SECTION 23 05 01.00 – COMMON REQUIREMENTS

General Provisions of the Contract including General and Supplementary Conditions and General Requirements apply to work of this section.

The base bid includes furnishing all materials, labor, tools, and equipment and the performance of all work required to install a complete heating and air conditioning system as outlined herein.

The contractor shall provide a guarantee in written form stating that all work under this section shall be free of defective work, materials, or parts for a period of one year from the date of owner's final acceptance and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period. Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.

Quality Assurance Provide a complete installation in conformance with the following standards. AGA: American Gas Association

ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers NFPA: National Fire Protection Association SMACNA: Sheet Metal and Air Conditioning Contractors National Association.

Statewide Building Code IMC: International Mechanical Code Permits, Fees, Inspections, Laws and Regulations Permits and fees of every nature required in connection with this work shall be obtained and paid for by this contractor who shall also pay for all the installation fees and similar charges. Laws and regulations, which bear upon or affect the various branches of this work shall be complied with by this contractor and are hereby made a part of this contract. All work, which such laws require to be inspected, shall be submitted to the proper public

official for inspection and a certificate of final approval must be furnished. Work in Existing Spaces General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed. Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the general contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor.

Match existing finishes. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

Any Equipment to be demolished shall also include the demolition of any and all ductwork, piping etc serving or served by the equipment, all accessories, air devices, wiring, gas piping, venting, control wiring and power wiring associated with the equipment. Demolition shall be coordinated with all trades. All

materials shall be turned over to the owner or disposed at the owner's direction Contractor is responsible for reclaiming any refrigerant in association with the demolition in accordance with all local, state and federal regulations Any roof or wall penetration shall be patched watertight to the satisfaction of the architect.

Tests and Adjustments No ducts, piping, fixtures or equipment shall be concealed or covered until they have been inspected and approved by the Architect and the inspector who shall be notified by the contractor when the work is ready for inspection. Work shall be completely installed, tested and leak tight before inspection is required. All tests shall be repeated to the satisfaction of those making the inspection. Architectural coordination items Cutting and Patching: Cut and drill all openings in walls

and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut. Fire Caulking: Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch. Access Panels and Pathways: Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls, cleanout doors, and sprinkler devices required by NFPA. Provide access panels for all fire and/or fire & smoke dampers. Provide frame as required for finish. Furnish

panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks. project conditions Where new HVAC systems are required to be connected to existing HVAC systems, it is the contractor's responsibility to verify the location, size, pressure, condition, and they shall verify that the existing HVAC system is indeed the correct and appropriate HVAC system before any work is done. Provide all necessary camera scoping and dye testing as necessary. If there is any need for concern, if it is determined that the existing HVAC system is not a correct or appropriate HVAC system or not connected to a correct or appropriate HVAC system, if the condition of the existing HVAC system is not

viable for re-use, or any other condition that would not allow the proper functioning of the new HVAC system, the contractor shall notify the engineer in writing immediately via RFI and wait for direction before proceeding. MECHANICAL EQUIPMENT COMMON REQUIREMENTS INSPECTION

Examine areas and conditions under which mechanical equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. Uncrate equipment and inspect for damage. Verify that nameplate data corresponds with unit designation. INSTALLATION

General: Install mechanical equipment as indicated, and in accordance with manufacturer's installation instructions. Location: Install each unit level/plum and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer

Coordinate with other trades to assure correct recess size for recessed units. Protect interior mechanical equipment with protective covers during balance of construction. For ducted equipment, connect ductwork to units with flexible duct connections. Provide transitions to exactly match unit duct connection size. Provide 1" acoustic duct lining on return air side a minimum of 10' from fan. Piping: Restrictors or piping changes shall be made as necessary to achieve manufacturers recommended pressure drops. The findings shall be reported to the engineer at project closeout. Provide trap at drain piping connection to unit sized per

manufacturer's recommendations. Access: Provide access space around and over mechanical equipment for service as indicated, but in no case less than that recommended by manufacturer or required by code in effect.

