 Bird Screens: Provide removable bird screens, 1/2" mesh, aluminum or galvanized steel hardware cloth.

2.3.3 Backdraft Dampers: Provide where indicated aluminum louvered gravity dampers with felt-edged blades and nylon bearings. Mount in curb base.

2.3.4 Filters: Provide 1" thick aluminum filters.

3 EXECUTION

3.1 Coordinate ventilator work with roofing work as necessary for proper interfacing. Framing of openings, caulking, and curb installation is not work of this section.

3.2 Roof Curbs: Furnish curbs to roofing installer for installation.

3.3 Installation: Install in accordance with the manufacturer's written instructions. Anchor housing to curb with cadmium-plated self-tapping screws or lag bolts as dictated by curb construction. Installation shall withstand 125 mph winds.

3.4 Provide for manual operation of smoke hatch doors with automatic reset of fire release mechanism. Mount release where shown on the drawings. Provide egg crate type grille in ceiling below smoke hatches.

3.5 Refer to Division-15 ductwork sections. Connect ducts to ventilators in accordance with manufacturer's installation instructions.

3.6 Provide one set of spare fusible links for each size door.

3.7 Adjusting and Cleaning: Clean tar and other soil from housing and hood. Repair any marred or scratched surfaces with manufacturer's touch-up paint. Adjust and test each ventilator for proper operation.

END OF SECTION

SECTION 15908/HVAC SEQUENCE OF OPERATION - UNITARY EQUIPMENT

1. GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

1.1.1 Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.1.2 Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this section.

1.1.3 Operating equipment, devices and system components required for control systems are specified in other Division-15 sections of these specifications.

1.1.4 Control Diagrams: Diagrams are essentially diagrammatic. This specification intends for all necessary devices and components (regardless whether shown on the diagrams or not) to be provided in order to have a complete and working system as described in the sequence of operation.

2. PRODUCTS: (Not applicable)

3. EXECUTION:

3.1 DX Equipment Control Sequences:

3.1.1 Split System Air Conditioning Units: Refer to Section 15710.

3.1.2 Ductless Split System Air Conditioning Units: Refer to Section 15715.

3.2 100% Outdoor Air DX Unit Control Sequences:

3.2.1 Preconditioning Units:

3.2.1.1 Smoke Detector: A smoke detector shall be installed in the supply air duct where shown on the drawings to stop fan and signal the fire alarm system.

3.2.1.2 Start-Stop Sequences: Provide the following operational and interlock functions when the air handling unit is started and stopped unless otherwise noted.

1. Outdoor Air Damper: Open damper on fan start. Close damper on fan stop.

2. Exhaust Fan(s): Provide interlock to start on fan start. Stop exhaust fan(s) on fan stop.

3.2.1.3 Occupied Cycle: When the unit is in the occupied mode in response to interlock EMCS time clock or a manual override, provide the following to temper and dehumidify the outdoor air.

1. Start: Initiate the start sequence described in "Start-Stop Sequences".

2. Air Handling Unit Fan Control: Operate fan continuously.

3. Compressor Control: Provide outdoor air thermostat to stage, unload and operate compressors as required whenever the outdoor air temperature is above 65°F (adjustable). The units have hot gas bypass and head pressure control. For units with unloading, verify that unloading is complete prior to onset of hot gas bypass.

4. Hot Gas Reheat Control: Provide supply air thermostat to maintain supply air temperature at 70°F(adjustable) when in the cooling mode by operating the hot gas reheat valve. The hot gas reheat valve shall be modulating .

5. Heating Control: Provide supply air thermostat to stage on electric heaters to maintain 60°F (adjustable) when in the heating mode.

6. Outdoor Air Control: A manual balancing damper is installed in the outdoor air duct to each unit served.

3.2.1.4 Unoccupied Cycle: When the unit is in the unoccupied mode in response to interlock EMCS time clock or manual override, initiate the stop sequence described in "Start-Stop Sequences".

3.3 General Exhaust Fan Control Sequences:

3.3.1 Operational Controls for Fans:

3.3.1.1 Manual Control: Where required by sequence of operation, control shall be manual on and off using switches or other disconnecting means provided by Division 16.

