4 AIR HANDLING EQUIPMENT

4.1 GENERAL

4.1.1 Scope

1 This Part specifies single zone, multizone, draw through and blow through type air handling equipment.

2 Related Parts and Sections are as follows:

Section 1	General
Section 16	Structural Metal Works
Section 17	Mechanical Works
Section 21	Electrical Installations

4.1.2 References

1 The following standards have been referred to in this Part:

BS 746.....Gas meter unions and adaptors

BS 2831.....Methods of test for air filters used in air conditioning and general ventilation

BS 3120 .....Performance requirements of flame proof materials for clothing and other purposes

BS 3928.....Method for sodium flame test for air filters (other than air supply) to i.c engines and compression

ASHRAE Standard 52-68

4.1.3 Quality Assurance

1 UL compliance: Fans shall be designed, manufactured, and tested in accordance with UL705 “Power Ventilators”.

2 NEMA compliance: Motors and electrical installation shall comply with NEMA standards.

3 Electrical Component Standard: component and installation shall comply with NFPA 70 “National Electrical Code”.

4.1.4 System Description

1 The units shall be installed to allow adequate access for the withdrawal of tubes, fan shafts, coils or other items for replacement or maintenance.

2 The internal surfaces of panels and frames shall be treated to prevent migration of particles into the air stream and to minimise the possibility of damage.

3 The overall dimension and weights shall be such that the units of sub-assemblies can be moved to their ultimate position on site through existing openings or, where possible, prearranged access ways.

4 All pipe inlets and outlets are to be sealed to prevent ingress of air moisture and foreign bodies.

5 Checks shall be carried out to ensure the frames are not distorted or twisted on arrival and, subsequently, after each every removal to another part of site. In addition checks shall be made of individual sections of equipment.

6 All associated control systems and wiring shall be provided with adequate protection against ingress of dirt and moisture.

7 Physical checks shall be made on all bases that have been provided for all equipment and on the installation of the equipment on the bases, to ensure correct level and alignment.

8 Where air handling units have to stand for long periods prior to use, the manufacturer shall be consulted as to any precautions to be taken. This may include rotating the fan impeller by hand at regular intervals to avoid a permanent set in the fan shaft owing to deflection and complete relubrication before start-up.

9 Fresh air intakes shall be as remote as possible from concentrations of surface or roof dirt and positioned to avoid the intake of fumes and odours.

10 The fresh air inlet shall be positioned at least 1.2 m above ground level.

11 The control system and wiring shall be provided with adequate protection against ingress of dust and moisture.

4.2 CONSTRUCTION OF AIR HANDLING UNITS

4.2.1 General

1 The unit casings shall be of double skinned sectional construction with all panels fitted on a penta post frame

2 The panels should be braced to avoid vibration and druming

3 Panels shall be bolted to the sub-frame, except Panels that are required for removal for securing. Service panels shall be hinged and latched

4 All casing panels shall be insulated with at least 50 mm thick for outdoor units and 37 mm thick for indoor units 48 kg/m^3 density rigid fibre glass with a k-factor not exceeding 0.037 W/m^2/K. Injected polyurethane can be used instead, provided that the overall heat transfer coefficient does not exceed the above construction.

5 Panels shall be either pre-plastisized, paint finish or aluminium.

6 Frame shall be insulated such that condensation does not occur due to the formation of cold bridges under adverse ambient conditions.

7 The interior of the air handling units shall be free from dangerous obstruction and projection to facilitate cleaning and thus maintain a supply of clean air.

8 Surfaces of the units table to be affected by any free water produced shall be protected by anti-corrosion paint.

9 The sealing of all panels and frames shall be made air tight by means of permanently plastic or rubber pressure sealant, and made weather proof for outdoor installation.

10 Air handing units for outside installation shall have sunshade cover and weatherproof canopy.

11 All air handling unit sections shall be produced with heavy duty lifting lugs

12 The drain pan shall be constructed no less than 1.0 mm stainless steel or heavy gage aluminium. It shall be rigidly supported by galvanized heavy duty frame.

13 The units shall include a mixing box section when required. The mixing box section shall include factory installed dampers.

14 Dampers shall be of rigid construction and should not rattle. Shut off dampers shall provide an effective seal to minimise air leakage.

15 The drain pan shall be adequately insulated to prevent sweating under adverse conditions.

4.3 FAN SECTION

4.3.1 General

1 The fans installed in all AHU shall comply with all relevant QGEWC regulations.

2 The type of fan installed in each AHU shall be as detailed in the Project Documentation.

3 Variable pitch pulleys shall be installed on all AHU drive motors on belt and pulley driven fans. The pulleys shall be sized to allow for ± 5 % fan speed adjustment from the design fan speed.

4 Flexible connection shall be installed on the supply, return and fresh air ducts to minimise vibration transmission to the adjacent ductwork.

5 The complete fan and motor shall be installed on a rigid frame. The frame will be supported by properly sized anti-vibration spring mounts to isolate the motor and fan from the units casing.

6 Where the fan volume or static pressure is to be variable one of the following methods of control shall be incorporated as detailed in the Project Documentation.

(a) Multi speed motors
(b) variable speed frequency drive
(c) variable pitch
(d) variable inlet guide valves.

7 The external pressure calculations shall be submitted by the contractor along with the AHU submission on order to select the suitable motor.