Access Panels: Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls and cleanout doors, and sprinkler devices required by NFPA. Provide frame as required for finish. Furnish panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks. Rooftop mechanical equipment shall be installed a minimum of 10'-0" from any roof edge regardless of location indicated on plans, unless a screen wall or railing

is installed per the local building code. See the architectural plans for coordination.

Roof Curbs: Furnish roof curbs to roofing Installer for installation. Install and secure roof curb to roof structure, in accordance with National Roofing Contractor's Association (NRCA) installation recommendations and shop drawings. Install and secure units on curbs and coordinate roof penetrations and flashing. Install according to roofing manufacturer's recommendation and specifications. Indoor Suspended Equipment: Install suspended from structure with all threaded rod and vibration isolators. **ELECTRICAL COORDINATION ITEMS** Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with

equipment start-up until wiring installation is acceptable to equipment installer. Install electric heating terminal units including components in accordance with equipment manufacturer's written instructions, and with recognized industry practices; complying with applicable installation requirements of NEC and NECA's "Standard of Installation". Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A. Grounding: Provide equipment grounding connections for electric heating terminals as indicated. Tighten

specified in UL Std 486A to assure permanent and effective grounding. FIELD QUALITY CONTROL Testing: After installation has been completed, test to demonstrate proper operation of mechanical equipment at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units, which cannot be satisfactorily corrected. Test controls and demonstrate compliance with requirements. Cleaning: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean coils and inside of cabinets. Clean factory-finished surfaces.

connections to comply with tightening torque values

manufacturer's touch-up paint. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. TRAINING OF OWNER'S PERSONNEL Provide services of manufacturer's technical representative for 1-half day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7-day notice to Contractor

Repair any marred or scratched surfaces with

SECTION 23 05 03.00 – SUBMITTALS FOR HVAC

and Engineer of training date.

Where submittals are required by the Contract Documents, they shall be prepared and supplied in accordance with the Contract Documents. In addition to Division 01, the Contractor is advised to review and comply with the requirements articulated within each Division and within each section of that Division. Some Divisions may include a division-specific "Submittal Requirements for" section. Where this section exists, it articulates additional requirements for submittals that apply to the work of that Division. The following requirements help to identify, track and keep the project organized for all parties involved. They are necessary to ensure a timely turnaround and an appropriate technical review. Submittals that do not conform to the administrative requirements are rejected and returned, without technical review. Requirements

Supply submittals for each section: Submittals shall be supplied on a section-by-section and type-by-type basis. For example, independent product data submittals shall be furnished for each section that requires product data submittals. Independent shop drawing submittals shall be furnished for each section that requires shop drawings. Refer to the specifications for identification of which submittals are required for the project. Separate PDF file packages shall be supplied for each section, for each submittal type, where electronic submittals are required. Each PDF shall represent a single standalone submittal. Separately bound and identified submittals shall be provided where hardcopies are required Include a transmittal: Transmittals shall enumerate each submittal for each section of each type and iteration. Include cover sheet / title page: The cover sheet shall include the information identified in the contract documents. It shall be included as the first page of each electronic and/or hardcopy document-based submittal. An editable and printable PDF form created with editable fields and specification compliant appearance is available from KLH upon request. It is also downloadable from the KLH website at www.klhengrs.com Include an index: The index shall enumerate the contents of the submittal Include checklists: Where checklists are included with the specifications, complete and include them within the appropriate submittal. Supply complete submittals: Complete submittals of each type are required. Partial submittals will be rejected. Where a section requires a product data submittal, all product data for that section shall be supplied together, at one time, as one complete submittal. Do not send half the product data as one submittal and the other half as a separate one. When resubmittal is required (e.g. Revise and Resubmit) the revised submittal shall be more complete, more accurate and more contract-compliant than its rejected predecessor. The submittal number (for each section and type) shall increment for each subsequent submittal (00 – Original submission, 01 – First Resubmission, 02 – Second Resubmission, etc...). Resubmittals shall include a copy of the reviewer's comments supplied with the prior submittal rejection and shall be amended with a

description of the specific action taken to comply with the reviewer's comments. The absence of this on resubmittal is cause for rejection.