3.3.1.2 Time Clock : Where required by sequence of operation provide for remote start-stop control function.

3.3.2 The following fans have manual control only: EF-2, EF-3

3.3.3 The following fans are controlled by time clock: EF-1.

END SECTION

SECTION 15915/ELECTRIC CONTROLS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of electric control systems work required by this section is indicated on drawings and schedules, and by requirements of this section. Control sequences are specified in Division-15 section "HVAC Sequence of Operation".

1.4 Refer to other Division-15 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.

1.5 Refer to Division-16 sections for the following work; not work of this section.

1.5.1 Power supply wiring for power source to power connection on controls and/or unit control panels. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.6 Provide the following electrical work as work of this section, complying with requirements of Division-16 sections. Control wiring 24 volt between field-installed controls, indicating devices, and unit control panels.

1.7 Codes and Standards:

1.7.1 Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

1.7.2 NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

1.7.3 NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.8 Approval Submittals:

1.8.1 Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

1.8.2 Shop Drawings: Submit shop drawings for each electric control system, containing the following information:

1.8.2.1 Schematic flow diagram of system showing fans and control devices.

1.8.2.2 Label each control device with setting or adjustable range of control.

1.8.2.3 Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.8.2.4 Provide details of faces of control panels, including controls, instruments and labeling.

1.8.2.5 Include written description of sequence of operation.

1.9 Test Reports and Verification Submittals:

1.9.1 Submit system verification letter stating that all HVAC controls have been checked, calibrated, started up and verified for proper operation.

1.10 O&M Data Submittals: Submit maintenance instructions and spare parts lists. Include this data and a copy of all approval submittals in O&M Manuals.

2 PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide electric control systems of one of the following:

Paragon
Tork
Intermatic

2.8 Programmable Time Clocks: Provide microprocessor-based programmable time clocks that are specified as part of HVAC control sequences. Programming features shall include: two start-stop cycles per day, automatic change to/from Daylight Savings Time, 365 days per year programming, channel bypass. The programming shall be accomplished by English language prompting. Provide battery backup for 48 hours. The devices shown on the drawings are based on eight channels per time clock. Adjust quantity of time clocks provided as required to meet the sequence of operation.

3 EXECUTION

3.1 Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Installation of Electric Control Systems:

3.2.1 General: Install systems and materials in accordance with manufacturer's instructions and shop drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-16 sections of these specifications. Mount room thermostats at 48 inches above finished floor.

3.2.2 Control Wiring: The term "control wiring" includes providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric control devices. All low voltage control wiring, except wiring located above accessible ceilings, shall be installed in conduit. Low

voltage wiring above accessible ceilings may be installed without conduit.

3.2.3 Wiring System: Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

3.2.4 Install control wiring in accordance with the National Electric Code and Division 16 requirements.

3.2.5 Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

3.2.6 Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers. Automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.

3.3 Adjusting and Cleaning:

3.3.1 Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.3.2 Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.3.3 Final Adjustment: After completion of installation adjust thermostats and similar equipment provided as work of this section. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of control system.

3.4 Install ionization smoke detectors provided by Division 16 and wall mounted keyed resets.

3.4.1.1 Room Sensors/Thermostats: Map showing zone of control.

3.5 Owner's Instructions: Provide services of manufacturer's technical representative for 32 hours divided into four sessions instruct Owner's personnel in operation and maintenance of electric control systems. Schedule instruction with Owner. Provide at least 7-day notice to Owner and Engineer of training date.

3.6 System Verification: The manufacturer's authorized representative shall state in writing to the Engineer that the control system is operating properly, final adjustments and calibrations are complete, and Owner training has been accomplished.

END OF SECTION

SECTION 15970/START-UP REQUIREMENTS FOR HEATING, VENTILATING, & AIR CONDITIONING (HVAC) SYSTEMS

1 GENERAL

1.1 Intent: It is the intent of this section to require that the startup requirements and report noted herein be performed prior to starting TAB work on each system. Work can be phased with permission of the Engineer.

