**DUCT ACCESSORIES**

## 1. GENERAL

### 1.1 Scope

.1 Access doors.

.2 Balancing dampers.

.3 Flexible connections.

.4 Backdraft dampers.

### 1.2 Quality Assurance

.1 Fire dampers shall be ULC listed and constructed in accordance with ULC Standard S 112 "Fire Dampers".

.2 Fusible links on fire dampers shall be constructed to ULC Standard S 505.

.3 Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.

.4 Access doors shall be ULC labelled.

.5 Accessories shall meet the requirements of NFPA 90A, Air Conditioning and Ventilating Systems. Fabricate in accordance with ASHRAE Handbooks and SMACNA Duct Manuals.

.6 Prove all dampers to inspector at job completion.

### 1.3 Submittals

.1 Submit shop drawings of factory fabricated assemblies.

## 2. PRODUCTS

### 2.1 Duct Access Doors

.1 Fabricate rigid and close-fitting doors of galvanised steel with sealing gaskets and suitable quick fastening locking devices. Duct access panels with screws are not acceptable. Install minimum 25 mm thick insulation with suitable sheet metal cover frame for insulated ductwork.

.2 Fabricated with two butt hinges and two sash locks for sizes up to 450 mm two hinges and two compression latches with outside and inside handles for sizes up to 600 mm x 1200 mm and an additional hinge for larger sizes.

## 2.2 Balancing Dampers

.1 Fabricate of galvanised steel, minimum 1.6 mm. Full blade-length shafts of hollow square construction with blades rigidly fastened along entire blade length.

.2 Lockable quadrant type operating mechanism with end bearings on both accessible rectangular ducts up to 400 mm deep and on accessible round ducts.

.3 Wide pitch screw operating mechanism with crank operator and end bearings on accessible rectangular ducts 425 mm and over in depth and on all inaccessible rectangular and round ducts.

.4 On rectangular ducts up to 275 mm deep construct of single blade (butterfly) type.

.5 On rectangular ducts 300 mm to 400 mm deep construct of two opposed blades mechanically interlocked with pivots at quarter points.

.6 On rectangular ducts over 425 mm deep construct of multiple opposed blades mechanically interlocked with blades no greater than 200 mm deep and pivots equally spaced.

.7 On round ducts construct of single blade (butterfly) type. On 500 pascal class and on all dampers over 300 mm diameter fabricate with full blade-length shaft.

.8 Construct damper blades for medium and high pressure systems to block air passage 70% maximum. Provide complete with locking type handles.

.9 Provide over-ride limiting stops on all operating mechanisms.

.10 Identify the air flow direction and blade rotation and open and close positions on operating mechanism.

.11 On round ductwork install operating mechanism on a steel mounted base firmly secured to the ductwork.

.12 On externally insulated ductwork, install operating mechanisms on a steel bridge type mounting base to permit continuity of insulation under the mechanism.

## 2.3 Backdraft Dampers

.1 Construct of minimum 1.3 mm aluminum channel frame.

.2 Construct of minimum 0.6 mm aluminum blades, complete with stiffeners along trailing edge. Fabricate single blade dampers for duct sizes to 240 mm, multiblade dampers for ducts greater than 240 mm.

.3 Provide full blade-length shafts complete with brass or nylon bearings.

.4 Provide neoprene anti-clatter blade strips on pivot side of blades.

.5 Construct blade connecting linkage of minimum 2.0 mm aluminum rod with eyelet, pin bearings, and adjustable counter weight to assist blade opening action.

.6 Maximum blade length of 750 mm.

.7 Backdraft damper suitable for 10 m/s face velocity.

## 3. EXECUTION

### 3.1 Application

.1 Provide access door minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions indicated by drawings and as follows:

- Both sides of turning vanes in all ducts.
- At each side of all heating or cooling coils.
- At all locations of internally duct mounted devices including automatic dampers, damper motors and control sensors and devices.

.2 Provide fire dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Fire dampers shall be complete with required perimeter mounting angles sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.3 At each point where ducts pass through duct shall be sealed with non-combustible material.

.4 Provide balancing dampers at points on supply and exhaust systems where branches are taken from larger ducts as required for proper air balancing.

.5 Install ducts associated with fans and equipment subject to forced vibration with flexible connections, immediately adjacent to equipment and/or where indicated on drawing.

.6 All fire dampers and fire stop flaps are to be left in the closed position for balancing contractor to fix open.

.7 Support ceiling fire stops from the structure above the fire stop and not from air outlets on associated ductwork.

