FIRE EXTINGUISHERS

1. GENERAL

1.1 Scope

.1 Fire extinguishers.

.2 Fire extinguisher cabinets and mounting hardware

1.2 General Requirements

.1 Provide portable hand extinguishers where indicated on drawings and specified herein.

1.3 Quality Assurance

.1 Fire protection equipment and installation shall be approved by local Fire Commissioner.

.2 Equipment and installation shall meet the requirements of NFPA No. 10 Portable Fire Extinguishers. – latest edition.

1.4 Submittals

.1 Submit shop drawings for review. Submit with shop drawings Material Safety Data Sheets (MSDS) for each chemical used in the Fire Extinguishers.

2. PRODUCTS

2.1 Portable Hand Fire Extinguishers

.1 Multi-Purpose Dry Chemical: Pressurised with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets, 9.0 kg capacity rating 10A:80BC.

2.2 Fire Extinguisher Cabinets and Brackets.

.1 Fire Extinguishers Cabinet: Surface type 16 gauge steel construction with 12 gauge fully opening door in adjustable frame, 6 mm wired glass full panel door, approved latching device, prime coat.

3. EXECUTION

3.1 Installation

.1 Install extinguishers so that the bottom of extinguisher is no more than 1200 mm above floor.

END OF SECTION

CAST IRON BOILERS

1. GENERAL

1.1 Scope

.1 Boilers.

.2 Controls and boiler trim.

.3 Glycol connections.

.4 Fuel connections.

.5 Electrical connections.

.6 Collector, draft hood and chimney connection.

1.2 Quality Assurance

.1 Comply with Territorial Regulations and have CSA approval.

.2 Units shall be approved and labelled by Underwriter's Laboratories, and bear Canadian CRN registration number.

1.3 Start-up

.1 Provide services of factory trained representative to start up unit, test efficiency, and train operators.

1.4 Submittals

.1 Submit shop drawings indicating capacity rating, physical dimensions, wiring diagrams, materials of construction, code compliance, etc.

.2 Provide operating and maintenance manuals with complete description of installation and operation of boilers.

.3 Refer to Division 1.

2. PRODUCTS

2.1 Type

.1 Provide propylene glycol boiler suitable for power burner with insulated jacket, sectional cast iron heat exchanger oil burning system, controls and boiler trim.

2.2 Construction

.1 Assemble of cast iron sections conforming to ASME Code requirements and test for maximum working pressure of 206 kPa water.

.2 Permanently seal sections using asbestos rope seal and short draw rods for each pair of sections.

.3 Fuel passages shall be readily accessible without use of special tools. Provide adequate clean-out and access doors, and openings including observation ports and relief openings.

.4 Provide structural steel base with front plate, removable panels and lifting lugs.

.5 Insulate entire boiler with glass fibre and finish with steel cover jacket with factory applied baked enamel.

2.3 Glycol Boiler Trim

.1 Provide combination water pressure and temperature gauge, and ASME rated pressure relief valve set at 206 kPa

.2 Provide low water cut-off with manual reset to automatically prevent burner operation when boiler water falls below safe level.

.3 Provide flow switch with each boiler.

.4 Provide operating temperature controller and two high limit controllers.

.5 Limit temperature controller shall control burner to prevent boiler water temperature from exceeding safe system temperature. One high limit to be automatic reset, one to be manual reset.

.6 Provide boiler air vent tapping. Connect air vent tapping to expansion tank to bleed air.

2.4 Fuel Burning System

.1 General: Burner operation shall be two stage LOW-HIGH.

.2 Oil Burner: Low pressure atomising type with electric ignition.

.3 Collector and Draft Hood: Provide atmospheric natural draft operation equipment as regularly supplied by boiler manufacturer.

.4 Controls: Pre-wired, factory assembled electronic controls in control cabinet with flame scanner or detector, programming control, relays and switches. Provide pre-purge and post-purge ignition and shut-down of burner in the event of ignition pilot and main flame failure with manual reset.

2.5 Boiler Control Panel

.1 Provide microprocessor control panel to control the two new boilers and primary system pumps.

.2 System to incorporate time delay to prevent boiler cycling, boiler and pump duty/standby control, temperature reset based on outdoor air temperature, boiler staging control.

.3 Panel to contain digital display to manually step through set points and system data, LEDs to indicate lead stage and boiler operating status.