1.2 Coordination:

1.2.1 The Contractor shall furnish to the TAB Contractor a complete set of plans, specifications, addenda, shop drawings, equipment performance data sheets, change orders, etc. as requested by the TAB Contractor.

1.2.2 The Contractor shall participate in a TAB coordination meeting to discuss interface requirements with the TAB Contractor and to establish a schedule for TAB work prior to start of TAB work.

1.3 Test Reports and Verification Submittals:

1.3.1 Submit Startup Report as described herein for each system. Attach Factory Startup Report for equipment as required by other Division-15 sections.

2 PRODUCTS: None

3 EXECUTION:

3.1 The TAB work shall not commence until the Engineer has received written notice from the Contractor that HVAC systems are 100% complete and are fully operational. Submit Startup Report as described herein.

3.2 The Contractor shall place all HVAC systems and equipment into complete operation during each working day of TAB work.

3.3 The Contractor shall provide access to HVAC systems and equipment by supplying ladders and/or scaffolding, and opening access panels and equipment room doors.

3.4 The TAB Contractor will provide to the Contractor TAB punch lists of non-complying HVAC work as they are discovered. The Contractor shall replace or repair non-complying work as soon as possible in order not to delay completion of TAB work.

3.5 Airside Systems: The Contractor shall provide the following information to the Engineer to substantiate proper start-up and preliminary adjustments of air handler units, belt driven fans, and duct systems.

3.5.1 Verify that air grilles (supply, return, exhaust, transfer, outdoor, etc.) are installed and connected to the duct system.

3.5.2 Verify that duct systems are clean of debris.

3.5.3 Verify that ducts attached with flexible connectors are aligned within ½" and have a uniform gap between ducts of 1"-1.5". Flexible connectors shall not leak and shall be insulated.

3.5.4 Verify that filters are clean and filter spacers are installed.

3.5.5 Verify that balancing dampers at grilles and branch ducts are operational and are fully opened.

3.5.6 Verify that fire dampers are correctly installed and are fully opened.

3.5.7 Verify that fan discharges are appropriate for the outlet ductwork with regards to the "system effect" per AMCA Publication 201. Inappropriate fan discharges will not be accepted.

3.5.8 Verify proper fan rotation.

3.5.9 Verify proper belt drive alignment.

3.5.10 Verify fan motor overload elements are correctly sized.

3.5.11 Adjust fan sheave until CFM is at or above design CFM. Provide additional sheaves and belts as required. Verify that motor is not overloaded.

3.5.12 Verify that HVAC control systems are fully operational.

3.6 Startup Report: The Contractor shall submit the startup information required by this section to the Engineer in a typed report organized as outlined herein. The Startup Report is required to meet the written notice described herein prior to starting TAB work. TAB work will not start until the Startup Report has been submitted and approved.

END OF SECTION

SECTION 15985/TESTING AND BALANCING OF MECHANICAL SYSTEMS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section. Division-15 Basic Mechanical Materials Sections apply to work of this section.

1.2 Description of Work:

1.2.1 Extent of testing, adjusting, and balancing work (TAB) is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

1.2.2 Coordination Meeting: A pre-TAB meeting shall be held to coordinate with the Engineer, General Contractor, Mechanical Contractor and Controls Contractor responsible for the HVAC system installation as required to complete the TAB work. TAB requirements for reporting, testing and optimization shall be reviewed at this meeting.

1.3 The intent of this specification is to balance HVAC systems within the tolerances listed, maintaining the pressure relationships indicated, with a minimum of noise and energy use. This process is inherently iterative in nature.

1.3.1 Airflow Tolerances:

1.3.1.1 Air Handling: The supply air, return air and outdoor air quantities shall be balanced within ±5% of design values.

1.3.1.2 Exhaust Fans: The exhaust fan quantities shall be set as required to maintain the design exhaust terminal flows within ±5% of design values.

1.3.1.3 Ceiling Diffusers, Supply Registers, Return and Exhaust Inlets: Balance to an air quantity within ±10% of the design values. Where the drawings indicate a design pressure differential for the room, air quantities shall be further adjusted to a more restrictive tolerance as required to establish the pressure differential.