Name electronic files to match the submittal ID and cover sheet: The electronic file name of submittals shall match the submittal ID included on the submittals cover page. For example: The original/first product data submittal for Section 234116 would be labeled as "234116.00-PD-00"; the first resubmittal of same shall be labeled "234116.00-PD-01". The original/first shop drawings submittal file for the same section would be labeled "234116.00-SD-00"; the first resubmittal of same shall be labeled "234116.00-

Use of Electronic Drawings from the Owner's Design Plan drawings for the Project were created with AutoCAD If expressly permitted by the Owner and the terms of the

Contract, editable electronic versions of standard-scale. AutoCAD-based plan drawings may be made available for the creation of shop and as-built drawings. Upon request when available, electronic versions of standard-scale, Navisworks (.dwf) and (.nwc) or AutoCAD 36 (.dwg) files may be made available for coordination Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable

electronic form, at the sole discretion of the Design The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): http://www.klhengrs.com.

SECTION 23 05 29.00 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

Submittal Requirements Product Data: For each type of product indicated. Shop Drawings: Fabrication and installation

Support all piping, ductwork and equipment by hangers or brackets properly from the building structure. Support from decking above is prohibited. Furnish structural stee members where required to support piping and equipment. No portion of piping or valves shall be supported by equipment. Ductwork - Support by means of hangers as follows: Duct Width Hanger Size and Type Max. Spacing 30 or less (#16 gage) 31 to 60 (#14 gage)

SECTION 23 05 93.00 – TESTING, ADJUSTING AND BALANCING FOR HVAC

A pair of hangers shall be located at every transverse joint

and elsewhere according to the table.

Submittal Requirements Shop Drawings: Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Final Report: Upon verification and approval prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final report to the landlord.

Test, adjust, and balance the following mechanical Supply air systems, all pressure ranges Return air systems Exhaust air systems.

Test systems for proper sound and vibration levels. **Quality Assurance** Codes and Standards: AABC: "National Standards for Total System Balance". ASHRAE: ASHRAE Handbook, 2011 Applications, Chapter 38, Testing, Adjusting, and Balancing.

Qualifications The contractor shall procure the services of an independent Balance and Testing Agency, approved by the Engineer, and a member of Associated Air Balance Council (AABC) or NEBB, which specializes in the balancing and testing of heating, ventilating and air conditioning systems, to balance, adjust and test all air and water systems and equipment as herein specified. All work by this agency shall be done under direct supervision of a qualified heating and ventilating Engineer employed by this agency. All instruments used by this agency shall be accurately calibrated and maintained in good working

Sequencing and Scheduling Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg F wet bulb temperature of maximum summer design condition, and within 10 deg F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal

Check all filters for cleanliness, provide new as required. Check dampers (volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans. Place outlet dampers in full open position. Lubricate all motors and bearings. Check fan belt tension. Check fan rotation. Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. The contractor shall submit within 30 days after receipt of contract, 8 copies of submittal data for the testing and balancing of the air conditioning, heating, and ventilating systems. The Air Balance and Testing Agency shall provide proof of having successfully completed at least five projects of similar size The air balancing contractor shall include the additional

cost to change every fan factory installed sheave, pulley and/or belt of in order to obtain the design air flows. Renovations: In areas where existing HVAC equipment is being utilized, balancing contractor shall include the cost to pre-check each equipment air flows, serving the area of work, prior to demolition, and re-check and adjust each air handler after new construction. Air flows of existing air

handlers serving existing spaces shall be similar after project is complete Performing Testing, Adjusting and Balancing Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. Patch insulation, ductwork, and housings, using materials identical to those removed. Seal ducts and piping, and test for and repair leaks. Seal insulation to re-establish integrity of the vapor barrier. Mark equipment settings, including damper control positions; valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification Retest, adjust, and balance systems subsequent to

SECTION 23 07 13.00 – DUCT INSULATION

Submittal Requirements Product Data: For each product indicated. Shop Drawings: Include plans, elevations, sections, details and attachments to other work.

significant system modifications, and resubmit test results.