**END OF SECTION**

# AIR OUTLETS

## 1. GENERAL

### 1.1 Scope

.1 Diffusers.

.2 Grilles and registers.

.3 Outside louvres.

.4 Goosenecks.

### 1.2 Quality Assurance

.1 Air flow tests and sound level measurement shall be made in accordance with applicable ADC equipment test codes, ASHRAE Standards and AMCA Standards.

.2 Unit rating shall be approved by ADC and AMCA.

.3 Manufacturer shall certify catalogued performance and ensure correct application of air outlet types.

.4 Outside louvres shall bear AMCA seal for free area and water penetration.

### 1.3 Project Conditions

.1 Review requirements of outlets as to size, finish and type of mounting prior to submitting shop drawings and schedules of outlets.

.2 Positions indicated are approximate only. Check locations of outlets and make necessary adjustments in position to conform with Architectural features, symmetry and lighting arrangement.

### 1.4 Submittals

.1 Submit shop drawings with complete catalogue information, materials of construction, dimensions and accessories for all air outlets, louvres and components in this specification section, and as scheduled.

.2 Submit colour selection charts of finishes for approval prior to fabrication.

## 2. PRODUCTS

### 2.1 General

.1 Base air outlet application on space noise level of NC 30 maximum.

.2 Provide supply outlets with sponge rubber seal around the edge.

.3 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.4 Provide plaster frame for diffusers located in plaster surfaces.

.5 Provide anti-smudge frames or plaques on diffusers located in rough textured surfaces such as acoustical plaster.

.6 Refer to Air Outlet Schedule for specifications of air outlets.

**2.2 Outside Louvres**

.1 Louvres 150 mm deep with blades on 45° slope with centre baffle and return bend heavy channel frame, birdscreen with 15 mm square mesh.

.2 Fabricate of 2.0 mm extruded aluminum blades and frame. Where openings exceed 1800 mm in height, jamb frames shall be 2.0 mm. Provide welded assembly.

.3 Finish in factory baked enamel finish. Colour shall be selected by the Architect.

**2.3 Goosenecks**

.1 Fabricate goosenecks of minimum 1.3 mm galvanised steel.

.2 Mount on minimum 300 mm high curb base where size exceeds 225 mm x 225 mm.

## 3. EXECUTION

**3.1 Priming**

.1 Paint ductwork visible behind air outlets matte black.

**3.2 Sizing**

.1 Size outside air louvres as indicated on drawings.

.2 Size air outlets as indicated on drawings.

**3.3 Air Outlets Schedule**

.1 Refer to Equipment Schedules.

**END OF SECTION**

# BREECHING AND CHIMNEYS

## 1. GENERAL

### 1.1 Scope

.1 Site fabricated breeching.

.2 Manufactured chimneys for oil fired equipment.

### 1.2 Quality Assurance

.1 Vents and Chimneys: Labelled by Underwriters' Laboratory of Canada.

### 1.3 Definitions

.1 Vent: Enclosed passageway for conveying flue gases from the appliances to outdoors.

.2 Breeching: Portion of vent from the appliance to the chimney.

.3 Chimney: Primary vertical portion of vent.

.4 Draft: Flow of air or combustion products or both, through an appliance and its venting system.

.5 Mechanical Draft: Draft produced by a mechanical device such as a fan, blower, or aspirator which may supplement natural draft.

.6 Forced Draft: A mechanical draft produced by a device upstream of the combustion zone of an appliance.

.7 Induced Draft: A mechanical draft produced by a device downstream from the combustion zone of an appliance.

.8 Natural Draft: A draft other than mechanical draft.

### 1.4 Submittals

.1 Comply with requirements of Section 15010, supply shop drawings for all fabricated and pre-manufactured breeching and fuel elements.

## 2. PRODUCTS

### 2.1 Vents

.1 Type A: To CAN 4-S604.

.1 Application: Gas and liquid fuel fired appliances.

.2 Service Temperature: Maximum flue gas temperature of *540°C1000 °F*.

.2 Type A-2 Vent: To CAN 4-S629.

.1 Application: Gas, liquid and solid fuel fired appliances.

.2 Service Temperature: Maximum flue gas temperature of *650°C1200 °F*.