3. EXECUTION

3.1 Housekeeping Pads

.1 Mount boilers on 100 mm housekeeping pads.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Wall fin radiation

.2 Unit heaters.

.3 Related accessories and specialties.

1.2 Quality Assurance

.1 Terminal heat transfer units shall be product of manufacturer regularly engaged in production of such units who issues complete catalogue data on such products.

1.3 Submittals

.1 Submit, in addition to shop drawings, schedules of radiation heating elements and enclosure indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and a comparison of specified heat required to actual heat output provided.

2. PRODUCTS

2.1 General

.1 Factory apply baked primer coat on metal surfaces of enclosure or cabinet of all baseboard, wall fin, convectors, unit heaters, cabinet unit heaters and unit ventilators.

.2 Refer to all mechanical and architectural drawings as well as the "Room Finish Schedule" for surfaces to be provided with various types of radiant panel units.

.3 Mechanical contractor shall provide all necessary trim to properly install radiant panels in all types of ceilings. Panel suppliers will provide all required accessories and trim to contractor.

2.2 Wall Fin Radiation

.1 Heating Elements: 30 mm seamless copper tubing, 1 mm minimum wall thickness, mechanically expanded into evenly spaced aluminum fins, suitable for sweat fittings.

.2 Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure bracket.

.3 Enclosures: 18 gauge steel up to 450 mm in height, 16 gauge steel over 450 mm in height c/w easily jointed components for wall to wall installation. Support rigidly, top and bottom, on wall mounted brackets at 900 mm centres maximum.

.4 Provide access door at each shut-off, control valve and balancing valve. Access door shall be 150 mm x 175 mm, integral with cabinet.

2.3 Unit Heaters

.1 Casing: 18 gauge steel with threaded connections for hanger rods.

.2 Coils: Seamless copper tubing, 0.6 mm minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

.3 Fan: Direct drive propeller type, statically and dynamically balanced. Horizontal models complete with sleeve bearings and fan guard. Vertical model complete with grease lubricated ball bearings.

.4 Air Outlet: Adjustable pattern diffuser on projection models and four-way louvers on horizontal throw models.

2.4 Cabinet Unit Heaters (Force Flows)

.1 Cabinet: 16 gauge steel with rounded exposed corners and edges, easily removed panels, glass fibre insulation, integral air outlet and inlet grilles (as required). Finish exposed surfaces in baked enamel of approved colour.

.2 Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for maximum operating limits of 1380 kPa.

.3 Fans: Centrifugal forward curved double width wheels, statically and dynamically balanced, direct driven, on sleeve bearings resiliently mounted, complete with three speed solid state motor switches supplies by mechanical wired by electrical.

.4 Filters: Easily removed 25 mm thick glass fibre throw-away or permanent washable type filtering air before coil.

3. EXECUTION

3.1 Installation

.1 Provide each terminal heat transfer unit with shut-off valve on supply and lockshield balancing valve on return piping.

.2 Provide each unit at high points with easily accessible manual air vent. If not easily accessible, extend vent to exterior surface of cabinet for each servicing.

.3 Copper tube elements to be joined by sweat solder joints using 95-5 solder for working pressure of 345 kPa and less, and silver brazing for higher pressures.

.4 Grade piping to allow for air elimination.

.5 All heating system piping shall be thoroughly cleaned, flushed, drained and refilled before radiant panels are connected to the system.

3.2 Performance

.1 Refer to Equipment Schedules.

.2 Radiation and convector capacities are based on 18°C entering air temperature, 82°C average water temperature with an 11°C temperature drop.

.3 Unit heater capacities are based on 15.6°C entering air temperature, 82°C average water temperature, with an 11°C temperature drop.

END OF SECTION

COILS

1. GENERAL

1.1 Scope

.1 Glycol coils.

.2 Coil installation.

.3 Coil piping and accessories.

1.2 Quality Assurance

.1 Coils shall be the product of manufacturer regularly engaged in production of coils who issues complete catalogue data on such products.

.2 Coil capacities, pressure drops, and selection procedures shall be certified in accordance with ARI Standards and bear ARI seal.

1.3 Submittals

.1 Shop drawings shall include dimensions, materials of construction and performance data to match specifications.

.2 Submit coil selection sheets or computer calculations with shop drawings.