All liners, insulation and adhesives shall have a flame spread index not more than 25 and a smoke developed index of not more than 50. Insulation shall have a minimum installed thermal resistance value of R6 or code minimum, whichever higher. Rigid Fiberglass Ductwork Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with vapor barrier all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. Flexible Fiberglass Ductwork Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with vapor barrier all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. Vapor Barrier Material for Ductwork: Paper-backed aluminum-foil, except as otherwise indicated; strength and permeability rating equivalent to factory-applied vapor barriers on adjoining ductwork insulation, where available; with following additional construction characteristics: High Puncture Resistance: Low vapor transmission (for ducts in exposed areas: Mech. Rooms, etc.) Moderate Puncture Resistance: Medium vapor transmission (for ducts in concealed areas). All ductwork shall be insulated except: Double wall ductwork Fabric ductwork Metal ducts with duct liner of sufficient thickness to comply

with energy code.

Flexible connectors

Factory insulated flexible ductwork

Factory insulated plenums and casings

Vibration control devices Factory insulated access panels and doors Supply ductwork exposed in conditioned spaces excluding mechanical rooms, server rooms and electric equipment Toilet exhaust, general exhaust and return ductwork in an insulated joist or attic space.

SECTION 23 09 93.00 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

Submittal Requirements Product Data: Provide written sequences of operation for each controlled system and piece of equipment.

Packaged Rooftop Unit

1. Startup The unit shall operate on a 7 day/night programmable During startup, the fan shall run with the dampers in the full recirculation position. Provide occupied changeover sequence with optimum start function. When the return air temperature reaches occupied setpoint (adjustable), the minimum outside air damper shall open to the controlled minimum outdoor air position. Supply Fan Control

The supply fan shall be two staged and modulate up and down based on a call for heating or cooling. 3. Space Temperature Control Provide 7-day programmable thermostat with digital display of space temperature and setpoint (+/- deg. F. adjustable), with override feature and remote space temperature sensor.

4. Minimum Outside Air Control Provide carbon dioxide sensors in the space to measure carbon dioxide levels. Outside air damper shall modulate to maintain maximum carbon dioxide level setpoint at all times during occupied mode. CO2 levels shall be held below 1000 ppm (adjustable). When CO2 levels are below setpoint, outside air damper shall be at a minimum position, which equates to the sum of the "OA SQFT" multiplied by the room areas of each room in the "HVAC Ventilation Schedule" during occupied mode. Economizer Control

Provide dual enthalpy economizer control. Economizer control shall be enabled whenever the outside air enthalpy is lower than the return air enthalpy. Enthalpy shall be calculated from sensors which are tied to the same controller for accuracy. During economizer mode, the outside air damper shall modulate to 100% open. The economizer damper shall modulate open on a call for cooling and modulate closed on a call for heating. The return damper shall modulate inversely with the economizer damper.

6. Cooling Control Cooling shall be controlled to maintain space temperature setpoint. On a call for cooling, the heating shall be off and supply fan speed shall be low. On a further call for cooling, the economizer shall be enabled. On a further call for cooling, disable the economizer and energize first stage cooling on. On a further call for cooling, the supply fan speed shall be high and energized second stage of cooling 7. Heating Control

Heating shall be controlled to maintain space temperature setpoint. On a call for heating, the mechanical cooling shall be off. On a further call for heating, the economizer mode shall be disabled. On a further call for heating, the supply fan shall be set to low speed and the gas heating shall be disabled. On a further call for heating, the supply fan shall be set to high speed and the gas heating shall be staged on. Smoke Detector

When the smoke detector is alarmed, the system shall be alarmed and the air handler shall fail safe with manual Unoccupied Mode During the unoccupied mode of operation, the RTU shall go into night setback mode. Night Setback/Shutdown

At night setback/shutdown the RTU shall go to fail safe position. Fail safe position is defined by the following: The supply fan is off, the outdoor air intake damper is closed, the heating is off and the mechanical cooling is off. The supply fan shall cycle in conjunction with either the heating or cooling system to maintain a minimum/maximum space temperature depending on the season.