## 2.2 Breeching

.1 Breeching Type 2: For forced, induced, or natural draft with dilution, gas or liquid fuel fired appliances, use one of the following:

.1 Mild steel, all welded construction with thicknesses as follows:

| Vent Diameter | Min. Thickness |
|---|---|
| 300 mm and smaller | 1.3 mm |
| 325 mm and 600 mm | 1.6 mm |
| 625 mm to 900 mm | 2.0 mm |
| 925 mm and larger | 3.0 mm |

.2 Breeching constructed of same vent components as chimney.

## 2.3 Accessories

.1 Cleanouts: Bolted, gasketted type, full size of breeching area.

.2 Barometric Damper: single acting sized to 70% of full size of breeching area.

.3 Appurtenances: Raincap, thimbles, support brackets and guys, flashing and counter flashings, fly ash screen, and other materials required to complete the assembly.

# 3. EXECUTION

## 3.1 Vent Installation

.1 Install vents, complete with accessories and appurtenances, in accordance with latest editions of CAN 1-B139, National Building Code, manufacturer's instructions and as follows:

.1 Type A: To CAN 4-S604.

.2 Type A-2: To CAN 4-S629.

.2 Do not penetrate flue gas chamber of vent with screws or mechanical fasteners.

.3 Install breeching with positive slope upward from appliance, min. 2%.

.4 Suspend breeching using trapeze hangers at 1500 mm centres.

.5 Install cleanout at base of chimney.

.6 Provide properly sized barometric damper as required.

.7 Support chimney at bottom, roof and intermediate levels.

.8 Install thimbles where penetrating roof, floor and ceiling.

.9 Install raincap on chimney outlet.

.10 Install counterflashing where chimneys pass through roof.

.11 Provide for expansion and contraction of chimney and breeching.

**END OF SECTION**

# AIR FILTERS

## 1. GENERAL

### 1.1 Scope

.1 Panel filters.

.2 Pleated filters.

### 1.2 Quality Assurance

.1 Filters shall be product of and supplied by one manufacturer.

.2 Filter media shall be UL listed, Class I or Class II.

.3 Filter components assembled to form filter banks shall be products of same manufacturer.

.4 All filters shall be in accordance with ASHRAE Standard 52.76.

.5 Filters containing asbestos, urea formaldehyde or fibreglass shall not be acceptable.

### 1.3 Alternatives

.1 Size, media face area, material, test efficiency, initial and final air resistance of alternative manufacturers shall be as specified.

### 1.4 Submittals

.1 Provide shop drawings of all filters, and filter racks/housings.

## 2. PRODUCTS

### 2.1 Frames

.1 Fabricate filter frames and supporting structures of galvanised steel or extruded aluminum with necessary gasketting between frames and walls. Provide holding frames 1.6 mm "T" section construction.

.2 Provide standard size frames to provide interchangeability of filter media of other manufacturers.

### 2.2 Panel Filters

.1 Media: The air filter shall consist of a 3 ply panel filter element in a uniform non woven structure. The filter shall be fabricated from variable denier Dacron fibres offering a graduated media with minimum loft of 40 mm and shall be progressively bonded with a fire retardant latex binder.

.2 The filter shall contain a non migrating tackifier impregnated between the second and third ply to prevent unloading of the tackifier downstream.

.3 Holding Frames: 1.3 mm minimum galvanised frame with expanded metal grid on leaving air side and steel rod grid on air entering side, hinged with pull and retaining handles.

.4 The filter shall be Class II listed by UL.

.5 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

.6 The filter shall have an average dust spot efficiency of 45% (ASHRAE 52-76) at 2.54 m/s maximum face velocity at a final resistance of 125 Pa

## 2.3 Pleated Filters

.1 Media: The filter shall be constructed of non-woven reinforced cotton rayon. A diamond grid with 98% open area shall provide support for the media. The media shall be bonded to media support to ensure pleat stability. A rigid, moisture resistance heavy duty kraft board shall enclose the media. The filter pack shall be bonded to the inside periphery of the frame to eliminate air bypass.

.2 The efficiency shall be 30-35% based on ASHRAE 52-76 up to 2.54 m/s for 25 mm and 50 mm thick and up to 3.05 m/s for 100 mm thick.

.3 Filters containing asbestos, urea formaldehyde or fibreglass will not be accepted.

# 3. EXECUTION

## 3.1 Installation

.1 Construct and install filters to prevent passage of unfiltered air. Provide felt, rubber or neoprene gaskets.

.2 Do not operate fan system connected to filter banks until filters (temporary or permanent) are in place. Provide new filters at take-over by the Owner. Replace filters used during construction.

.3 Provide filter banks in arrangement shown with removal and access indicated.