2. PRODUCTS

2.1 General

.1 Provide extended surface type coils with tubes of copper or brass, and plate of helical type fins of copper or aluminum.

.2 Space fins 14 per 25 mm maximum. Helical fins may be crimped.

.3 Mount coil section in galvanised steel casing designed for bolting to other sections of ductwork.

2.2 Glycol Heating Coils

.1 Design for maximum operating limits of 1380 kPa and 104°C

.2 Coil headers shall be cast iron, copper tube or steel pipe.

.3 Face length shall not exceed 3 m.

3. EXECUTION

3.1 Installation

.1 Support coil sections on steel channel or double angle frames and secure to casings. Arrange supports for cooling coils so they do not pierce or short circuit drip pans. Level serpentine coils and install drainable tube coils with pitch within casing. Arrange galvanised steel casings for bolting to other section, ductwork or unit casings. Provide airtight seal between coils and duct or unit cabinets.

.2 Make necessary connections to coils, including valves, air vents, unions and connections from drip pans. Provide isolating valve on supply line and eccentric plug valve on return line to each water coil.

.3 Locate water supply at bottom of supply header and return water connection at top to provide self-venting and reverse return arrangement. Provide manual air vents at high points complete with stop valves. Ensure water coils are drainable and provide drain connection at low points.

.4 Protect coils so fins and flanges are not damaged. Replace loose and damaged fins. Comb out bent fins unless required to be replaced.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

HEAT RECOVERY VENTILATORS

1. GENERAL

1.1 Scope

.1 Packaged indoor indirect fired heat recovery ventilators.

.2 Operating controls.

1.2 Quality Assurance

.1 Unit manufacturer shall have a minimum of 15 years experience in the heat recovery market

.2 The complete unit and heat recovery device shall be manufacturered by the same company.

.3 Meet the requirements of CGA/CSA, Provincial and Municipal Codes and be CSA listed.

.4 Heat recovery systems shall be certified to ARI Standard 1060.

.5 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer or certified maintenance service shop.

.6 Provide start-up service by factory trained representative, to make adjustments, make efficiency tests, start-up units, train and instruct owners personnel.

.7 The unit shall be fully assembled and 100% factory tested prior to shipment. A detailed pre-shipment test report shall be provided to the Consultant.

1.3 Warranty

.1 Provide 10 years unconditional parts warranty on heat exchangers.

.2 Provide 15 year unconditional parts warranty on heat recovery core.

2. PRODUCTS

2.1 Type

.1 Provide indoor mounted type units.

.2 Units shall be self-contained packaged, indoor, CSA approved, ARI certified, factory assembled consisting of fan and motor assemblies, air-to-air plate heat recovery device, preheat coil, all necessary dampers, plenums filters drain pans, wiring and controls.

2.2 Construction

.1 Cabinet: The unit base frame shall be constructed from a formed structural channel 127 mm high with internal structural cross members properly sized to allow for rigging and handling of the unit. The deflection of the base frame shall be less than 1/360 the length of the unit when rigging. All major components shall be supported by the base without sagging or pulsating. A minimum of four (4) lifting lugs per section shall be provided and strategically located to allow equilibrium during lifting. Unit construction is made of an insulated 14 gauge galvanized structural frame complete with die cast aluminum corners. The rigid frame provides stable construction allowing for panel removal without affecting the unit integrity. Panels shall be double wall construction using 25 mm thick fiberglass insulation (48 kg/m^3 density), 18 gauge galvanized steel exterior panels and 26 gauge G90 galvanized steel inner liner.

.2 Access Doors: Full size access door(s) to allow for periodic maintenance and inspections must be provided for all serviceable components. Doors shall be double wall construction made of 18 gauge galvanized steel on both outer and inner liner for maximum rigidity. Door insulation is the same as unit panels. Provide doors with heavy duty corrosion resistant aluminum hinges that allow the door to open at 180°. Compression type handles operable from both sides of the unit access door(s) and neoprene resilient bubble gaskets for an enclosure that is sealed tight shall also be provided. Door openings shall be flush with all surrounding panels. Plastic latches and continuous hinges are not acceptable.

.3 Drain Pans: Recessed, double wall drain pans shall be made of formed sections of 18 gauge stainless steel. Drain pans are sloped at a minimum of 1.5% with a drain pipe connection of 38 mm in diameter ending outside through the structural base channel. All drain pan corners shall be welded.