Exhaust Fans (Manual) Exhaust fans shall be controlled by local manual switch furnished, installed and wired by electrical contractor. When activated, exhaust fan motor damper shall open and fan shall start. (Indicated by EC on HECS schedule)

Electric Wall Heater/ Unit Heater Provide a self-contained integral thermostat with adjustable setpoint. On a call for heating, fan shall start and coil shall activate to maintain room temperature Provide relays and controls to automatically disconnect power to the electric heaters when the Cooling system is

Air Curtain Provide a self-contained integral thermostat with adjustable setpoint. On a call for heating, fan shall start and to maintain room temperature setpoint. Provide relays and controls to automatically shut off heat when outdoor air temperatures are greater than 45F.

Electrical contractor will provide power wiring. HVAC contractor shall provide all the low voltage wiring of HVAC units and controls, thermostats and controllers. Thermostat shall be by the manufacturer of the HVAC unit (heat/cool/auto/off) with night setback. Provide plastic protective cover for all thermostats.

Low Voltage Thermostats Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor. The electrical contractor shall provide 4" square x 1- 1/2" deep wall outlet boxes (with single-gang rings) for all thermostats/sensors. The electrical contractor shall provide one 3/4" empty conduit from each thermostat/sensor location, turned out above accessible ceilings (in joist space or against overhead slab/deck). The HVAC/Temperature Control Contractor shall provide all other necessary conduit, raceway and wiring related work. Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and dragline.

The HVAC/Temperature Control Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

Carbon Dioxide Sensors Carbon dioxide sensors shall be non-dispersive infrared (NIDR) type with a measurement range of 0-2000 ppm, repeatability of +/-20 ppm and a measurement accuracy of +/-75 ppm. The recommended calibration interval shall be a minimum of 5 Space mounted applications shall utilize diffusion through an

attractive, satin finish, high impact housing. General Control Wiring Requirements and Installation Except where specifically indicated otherwise above, the HVAC/Temperature Control Contractor shall provide all electrical work as required for all temperature control related wiring (i.e. conduit, raceway, outlet boxes, junction boxes, wiring, etc.) in accordance with Electrical Specifications requirements. All conduit shall be 3/4"

Coordinate all thermostat/sensor locations in field (case by case) with Architect, Owner and Electrical Contractor to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. All thermostat/sensor wall locations indicated on HVAC drawings are schematic only and must be verified case-by-case prior to rough-in. All electrical work as described in this specification shall be per the latest edition of the National Electrical Code (NEC) and per applicable state and local codes.

Where "free-air" installation methods (either exposed above the ceilings, in bridle rings or in cable trays) are permitted under Electrical Specifications above ceilings, provide plenum-rated cables wherever plenum ceilings (if any) exist and install as defined under Electrical Specifications. Install low voltage circuits, located in concrete slabs and masonry walls, in inaccessible locations, or exposed in occupied areas, in electrical conduit regardless of what wiring methods are permitted under Electrical Specifications. Where cable trays or bridle rings are provided by the electrical contractor for low voltage cables, these raceways may be utilized for control wiring by this contractor (provide special color coded jackets, label cable jackets per Electrical Specifications and group control wiring cables together). Provide conduit drops from cable tray/bridle ring paths to wall outlet boxes and equipment unless directed otherwise under Electrical Specifications. Regardless of permitted methods in Electrical Specifications, all cables/wiring installed concealed by gypsum board, masonry or other inaccessible materials in walls or above ceilings shall be installed in conduit, 3/4" All conduit, bridle rings, raceway, outlet boxes, etc. necessary for complete operational installation of control wiring shall be provided (furnished and installed) by the temperature control contractor in strict compliance with Electrical Specifications documents. Coordinate all work with all other applicable trades including the electrical Provide all required conduit work to and between equipment in a manner compliant with that described above (i.e. between VAV boxes, to boilers, starters, condensing units, etc. as applicable). Install control wiring without splices between terminal

points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and per Electrical Specifications. Install circuits over 25 volt with color-coded No. 12 wire in electrical metallic tubing, per Electrical Specifications. Install circuits under 25 volt with color-coded No. 18 wire with 0.031" high temperature (105 degs. F) plastic insulation on each conductor and plastic sheath over all. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.