1.3.2 Temperature Tolerances:

1.3.2.1 Air Handling Temperatures: The controlled temperatures at AHUs shall be verified to be under control within ± 1 °F of design values.

1.3.2.2 Room Temperatures: Balance systems and controls within ±2 °F of indicated settings.

1.4 Quality Assurance: The TAB Contractor shall be certified as follows:

1.4.1 Tester: A firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, who is not the Installer of the systems to be tested and is otherwise independent of the project. Comply with NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" as applicable to this work.

1.4.2 Tester: A firm certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project. AABC-certified firms are independent by definition. Comply with AABC's Manual MN-1 "AABC National Standards", as applicable to this work.

1.4.3 Industry Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

1.5 Job Conditions:

1.5.1 Do not proceed until coordination meeting has been held.

1.5.2 Do not proceed with testing, adjusting, and balancing work until HVAC work (including Controls) has been completed and is operable. Ensure that there is no residual work still to be completed.

1.5.3 Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

1.5.4 Do not proceed until duct pressure tests are complete and satisfactory.

1.5.5 Do not proceed until architectural work that would affect balancing (walls, ceiling, windows, doors) have been installed.

1.5.6 Testing may proceed system by system, but each HVAC system must be complete as describe herein.

1.5.7 The mechanical contractor shall make any changes in pulleys, belts, and dampers, and/or add dampers as required for correct balancing.

1.6 Approval Submittals

1.6.1 Submit the name of the proposed test and balance company for the Engineer's approval within thirty (30) days after awarding of contract.

1.7 Test Reports and Verification Submittals:

1.7.1 Submit four (4) copies of the dated test and balance report upon completion of TAB work. The report shall include a list of instruments used for the work. The report shall be signed by the supervisor who performed the TAB work.

2 PRODUCTS

2.1 Patching Materials: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

2.2 Test Instruments: Utilize test instruments and equipment of the type, precision, and capacity as recommended in the referenced standard. All instruments shall be in good condition and shall have been calibrated within the previous six (6) months (or more recently if required by standard).

3 EXECUTION

3.1 General:

3.1.1 Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.

3.1.2 Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as modified or detailed herein.

3.1.3 Test, adjust and balance systems during summer season for air conditioning systems and during winter season for heating systems, including at least a period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit. The Contractor shall return for a change of seasons test at no additional cost to the Owner and submit the revised TAB report.

3.1.4 Punch List: Prepare a deficiency (punch)list for the Contractor with a copy to the Engineer that lists all items that are incorrectly installed or are functioning improperly. Provide a retest after all items are corrected.

3.1.5 Prepare TAB report of test results, including instrumentation calibration reports, in format recommended by applicable standards, modified as required to include all data listed herein.

3.1.6 Patch holes in insulation, ductwork and housings which have been cut or drilled for test purposes in manner recommended by original Installer.

3.1.7 Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

3.1.8 Include in the TAB report recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.1.9 Include an extended warranty of ninety (90) days after completion of test and balance work, during which time the Engineer, at his discretion, may request a recheck, or resetting of any component as listed in test report. The TAB company shall provide technicians and instruments and make any tests required by the Engineer during this time period.

3.2 Controls

3.2.1 Check all HVAC controls for proper location, calibration and sequence of operation.

3.2.2 Check operation of all controllers and controlled devices to verify proper action and direction. Check the operation of all interlocks.

3.2.3 Check all motorized dampers for leakage when in closed position. If leakage is more that 5%, mechanical contractor shall reset damper linkages.

3.2.4 Check all control valves for complete closure and correct action under all operating conditions.

3.2.5 Check control of outdoor air at air handling units at maximum and minimum supply air cfm and at clean and dirty filter conditions. Verify proper operation of outdoor air controls at all points.

3.2.6 Smoke Detectors: Perform differential pressure test at each smoke detector and report required and measured values.