.4 Supply and Return Fan: Units shall be equipped with forward curved, DWDI supply and exhaust fans, to provide scheduled airflows against static pressures indicated. All fans shall be constructed in accordance with the standard adopted by AMCA.

.5 Entire fan assembly shall be seismically restrained using approved methods.

.6 **Fans located in classified areas to be AMCA B rated spark proof.**

.7 Air Filters: 50 mm thick glass fibre disposable media in metal frames arranged for easy replacements.

2.3 Air to Air Plate Heat Exchanger

.1 The air-to-air heat exchanger assembly shall be certified for performance as per ARI Standard 1060 and ASHRAE 84-91.

.2 The air-to-air plate heat exchanger media shall be able to withstand 10 inches w.g. of pressure differential between air streams.

.3 The air-to-air plate heat exchanger shall be cross-flow type, made of non-corrosive polypropylene, UL-94HB rated, designed to maximize the efficiency and the cleanability while minimizing the pressure loss.

.4 The air-to-air plate heat exchanger shall be sectioned within the unit to allow for a section replacement without requiring any lifting devices. All sections are to be joined together with a silicone joint for an airtight assembly.

.5 Access to all four sides of the air-to-air plate heat exchanger for cleaning and inspection shall be provided.

.6 An access section with a sloped drain pan shall be provided upstream and downstream of the air-to-air plate heat exchanger allowing for service, collection of condensate, and cleaning of the air-to-air plate heat exchanger without allowing any standing water to be contained within the unit cabinet.

2.4 Air-To-Air Plate Heat Exchanger Defrost Strategies

.1 Face and Bypass defrost including outside air, exhaust air and face & bypass dampers with actuators and the appropriate controls. Bypass defrost may also be used for free-cooling in summer operation.

2.5 Filters

.1 Filters shall be UL 900 Class II.

.2 Outside and return air inlets, shall be equipped with galvanized steel racks that permit slide out removal of filters (side access).

.3 Filter banks shall be arranged for flat orientation. The air velocity shall not exceed 2.5 m/s through each filter bank.

.4 Filters in supply and exhaust air streams shall be medium efficiency, 50 mm pleated, disposable type. Each filter shall consist of viscous coated fibers with filtering media encased in fiberboard cell sides having perforated metal grids on each face to provide media support. The filter media shall have an average efficiency of 25-30% on ASHRAE Test Standard 52.1-92.

2.6 Dampers

.1 Leakage rate when tested in accordance with AMCA 500 shall not exceed 0.6% of air quantity calculated at 10 inches w.g. pressure. Net face velocity shall not exceed 500 fpm for all outside air intake.

.2 Dampers are designed for operation in temperatures ranging between -40°C and 100°C.

.3 Unit shall be equipped with all necessary dampers.

.1 Recirculation damper.

.2 Bypass dampers are provided for defrost purposes. Bypass damper is provided for free-cooling and defrost purposes.

.4 Face and bypass dampers shall be opposed blade type. All other dampers shall be parallel blade type.

.5 All unit dampers shall be motorized. Provide factory mounted damper actuators with 24 VAC drive voltage.

.6 Damper construction shall be as followed:

.1 Damper frame shall be extruded aluminum.

.2 Blades shall be extruded aluminum.

.3 Damper blade ends shall be sealed with neoprene flexible edge seals complete with bottom and top blade wiper seals.

.4 Frame and blades shall be insulated.

.5 **Dampers located in classified areas to be explosion proof.**

2.7 Operating Controls

.1 Low voltage, adjustable thermostat shall control burner and free-cooling operation .

.2 Thermostat shall include system selector switch heat-cool-off.

.3 Provide remote mounted fan control switch (on-auto).

.4 Provide in supply air low limit thermostat to close outside air dampers and stop fans.

.5 Locate thermostat in room as shown.

.6 Provide night control energized by central time clock to maintain night setback setpoint by cycling fans and burner section with the outside air damper closed.

2.8 Electrical

.1 All electrical controls shall be ETL listed and the entire unit shall be factory wired in accordance with the National Electrical Code Standard.

.2 The unit shall be supplied with a non-fused main power disconnect switch for indoor applications. A single point power connection shall be provided for all units.

.3 Unit shall be equipped with all necessary high voltage components as follows:

.1 Motor starters on all high voltage motors for constant speed applications.