**END OF SECTION**

# 1. GENERAL

## 1.1 Scope

.1 Complete and fully operational system of automatic controls, including all materials and labour.

.2 120 V and 24 V electric control system.

.3 Instructions to Owners and Operation & Maintenance materials.

.4 Warranty and site inspections.

## 1.2 Work by Other Trades

.1 Electrical contractor shall provide 120V power for Controls Equipment.

.2 Mechanical contractor shall install thermal wells, control valves and devices on piping, furnished by controls contractor.

.3 Unless noted otherwise in contract documents, control dampers integral with the air handling units are supplied by air handling unit supplier. Damper operators are supplied by controls contractor and installed by the air handling unit manufacturer at the factory. All other control dampers are supplied by controls contractor.

## 1.3 Codes and Standards

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

## 1.4 Renovation or Addition Projects

.1 Control work involves renovations to an existing facility. The Contractor shall inspect the systems prior to tender close and include in the submission all interlocks and relays required to provide a fully operational controls system.

.2 The Contractor shall ensure that the installation and commissioning of the automation system shall not disrupt the use of the facilities.

.3 Prior to close of tender the Contractor shall inspect the system and include for replacement of defective control equipment and components.

## 1.5 Quality Assurance

.1 Install all components in accordance with the latest regulations of the Canadian Electrical Code, applicable Municipal and Provincial Codes and Regulations, and latest CSA Electrical Bulletins.

.2 The equipment manufacturer shall have trained service representatives resident in the City of Iqaluit.

## 1.6 Submittals

.1 Submit shop drawings in accordance with Section 15010.

.2 Provide shop drawings including complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and engineering data on each control system component. Include sizing and arrangements as requested.

.3 Submit approved shop drawings to mechanical contractor for inclusion in operations and maintenance manuals.

## 1.7 Owner Orientation

.1 Contractor to provide three weeks written notice to the Consultant and building Owner prior to commencing formal training sessions.

.2 Formal training sessions shall commence only after "as-built" drawings have been completed, reviewed and approved by the Engineer and shall be in addition to 15010 requirements.

.3 Provide for operator training according to the following schedule.

.1 A seminar/workshop covering all aspects of system use as follows:

- operation of control components
- calibration of sensors and system
- trouble shooting of system and components
- preventative maintenance

.2 A review workshop after six months of operation for clarification of system operating techniques for building operators.

.3 Controls contractor to provide three complete sets of training manuals to the Owner prior to commencing of the training session, plus one manual to the Consultant.

## 1.8 Warranty

.1 Include warranty provisions identified in the Division 1 contract.

### 1.9 System Activation

.1 Submit control calibration check sheet prior to system acceptance. Check sheets to include unit identification, controller/transmitter tag numbers, device controlled, controller PID settings, interlock devices and wire tag numbers.

.2 Set damper linkages, static pressure/volume controls as required by the Balancing Trade.

.3 Adjust and calibrate all room thermostats 30 days prior to system acceptance.

## 2. PRODUCTS

### 2.1 Standard of Acceptance

.1 Honeywell 120 volt and 24 volt components.

.2 Components used are to be readily accessible in the area.

### 2.2 Control Panels

.1 Provide control panel of unitised cabinet type construction. Mount relays, switches and control point adjustment in cabinet and pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face

.2 Fabricate panels from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.4 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.5 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 volt supply.

.6 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.7 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum 25 conductors to each wire bundle.

.8 Provide terminal blocks, tabular clamp, 300 v, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.9 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position.

## 2.3 Wire

.1 Refer to section 16122 "Wires and Cable".

## 2.4 Conduits and Cables

.1 All wiring shall be in conduit or trays. Conform to Division 16 requirements for conduit and tray specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 Run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point.

.5 Where applicable, mount field interface equipment (i.e. relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.6 Separate conduits shall be provided for pneumatic tubing and electrical wiring runs.

.7 Colour code all conductors and conduits by permanently applied colour bands on maximum 10 m interims. Colour code shall follow base building schedule.

## 2.5 Related Accessories

.1 Provide and install all necessary transformers, transducers, interposing relays, interface devices, contractors, starters and EP's to perform control functions required.

.2 It is the responsibility of the Contractor to identify, at the time of tender submission, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of tender acceptance shall be the Contractor's responsibility.

## 2.6 Freezestats

.1 Safety low limit protection (freezestats) shall be manual reset type with 6 m elements. Provide multiple thermostats for large duct cross-sectional areas. (Mount freezestats on the

outside of the ductwork and no higher than 1500 mm above the floor). Provide DPDT contacts for connection to SCU.