3.3 Air Balancing

3.3.1 Leakage tests on ductwork must have been completed before air balancing.

3.3.2 Set dampers, volume controls and fan speeds to obtain specified air delivery with minimum noise level and minimum energy use. Rebalance as required to accomplish this. Simulate fully loaded filters during test.

3.3.3 Set grille deflections as noted on plans. Modify deflections if required to eliminate drafts or objectionable air movement. Record air terminal velocity after completion of balance work. Record final grille and register deflection settings if different from that specified on contract drawings.

3.3.4 Record all fan speeds.

3.3.5 Airflow Measurement: Airflow measurements for air handling units (AHU), exhaust fans (EF) shall be obtained by duct traverse and reported in the TAB Report. The location of the traverse shall be indicated on a sketch included in the TAB Report. If airflow is determined by any other means than a traverse (i.e., sum of outlets, or other indirect method) it shall be clearly stated in the TAB Report. Organize TAB Report contemporaneous data so that the following can be readily checked:

3.3.5.1 Comparison of actual cfm to design cfm and percent variance.

3.3.5.2 Comparison of supply air cfm to return plus outdoor air cfm.

3.3.5.3 Comparison of each AHU supply air cfm to the sum of its terminals.

3.3.5.4 Comparison of each EF cfm to the sum of the inlets for the EF.

3.3.6 Static Pressure Measurement: Static pressure (SP) measurements for AHUs and EFs shall be obtained at both suction and discharge so that total static pressure (TSP) can be reported. Plot design cfm and SP on fan curve and include in TAB Report. In addition, the static pressure drop across each component of the equipment (such as coils, filters, etc.) shall be reported and shown on a sketch included in the TAB Report. Organize TAB Report contemporaneous data so that the following can be readily checked:

3.3.6.1 Comparison of actual SP to design SP for each fan.

3.3.6.2 Comparison of TSP to sum of component SPs for each fan.

3.3.6.3 Comparison of measured SPs to BAS filter DP and duct SP readings.

3.4 Data Collection:

3.4.1 In addition to the data required for any specified performance tests, measure and record the temperatures, pressures, flow rates, and nameplate data for all components listed herein.

3.4.2 It is the intent of this section to record data on balanced systems, under normal operating or design conditions. Data collection and recording shall be precise and contemporaneous so that flows and temperatures can be used to calculate coil Btu/hr for both airside and waterside. Acceptable Btu/hr calculation variation is 10%.

3.4.3 Temperatures:

1. Outside dry and wet bulb temperatures.
2. Dry bulb temperature in each room and at least one wet bulb temperature in each zone.

3.4.4 Pressures:

1. Suction and discharge static pressure of each fan.
2. Air pressure drop across each coil and component of each AHU.

3.4.5 Flow rates:

1. Flow rate through each fan.
2. Flow rate through each pump.
3. Flow rate through each air distribution device.

3.4.6 Nameplate Data:

1. Complete nameplate data for all equipment.
2. Motor data to include horsepower, phase, voltage, RPM, full load nameplate current, fuse rating in disconnect switch, number or manufacturer's size designation, and ampere rating of overcurrent and low voltage protection devices in starters.

END OF SECTION

SECTION 16005/ELECTRICAL GENERAL

1 GENERAL

1.1 The work covered by this division consists of providing all labor, equipment and materials and performing all operations necessary for the installation of the electrical work as herein called for and shown on the Drawings.

1.2 Related Documents:

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

1.2.2 This is a Basic Electrical Requirements Section. Provisions of this Section apply to work of all Division 16 Sections.

1.2.3 Review all project Drawings to be aware of conditions affecting work herein.

1.2.4 Definitions:

1.2.4.1 Provide: Furnish, install, and test, complete and ready for intended use.

1.2.4.2 Furnish: Supply and deliver to project site, ready for subsequent requirements.

1.2.4.3 Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, test complete ready for intended use, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing work the Contractor shall satisfy himself as to the accuracy of all data indicated on the Drawings and/or provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Engineer. Commencement of work by the Contractor shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and damage.