All duct smoke detectors will be furnished by electrical contractor, installed by the HVAC contractor, and wired by the electrical contractor per local codes. HVAC contractor will interlock fan with smoke detector

SECTION 23 31 13.00 – METAL DUCTS

Submittal Requirements Product Data: For liners, adhesives, sealants and Shop Drawings: Sheet metal thickness, reinforcing details, duct layouts indicating sizes, configuration, liner material, elevation and static pressure class.

Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Mechanical contractor shall confirm ductwork paint scope and color with architect. Exposed ductwork which is to be painted shall have paint grip applied and be oil free. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel, lock forming quality; with G 90 zinc coating and mill phosphatized for exposed locations. Minimum gauge shall be 24. Miscellaneous Ductwork Materials Volume Dampers: Provide volume dampers in all branch

ducts or as required for balancing to required air flows.

Fittings: Provide radius type fittings fabricated of multiple

sections with maximum 15 deg. change of direction per

section. Unless specifically detailed otherwise, use 45 deg. laterals and 45 deg. elbows for branch takeoff connections. Where 90 deg. branches are indicated, provide conical type tees Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork Duct Cement: Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of

ductwork. Flexible Ducts Either spiral-wound spring steel with flameproof vinyl sheathing, or corrugated aluminum. Unless specifically mentioned, the maximum length of flex duct on the supply equals 5 feet. Flex is not allowed for return, relief or exhaust applications. The flexible ducts indicated for use in the H.V.A.C. system shall conform to the requirements of UL 181 for Class 0 or Class 1 flexible air ducts and shall be so identified Where installed in unconditioned spaces other than return air plenums, provide 1" thick 1-1/2 lb. continuous flexible fiberglass sheath with vinyl vapor barrier jacket. Installation is not permitted above drywall ceilings and

inaccessible ceilings. Fabrication Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. All ductwork shall be Pittsburgh Construction with a minimum of thickness of 24 gauge. In addition, ductwork used in systems over 3" W.G. shall have cold sealant applied. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction

Standards". Lined Duct Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Duct liner to be 3-lb density for acoustic requirements 1" thick or as noted. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if

Duct Liner: Fibrous glass of thickness indicated. 3-lb density. All liners, insulation and adhesives shall have a flame spread index not more than 25 and a smoke developed index of not more than 50. Duct Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA Duct Liner Fasteners: Comply with SMACNA HVAC Duct Construction Standards.

lined duct is used.

Installation of Metal Ductwork General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every Sealing: Seal all longitudinal seams, S's and drives and all joints with mastic or cement. Install according to SMACNA

Balancing Dampers: The sheet metal contractor shall be

fully responsible for installing balancing dampers in the

to arrive at the intended air flow. The balancing sub-

ductwork, (whether shown on the drawing or not) in order

contractor shall provide direction and assistance in determining locations where dampers are required. Additional dampers, if required shall be installed at no additional cost to the owner. Wall Penetrations: Seal and pack around all ducts and piping sleeves which pass through walls that extend to bottom side of structure and rated walls. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and

accommodate installation requirements. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate Where ducts pass through fire-rated floors, walls, or

partitions, provide fire dampers and firestopping between duct and substrate, in accordance with requirements of Division-7 Section "Firestopping" All dampers integral to or utilized as part of an engineered smoke control system shall be listed and comply with UL All fire dampers shall be listed and comply with UL 555. All dampers shall be low leakage with edge and blade seals. Damper manufacturers are subject to specification compliance. Provide products by one of the following: Greenheck Fan Corporation Nailor Industries

Ruskin Company Young Regulator Company Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

Installation of Duct Liner General: Install duct liner in accordance with SMACNA HVAC Duct Construction Standards. Size of ductwork shown on the drawings is free net area, outside dimension of ducts will need to be increased if lined duct is used. Store internally lined ductwork up off of the floor. Protect internally lined ductwork from water and dust. The following ductwork shall be lined in addition to that shown per plans: Return from open ceiling plenum return to HVAC unit. Supply and return ductwork 10 feet downstream of HVAC

Transfer air ducts. Butter the leading edge of all internal duct lining with the manufacturer's recommended adhesive. Inspect and repair all damaged lining prior to installation of ductwork. Installation of Flexible Ducts Maximum Length: For any duct run using flexible ductwork, do not exceed 5' - 0" extended length. Installation shall have smooth full radius turns down to

23 34 23.00 - HVAC POWER VENTILATORS

mesh, 16-ga aluminum or brass wire.