.2 Remote bulb elements shall be either averaging type of suitable length for air or rigid bulb type for liquids.

## 2.7 Thermostat Line Voltage, Heating

.1 Line voltage wall mounted electric heating thermostat with:

.1 Full load rating: 22 A at 120 V.

.2 Temperature setting range: 5 C to 30 C.

.3 Thermometer range: 5 C to 30 C.

.4 Scale markings: Off-5-10-15-20-25C.

## 2.8 Thermostat Low Voltage

.1 Low voltage wall thermostat:

.1 For use on 24 V circuit at 1.5 A capacity.

.2 With heat anticipator adjustable 0.1 to 1.2 A.

.3 Temperature setting range: 10C to 25C.

## 2.9 Thermostat Remote Bulb

.1 Line voltage remote bulb type thermostat with:

.1 8 A rating on 120 V.

.2 3 m copper capillary tube nylon coated.

.3 Moisture and dust-resistant enclosure.

## 2.10 Thermostat Guards

.1 Thermostat guards: lockable, clear. Slots for air circulation to thermostat.

## 2.11 High Limit Temperature Alarm

.1 High limit temperature alarm with:

.1 Rating 10A at 120V.

.2 Positive lock-out.

.3 Manual reset only after [14] C drop-in temperature.

.4 Cutout setting: [50] C.

## 2.12 Flow Switch

.1 Flow switch for propylene glycol heating, pipe size as indicated, CSA Enclosure, rated at 16 A at 120 V. Maximum liquid temperature: 121C. Maximum liquid gauge pressure of 1034 kPa ambient temperature range 0°C to 82°C.

## 2.13 Thermowells

.1 Provide stainless steel wells for domestic water applications.

.2 Provide brass wells for heating water applications.

## 2.14 Dampers

.1 Automatic dampers shall be extruded aluminum thermally insulated multiple blade mounted in insulated extruded aluminum flanged frame. Individual blades shall not exceed 150 mm in width or 1200 mm in length. Provide interlocking edges and compressible seals. Provide dual bearing system with additional thrust bearings for vertical blades. Damper configuration to be as shown on drawings. Use flanged to duct type dampers for all sizes under $0.4m^2$.

.2 Mixing dampers of parallel blade construction arranged to mix streams.

.3 Damper leakage shall be certified under the AMCA certified rating program and shall carry AMCA seal:

.1 Low Leakage: 8.6 l/s per $m^2$ at 250 Pa pressure difference for a 1220 x 1220 mm damper.

Standard of Acceptance: TAMCO 9000.

## 2.15 Control Valves

.1 Two-way and three-way valves for liquids: Two-way valves shall have equal percentage characteristics and three-way valves shall have linear characteristics. Size two-way valve operators to close against maximum pump shut-off head. Ball valves as control valves are not acceptable.

.2 Control valve sizes as shown on drawings.

.3 Size control valves as per following criteria:

- Select control valves in equipment room to supply varying water temperature to the system at 24 kPa or less pressure drop.
- Select two-way control valves for coils, heat exchangers, terminal units, etc., with a minimum pressure drop of 35 k and a maximum pressure drop of 70 kPa.

.4 Valves shall "fail-safe", spring return to normal position.

.5 Provide valves complete with electric operators.

.6 Two Way Valves for Terminal and Radiation

.1 Globe valve, threaded ends, bronze body, stainless steel trim, 689 kParated, double O-ring packing.

.2 Maintenance free, spring return electronic actuator, modulating, 24 Vac operating voltage, 0-10 Vdc position output signal. Manual adjustment knob with indication of stroke. 30 seconds running time, 8 seconds spring return. Fail open upon power outage.

.7 Three Way Valves for AHU Coils:

.1 15 mm to 50 mm: Globe valve, threaded ends, bronze body, stainless steel trim, 1722 kPa rated.

.2 65 mm and up: Globe valve, flanged ends, cast iron body, bronze trim, 689 kPa rated.

## 3. EXECUTION

### 3.1 Installation

.1 Verify location of thermostats and other exposed control sensors with drawings before installation. Locate thermostats 1500 mm above floor. Install all thermostats on brackets to maintain min 50mm clearance between wall and thermostat.

.2 Install damper motors on outside of ducts. Do not locate in air stream, except for roof mounted equipment.

.3 Wire "hand/off/auto" selector switches such that automatic operating controls and not safety controls and electrical over current protection shall be overridden when switch is in the "hand" position.