1.6 Extent of work is indicated in the Drawings, Schedules, and Specification. Singular references shall not be construed as requiring only one device if multiple devices are shown on the Drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

1.7.1 The intent of the Drawings and Specifications is to obtain a complete and satisfactory installation. Separate divisional Drawings and Specifications shall not relieve the Contractor from full compliance of work indicated on any of the Drawings or in any Section of the Specifications. Report conflicts prior to start of work.

1.7.2 Verify all field dimensions and locations of equipment to insure close, neat fit with other trades' work. Make use of all Contract Documents and approved shop drawings to verify exact dimension and locations. Do not scale electrical drawings, rely on dimensions shown on architectural or structural drawings.

1.7.3 Coordinate work in this Division in proper sequence to insure that the total work is completed within Contract time schedule and with minimum cutting and patching.

1.7.4 Locate all equipment, materials, and apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on electrical drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

1.7.5 Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval from Engineer or Architect.

1.7.6 Carefully examine any existing conditions, piping, and premises. Compare Drawings with existing conditions. Report any observed discrepancies. Written instructions will be issued by the Engineer to resolve discrepancies.

1.7.7 Because of the small scale of the Drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate material, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and shall not order materials or perform work without verification. No extra compensation will be allowed because field measurements vary from the dimensions on the Drawings. If field measurements show that equipment or material will not fit, the Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee and Service:

1.8.1 Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.8.2 The Contractor shall guarantee labor, materials and equipment for a period of one (1) year from Substantial Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

1.9 Approval Submittals:

1.9.1 When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1.9.1.1 Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

1.9.1.1.1 Submittals shall be properly organized in accordance with the approved submittal control log.

1.9.1.1.2 Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

1.9.1.1.3 Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

1.9.1.1.4 Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

1.9.1.1.5 Submittals that include a series of fixtures or devices (such as lighting fixtures) shall be organized by the fixture number and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

1.9.1.1.6 The electrical design shown on the drawings supports the mechanical equipment basis of design specifications at the time of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this change will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

1.9.2 If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

1.9.3 Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

1.9.4 Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than ¼" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final "Approved" or "Approved as Noted" copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein. Submit manuals at the Substantial Completion inspection.

2 PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

2.2.1 Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

2.2.2 Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated or painted.

2.2.3 The label of the approving agency, such as UL or NEMA, by which a standard has been established for the particular item shall be in full view. Materials shall be UL-listed for the application specified or indicated on the Drawings or Specifications.

2.2.4 The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

2.2.5 A service organization with personnel and spare parts shall be available within two hours for each

type of equipment furnished.

2.2.6 Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

2.2.7 Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material and type of construction desired. Manufacturer's products shown on the Drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products meet detailed specifications and that size and arrangement of equipment are suitable for installation.

2.2.8 Model Numbers: Catalog numbers and model numbers indicated in the Drawings and Specifications are used as a guide in the selection of the equipment and are only listed for the Contractor's convenience. The Contractor shall determine the actual model numbers for ordering equipment and materials in accordance with the written description of each item and with the intent of the Drawings and Specifications.

2.3 Requests for Substitution:

2.3.1 Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product or material specified.

2.3.2 Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

2.3.3 Required product cannot be supplied in time for compliance with Contract time requirements.

2.3.4 Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.

2.3.5 Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.

2.3.6 All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

2.3.6.1 Principal of operation.

2.3.6.2 Materials of construction or finishes.

2.3.6.3 Thickness of gauge of materials.

2.3.6.4 Weight of item.

2.3.6.5 Deleted features or items.

2.3.6.6 Added features or items.

2.3.6.7 Changes in other work caused by the substitution.

2.3.6.8 Performance curves.

2.3.7 If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

2.4 Prior Approval

2.4.1 Prior Approval shall be required for any manufacturer other than those listed for all specified items in the Drawings and Specifications. Submit all requests for approval of the alternate manufacturer's products two weeks prior to bid opening. Approval will be in the form of an Addendum to the Specifications and Drawings. Clearly indicate all differences between the specified and proposed product following the guidelines for "Request for Substitution" herein. This requirement may be waived if, in the opinion of the engineer, it is in the best interest of the Owner. Submittals received after the award of the bid for equipment that has not been Prior Approved is subject to immediate rejection.