.2 Thermal protection on all high voltage motors.

.3 Fuses and fuse holders.

.4 All necessary control transformers.

.4 Unit shall be complete with all necessary relays, time delay, damper actuators with auxiliary switches.

.5 Terminal board shall be provided for low voltage control wiring. Low voltage is 24V.

.6 Fan access doors are equipped with a momentary interrupt switch that shuts off the fan motor when the door is opened.

.7 Unit shall be provided with free cooling controls. Free cooling shall be controlled by a two-stage set-point thermostat located in the outside air intake.

.8 An integral control panel shall be provided having a hinged access door and an approved locking device.

.9 Unit shall be provided with a low voltage (24V) remote wall control panel complete with On/Off/AUTO switch, Timeclock and indicator lights.

.10 All control devices, except those not mounted directly to unit, shall be factory mounted and wired. Control panel shall have a labeled strip to land all wires for field installed control components.

.11 All components are fully wired and 100% tested prior to shipping.

.12 **All electrical components on units located in classified areas to carry the rating of the area.**

3. EXECUTION

3.1 Installation

.1 Mount units on field fabricated structural mounting frame.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Centrifugal fans.

.2 Belted vent sets.

.3 Fan accessories.

1.2 Quality Assurance

.1 Conform to AMCA Bulletins regarding construction and testing. Fans shall bear AMCA certified rating seal.

.2 Fans shall bear CSA label.

.3 Motors to be high efficiency as specified in Section 15010.

1.3 Submittals

.1 Submit with shop drawings acoustical data and fan curves showing fan performance with fan and system operating point plotted on curves, including equipment weights and centre of gravity diagrams for suspended fans.

1.4 Job Conditions

.1 Do not operate fans for any purpose, temporary or permanent until ductwork is clean, filters are in place, bearings are lubricated and fan has been run under close supervision of unit manufacturer.

1.5 Alternates

.1 Equivalent fan selections shall not increase motor kilowatts, increase rpm, increase noise level, increase tip speed by more than 10%, or increase inlet air velocity by more than 20%, from that of the specified fan.

2. PRODUCTS

2.1 General

.1 Statically and dynamically balance fans so no objectionable vibration or noise is transmitted to occupied areas of the building.

.2 Provide balanced variable sheaves for motors 11.2 kW and under and fixed sheave for 15 kW and over.

.3 Fans are to be capable of accommodating static pressure variations of ±10% with no objectionable operating characteristics.

.4 Fan suppliers to provide replacement sheaves for balancing purposes.

.5 Provide cross linkage and inlet vanes on double inlet fan.

.6 Size motors for parallel operating fans for non-overloading operation with only one fan operating.

.7 Provide belt guards with tachometer holes.

.8 External static pressure means external to the fan cabinet and all accessories such as backdraft dampers, mixing boxes, filters and coils, etc. These accessories if supplied as part of the unit are considered as internal losses for fan.

.9 Two speed motors shall have separate winding for each speed.

2.2 Centrifugal Fans

.1 Fabricate with multi-blade wheels in heavy gauge steel housing reinforced for service encountered.

.2 Provide V-belt drives with fan and motor mounted on reinforced, rigid steel base with adjustable motor mount.

.3 Provide heavy duty, self-aligning, anti-friction bearings. Extend lubrication fittings to outside of fan casing.

.4 Provide where indicated variable inlet vanes complete with linkage and pneumatic operators.

.5 Provide access door and drain connection to scroll.

.6 Unless noted otherwise, centrifugal fans over 425 mm diameter shall have die formed air foil blades welded to side and back plate.

.7 Provide fan cabinets lined with minimum 25 mm acoustic insulation, unless noted otherwise elsewhere in the specifications.

2.3 Belted Vent Sets

.1 Comply generally with requirements of centrifugal fans suitable for pressure to 1000 Pa.

.2 Provide with multi-blade control and air damper. Damper free area to be 125% of fan outlet size.

.3 Provide belt guards with tachometer holes. Provide weatherproof housing.

3. EXECUTION

3.1 Installation

.1 Where inlet or outlet is exposed, provide safety screen.

.2 Provide belt guards on belt driven fans complete with tachometer access.

.3 Supply and install sheaves as necessary for final air balancing.

3.2 Priming

.1 Prime coat fan wheels and housing at factory inside and outside. Prime coating on aluminum part is not required.