Submittal Requirements Submittal Requirements DIFFUSERS, GRILLES AND REGISTERS Product Data: For each type of product indicated Centrifugal Roof Ventilators Provide centrifugal roof type, curb mounted, power provide diffusers of one of the following: ventilators of type, size, and capacity as scheduled, and as specified herein. Type: Centrifugal fan, direct or belt driven as scheduled. Titus Products Div., Philips Industries, Inc. Provide aluminum, galvanized steel, or fiberglass Tuttle and Bailey. weatherproof housings as scheduled. Provide square base to suit roof curb. Provide permanent split-capacitor Louvers and dampers type motor for direct driven fans; capacitor-start, inductionrun type motor for belt driven fans. Provide the Following Types of Housing Design: provide diffusers of one of the following: Hooded dome type Electrical: Provide factory-wired non-fusible type Prefco disconnect switch at motor in fan housing. Provide Greenheck thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection. Provide NEMA 1 disconnect factory mounted. For single phase fractional HP fans use a toggle type disconnect 23 82 39.00 - UNIT HEATERS switch. On three phase integral HP fans use a NEMA 1 Submittal Requirements safety switch. Bird Screens: Provide removable bird screens, 1/2"

Roof Curb: Provide factory fabricated roof curb by the same manufacturer as the equipment. Roof curb to be Manufacturer: Subject to compliance with requirements provide centrifugal roof ventilators of one of the following: CaptiveAire Cook (Loren) Co. Greenheck. Twin City Fan & Blower Prefabricated Roof Curbs

General: Provide manufacturer's standard shopfabricated units, modified if necessary to comply with requirements. Fabricate structural framing for units of structural quality sheet steel, formed to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45 deg. cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units. Clean and paint units with manufacturer's standard rustinhibitive metal primer paint Reinforce continuous runs of over 3'-0" length, by inserting welded stiffeners of heavy gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed Gage and Height: Fabricate units of metal gage and to height above roof surface as indicated. Where gage or height are not indicated, fabricate units of 14-ga metal, and nominal height of 14". Provide pressure treated wood nailer, not less than 1-5/8"

thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit. Provide lumber pressure treated with water-borne preservatives for "above ground" use. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2" minimum thickness, except as otherwise indicated. Manufacturer: Subject to compliance with requirements, provide prefabricated roof curbs of one of the following: Custom Curb, Inc. Equipment Manufacturer.

MicroMetI Pate Co. Shipman. Thycurb. **INSTALLATION**

Coordinate ventilator work with work of roofing, walls, and ceilings, as necessary for proper interfacing. Provide access door in duct below ventilator to service Solder bottom joints and up 2" of side joints of duct under roof ventilator to retain any moisture entering ventilator.

SECTION 23 34 33.00 - AIR CURTAINS

Submittal Requirements Product Data: For each type of product indicated.

General: Provide air doors of size and capacity as noted on drawings. Air doors shall operate at a low sound level and meet OSHA standards. Construction Wheels: Talc-filled polypropylene or aluminum. Housing: Galvanized steel. Motorboard: Galvanized steel. Velocity Control: Provide adjustable louver damper