3 EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

3.2.1 The Contractor shall be responsible for full coordination of the electrical systems with shop drawings of the building construction so the proper openings and sleeves or supports etc., are provided for conduit, devices, or other equipment passing through slabs or walls.

3.2.2 Any additional steel supports required for the installation of any electrical equipment, fixtures or conduit shall be provided by the Contractor.

3.2.3 It shall be the Contractor's responsibility to see that all equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the Drawings.

3.2.4 All connections to fixtures and equipment shown on the Drawings shall be considered diagrammatic unless otherwise indicated by a specific detail on the Drawings. The actual connections shall be made to fully suit the requirements of each case and adequately provide for

servicing.

3.2.5 The Contractor shall protect equipment and fixtures at all times during storage and construction. He shall replace all equipment and fixtures which are damaged as a result of inadequate protection.

3.2.6 Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

3.2.7 Start of work will be construed as acceptance of suitability of work of others.

3.3 Construction Electrical Utilities: Provide all temporary wiring for power and light required for construction purposes and remove such temporary wiring when use is no longer required.

3.4 Service Coordination: Prior to commencing any work, coordinate with utility/service provider to ensure proper services are available to project when needed.

3.5 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.6 Cutting and Patching: Contractor shall provide all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.7 Equipment Setting: Bolt equipment directly to concrete pads or foundations, using hot-dipped galvanized anchor bolts, nuts and washers. Level equipment.

3.8 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 16. Obtain matched color coatings from the manufacturer and apply as directed by manufacturer. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.9 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, Contractor is to carefully clean and leave premises free from debris and in a safe condition.

3.10 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.11 Record (As Built) Drawings:

3.11.1 During the progress of the work the Contractor shall record on their field set of Drawings the corrections, variations, and deviations for systems which are not installed exactly as shown on the Contract Drawings.

3.11.2 Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 Sections.

3.12 Acceptance:

3.12.1 Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

3.12.2 Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with the project, for a period deemed necessary by the Owner to instruct permanent operating personnel in the operation of equipment and control systems.

3.12.3 Operation and Maintenance Manuals: Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

3.12.3.1 Detailed operating instructions and instructions for making minor adjustments.

3.12.3.2 Complete wiring and control diagrams.

3.12.3.3 Routine maintenance operations.

3.12.3.4 Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.

3.12.3.5 Copies of approved submittals.

3.12.3.6 Copies of all manufacturer's warranties.

3.12.3.7 Copies of test reports and verification submittals.

3.12.4 Test together and separately to determine that:

3.12.4.1 System is free from short circuits and other faults.

3.12.4.2 Motor starter overload devices are sized correctly.

3.12.4.3 Motors rotate correctly.

3.12.4.4 All equipment operates correctly and as specified.

3.12.5 Record Drawings: Submit "Record Drawings".

3.12.6 Install engraved metal or plastic nameplates or tags on controls, panels, switches, starters, timers, and similar operable equipment, keyed by number to operating instructions. Dymo type labels

are not acceptable.

3.12.7 Acceptance will be on the basis of tests and inspections of the work. A representative of the firm which performed the testing shall be in attendance to assist during inspection. Contractor shall furnish necessary electricians to operate system, make any necessary adjustments and assist with final inspection.

3.12.8 Control Diagrams: Frame under glass and mount on equipment room wall.

This is a sample cover sheet. Use one for each shop drawing.

PROJECT NAME
PROJECT NUMBER

SAMPLE

ARCHITECT/ENGINEER: Moses & Associates, Inc.

CONTRACTOR: XYZ Construction

SUBCONTRACTOR: ABC Electrical Contractor

SUPPLIER: Jones Supply Co.

MANUFACTURER: Various

DATE: 2/12/07

SECTION: 16520 / Interior Lighting

Use whatever standard headings you want here

1. Type A

2. Type B

3. Type C

4. Type D

5. Type E

List each item separately

Typical - list mfr name & model number

General Contractor's APPROVAL stamp must be on this sheet.

END OF SECTION