.4 Unless specified otherwise, install all outdoor air sensors on the north exposure of the building.

.5 Install all safety limits at the operators level.

.6 Install pressure gauges on branch lines, at each controller, transmitter, and actuator excepting individual room thermostats.

**END OF SECTION**

# CONTROL SEQUENCES

## 1. GENERAL

.1 The control sequences contain a general description of the intent of the operation of the systems to be controlled. The Contractor shall review individual systems to ensure equipment and life safety interlocks are not overridden.

.2 The relationships between the points, systems and building are described in the control sequences.

.3 Review with the Consultant during the shop drawing stage to finalise the control sequences for each system.

## 2. PRODUCTS

Not Applicable

## 3. EXECUTION

.1 Provide data base for all hardware points listed for system operation to meet specification operating sequences.

## 4. CONTROL SEQUENCES

### 4.1 Unit Heaters & Cabinet Heaters

.1 The surface mounted electric thermostat shall cycle the fan motor on a drop in space temperature.

### 4.2 Fuel Oil System

.1 Fuel from the outdoor tank is transferred to the day tank via two (2) fuel transfer pumps. The pumps operate in a duty/standby configuration. The operating pump selection shall be via a manual switch located on a panel next to the pumps.

.2 Pump cut-in switch is mounted at 1/3 level and cut-out switch at 3/4 level in the day tank.

.3 Low and high level switches are to be provided in the day tank.

### 4.3 Standby Generator

.1 When the emergency generator starts, the minimum outdoor air damper shall open.

.2 As the space temperature changes, the room thermostat shall modulate the outdoor air, exhaust air and recirculation air damper to maintain set point.

.3 Upon generator shutdown, the outdoor air, minimum outdoor air, and exhaust air dampers are closed and recirculation air damper is opened.

.4 Hard wired electric controls are to be used. All controls shall be on emergency power.

## 4.4 Heating System

.1 New Building Heating Loop

.1 System consists of two boilers (B-03 and B-04) and two pumps (P-09 and P-10) and serves the building additions and additional heating coil for AHU-01.

.2 Boilers and pumps are 100% capacity each and operate in a duty/standby configuration.

.3 Boiler / pump control panel controls boilers and pump operation.

.4 Integral boiler controls are provided by the boiler manufacturer and connected to the boiler / pump control panel.

.5 Provide all safety or operational interlocks to boiler control panels as required.

.6 Supply temperature to building heating loop is reset as follows:

| O/A Temp. | HWS |
|---|---|
| -5°C or less | 88°C |
| 10°C | 60°C |

## 4.5 Air Handling Units (Common Controls)

.1 System Start/Stop

.1 The air handling units will normally be energized at all times.

.2 On 100% outdoor air units, upon system energisation, the outdoor air dampers will be energised open. A damper end-switch upon sensing damper full open position will permit the supply fan energisation.

.2 Freeze Stats: Provide averaging type freeze stat in each air handling unit at location indicated. Upon sensing a low temperature, the unit switches to "Defrost Mode". Refer to Section 15800.

## 4.6 Air Handling Unit AHU-2

.1 AHU-2 is a 100% outdoor air constant volume heat recovery system serving the Clarifier Room.

.2 AHU-1 supply temperature is to be constant and to be controlled by a duct thermostat initially set at 18°C.

**4.7 AHU -3**

.1 AHU-3 is a 100% outdoor air two speed heat recovery system serving the Clarifier Room.

.2 The unit consists of a two speed supply fan and two speed return/exhaust fan.

.3 The fan is manually started at low speed. Prior to the supply fan activation, return fan is switched on to low speed.

.4 A space temperature transmitter is located in the discharge duct. The signal from this transmitter is used to control the discharge temperature.

.5 Supply and return fans are switched on to high speed via manual switch, occupancy sensor or $H_2S$ sensor in the space.

**4.8 Exhaust Fans EF-1 and EF-2**

.1 Exhaust fans serving Anoxic Tanks.

.2

**4.9 Exhaust Fan EF-3 and EF-4**

.1 Exhaust fans serving Aerobic Tanks.

.2

**4.10 Ventilation Fan VF-1**

.1 Ventilation fan serving the Generator Room and Electrical Room. Fan is normally operated on a call for cooling from the local thermostat in the Electrical Room.

**4.11 Radiation**

.1 A room (zone) thermostat to modulate the reheat coil valve and zone heating valves in sequence to maintain room temperature.

**END OF SECTION**