controls for regulating rate of air flow. When louvers are completely closed air velocity shall reduce to sixty percent. Directional Control: Provide adjustable vanes at outlet nozzle for directing air where needed and readily set to compensate for possible draft conditions through door openings. Vanes shall have a forty percent girth sweep front to back. Motors: Provide totally enclosed shaded-pole, or permanent-split capacitor motors, Class "B" insulation resiliently mounted, tap wound with built-in thermal overload protection, and with permanently lubricated type sleeve or ball bearings. Select motors with the voltage as Extended Motor Oilers: Provide plastic tubes for lubricating motor bearings which are installed beneath Motor Controls: Provide multi-speed motor control switch with OFF position, mounted behind access door. Fans: Provide double width, double inlet centrifugal fans,

which are balanced statically and dynamically, of indicated capacity. Select fans with single or double extended motor shaft, with fan housing and motor fastened as an integral assembly to a motorboard. Electric Air Curtains Devices: Provide air doors with the following devices: Thermally activated fan switch to keep fan motor operating until residual heat is dissipated. Disconnect switch. Automatic reset, high limit cut-out switch located in discharge air stream.

Manual "Summer-OFF-Winter" switch. Unit-mounted line voltage thermostat Time delay relay Control Power Transformer Magnetic Contactor (Relay Kit) Manufacturers: Subject to compliance with requirements, provide electric air doors of one of the following:

Mars Sales Company, Inc. Powered Aire Inc. Schwank

Provide disconnect at side or unit for installation in recessed ceiling. Provide trim piece to finish linear slot supply in ceiling for recessed units. Coordinate with other electrical work, including wiring/cabling, as necessary to properly interface installation of heating terminal units with other work. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness. Comb out damaged fins where bent or crushed before covering elements with enclosures. Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes. Field Quality Control Upon completion of installation of electric heating terminals, and after building circuitry has been energized,

test heating terminals to demonstrate capability and compliance with requirements. Replace electric heating terminals and accessories which are damaged and remove damaged items from construction site.

Installation not permitted above inaccessible ceilings. 23 37 13.00 - DIFFUSERS, REGISTERS AND

Product Data: For each type of product indicated. Manufacturer: Subject to compliance with requirements, Anemostat Products Div., Dynamics Corp. of America.

Provide louvers and dampers of size as noted. Manufacturer: Subject to compliance with requirements,

Product Data: For each type of product indicated General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled. Provide temperature control valves for modulation during a call for heat and closed during

Wall and ceiling unit heaters General: Provide a heavy duty fan forced wall heater. Heating grid shall be made up of rugged steel fins, copper brazed to non glowing, steel sheathed elements. Unit to have built in, tamper proof thermostat or remote thermostat, built in disconnect switch. Front cover shall be decorative 16 gauge welded bar Fan delay and thermal cutout are standard

Provide all required control transformers.

Accessories:

Markel

24V time delay relay Surface mounting box Provide wall heaters with the following devices: Thermally activated fan switch to keep fan motor operating until residual heat is dissipated. Disconnect switch. Automatic reset, high limit cut-out switch located in discharge air stream Manual "Summer-OFF-Winter" switch

Unit-mounted line voltage thermostat Control Power Transformer Magnetic Contactor (Relay Kit) Manufacturers: Subject to compliance with requirements, provide wall heaters of one of the following: Qmark Trane Co.

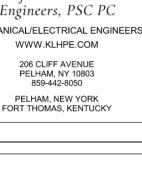
Installation of Heaters Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom

possible unless otherwise indicated. Support units with rod-type hangers anchored to building Protect units with protective covers during balance of construction. Coordinate with other electrical work, including wiring/cabling, as necessary to properly interface

installation of heating terminal units with other work. Clean dust and debris from each heating terminal as it is installed to ensure cleanliness. Comb out damaged fins where bent or crushed before covering elements with enclosures. Touch-up scratched or marred heating terminal enclosure surfaces to match original finishes. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A.

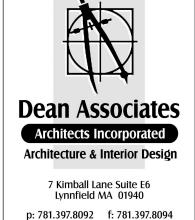
Provide equipment grounding connections for electric heating terminals as indicated. Tighten connections to comply with tightening torque values specified in UL Std 486A to assure permanent and effective grounding.

> Engineers, PSC PC HANICAL/ELECTRICAL ENGINEERS WWW.KLHPE.COM PELHAM, NEW YORK











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