.2 Provide two additional coats of paint on fans handling air downstream of humidifiers.

3.3 Performance

.1 Fan performance based on sea level conditions.

.2 Refer to Equipment Schedule.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Ductwork and plenums.

.2 Fasteners.

.3 Sealants.

.4 Duct cleaning.

1.2 Definitions

.1 Low Pressure: Static pressure in duct less than 500 Pa and velocities less than 10 m/s.

.2 Duct sizes shown on plans are inside clear dimensions. For acoustically lined or internally insulated ducts, maintain sizes inside ducts.

1.3 Quality Assurance

.1 Ductwork shall meet the requirements of NFPA No. 90A - Air Conditioning and Ventilating Systems; NFPA No. 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

.2 Fabricate in accordance with SMACNA duct manuals and ASHRAE handbooks.

1.4 Submittals

.1 Submit shop drawings and samples of duct fittings for approval, including particulars such as gauge sizes, welds and configurations prior to start of work.

1.5 Alternatives

.1 Obtain written permission from the Engineer prior to making variations in duct configuration or sizes. Size alternatives using ASHRAE table for circular equivalents of rectangular ducts.

2. PRODUCTS

2.1 Materials

.1 Ducts: Galvanised steel lock forming quality, having galvanised coating of 380 g/m^2 for both sides.

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

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

3. EXECUTION

3.1 Plenum Gauges

.1 Fabricate fan plenums and plenums downstream of fan in accordance with SMACNA manual.

.2 Fabricate plenums between fan and upstream apparatus of 1.6 mm thick material.

.3 Fabricate plenums between filters and upstream apparatus of 1.3 mm thick material.

3.2 Duct Sealing

.1 All supply, return and exhaust duct joints, longitudinal as well as transverse, should be sealed using:

.1 Low Pressure Ductwork:

- Slip Joints: Apply heavy brush-on high pressure duct sealant. Apply second application after the first application has completely dried out. Where metal clearance exceeds 1.5 mm use heavy mastic type sealant.

- Flanged Joints: Soft elastomer butyl or extruded form of sealant between flanges followed by an application of heavy brush-on high pressure duct sealant.

- Other Joints: Heavy mastic type sealant.

.2 Duct tapes as sealing method are not permitted.

.3 Surfaces to receive sealant should be free from oil, dust, dirt, moisture, rust and other substances that inhibit or prevent bonding.

.4 Prior to sealing all ductwork, demonstrate sealing of a section of each type of duct and obtain approval from the Engineer.

.5 Do not insulate any section of the ductwork until it has been inspected and approved of duct sealant application.

3.3 Installation

.1 Locate ducts with sufficient space around equipment to allow normal operation and maintenance activities.

.2 Coordinate the location of duct access doors.

.3 Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

.4 Interrupt duct linings at fire, balancing backdraft and smoke dampers so as not to interfere with operation of devices. Provide sheet metal edge protection over linings on both sides of damper device.

.5 Shield ductwork from dust and construction material during construction. Clean any ductwork found to be dirty at no extra cost to the Contract.

.6 Install ducts associated with fans subject to forced vibration with flexible connections immediately adjacent to equipment. Refer to Section 15860 - Duct Accessories.

.7 Do not use flexible duct.

.8 Prove that ductwork is substantially airtight before covering or concealing.

.9 Clean duct systems and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with filters or bypass during cleaning.

.10 Fabricate ductwork from field measurements and not from plans and shop drawings exclusively. Failure to do so will not constitute an extra to the Contract.

.11 Complete metal ducts within themselves with no single partition between ducts. Where width of duct exceeds 450 mm, cross brace for rigidity. Open corners are not acceptable.

.12 Lap metal ducts in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

.13 Construct tees, bends and elbows with radius of not less than 1-1/2 times width of cut on centre line. Where not possible and where rectangular elbows are specified, provide double wall air foil type turning vanes. Where acoustical lining is provided, provide turning vanes of perforated metal type with fibreglass inside.

.14 Increase duct sizes gradually, not exceeding 15° divergence wherever possible. Maximum divergence upstream of equipment to be 30° and 45° convergence downstream.

.15 Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled. Seal seams on fresh air and exhaust ducts watertight with mastic or low velocity duct sealant.

.16 Provide AHU drain pan connections with deep seal traps, sloped and drained to sewer.

END OF SECTION