8 Fan and motor drive shall be oversized by at least 20 %.

9 The fan shall be configured to minimise excessive pressure drop and air turbulence.

10 The fan and motor assemblies shall be mounted on suitable bases and anti-vibration mounts.

11 The motors shall be connected with flexible electrical connections.

4.3.2 Centrifugal Fans

1 Centrifugal fans larger than 7.5 kW output shall be of the backward curved blade type having fan total efficiency of not less than 78 %.

2 Centrifugal fans below 7.5 kW may be either forward curved or backward curved type.

3 Fan casings shall be constructed of mild steel plates with angle stiffeners and base angles to ensure freedom from drumming and shall be suitable for operation at the maximum static pressure of the system. The whole assembly shall be treated for resistance to corrosion.

4 Fan casings shall be constructed so that impellers can be easily hand driven after installation.

5 A drain plug shall be fitted to the fan casing at its lowest point.

6 Impellers shall be of mild steel or other approved material of riveted or welded construction, with spiders or hubs of robust design and shall be capable of running continuously at 10 % in excess of normal speed.

7 Impellers shall be keyed to a substantial mild steel shaft.

8 Fans and shafts shall be operate well below their critical speeds. Each shaft assembly shall be statically and dynamically balanced before shipment from the manufacturer.

9 Fan bearings shall be ring oiled sleeve bearings, or ball or roller type. Where silence is important, the bearing pedestal shall not be attached to the fan casing, and ring oiled sleeve bearings shall be applied.

10 Unless otherwise indicated centrifugal fans shall be driven by electric motors through v-belt drives.

11 The maximum fan outlet velocity shall be 10 m/s.

4.3.3 Axial Fans

1 Axial flow fans shall be either single stage type of the multistage contra rotating type with each impeller mounted on an independent motor, and having an efficiency of not less than 60 %.

2 Casings shall be rigidly constructed of mild steel stiffened and braced to obviate drumming and vibration. Cast iron or fabricated steel feet shall be produced where necessary for bolting to the base of supports.

3 Inlet and outlet ducts shall terminate in flanged steel rings for easy removal.

4 The length of the duct casing shall be greater than the length of the fan(s) and motor(s) in order that the complete section may be removed without disturbing adjacent duct work.

5 Electrical connections to the motor(s) shall be through an external terminal box secured to the casing.

6 The impeller shall be of steel or aluminium and the blades shall either be secured to the hub or the blades and hub shall be formed in one piece

7 The hub shall be keyed to a substantial mild steel shaft and the whole shall be statically and dynamically balanced before shipment from the manufacturer.

8 The fan blades shall be of an aerofoil section.

9 Shafts shall be carried in two bearings which may be ball, roller or sleeve type. Lubricators shall be extended to the outside of the casing.

10 Where axial flow fans are driven by a motor external to the fan casing, the pulleys and v-belts shall be provided with a guard and adequate sized access doors.

11 Where axial flow fans of the bifurcated type are indicated, the motors shall be out of the air stream. Motors may be placed between the two halves of the casing in the external air or may be placed within the fan casing provided that effective ventilation is given to the motor.

12 Where hot gasses or vapours are being handled, the motor and bearings shall be suitable for operation at the temperature they may experience.

13 Axial flow fans, which do not connect to suction duct, shall be supplied with a bellmouth inlet.

4.4 COIL SECTION

4.4.1 Coils General

1 The coil casing shall be of galvanized sheet steel not less than 1.2 mm and drilled to meet the adjacent sections of the AHU.

2 The coils shall be fabricated from heavy gauge solid drawn copper tubing expanded into the fins to give a mechanical bond.

3 The coil fins shall be aluminium or copper with the fin spacing not less than 2 mm.

4 The coils shall have a minimum of 4 rows

5 Return bends shall be die formed

6 Headers shall be heavy section seamless copper tubing and all joints shall be silver brazed

7 On systems where the static pressure exceeds 750 Pa, airtight cover boxes shall be provided over the header and bends. Provisions shall be made for draining the cover boxes.

8 The resistance to air flow shall not exceed 125 Pa and the face velocity shall not exceed 2.5 m/s.

9 The coil shall be constructed to maintain even leaving temperature across the total face area of the coil

10 Cooling coils shall be fitted with eliminator plates if the face velocity exceeds 2.5 m/s.

11 Cooling coil casings shall be made to form a water tight drip tray complete with drain connection. The drain shall be fitted with a water seal to prevent the ingress and discharge of air to and from the system. The drain pipe shall return to the nearest sump or gully.

12 Cooling and heating coils for large air handling units shall be fitted with slide rails to facilitate easy removal by personnel.

4.4.2 Chilled and Hot Water Coils

1 Coils shall be arranged in a contra flow Pattern, with the flow of water entering at the leaving air side and the leaving at the entering air side.

2 The flow and return headers and connections shall be arranged to ensure an equal flow of water through all tubes.

3 All coils shall be tested at the manufacturers factory to 1½ times the working pressure or to 7 bar whichever is the greater.

4 Coil connections up to and including 65 mm bore shall be screwed or flanged. Connections 80 mm bore and above shall be flanged.

5 Isolating valves shall be installed on the inlet and outlet connections. The valves shall be arranged so as to facilitate the removal of the coil without disturbing adjacent pipework.

6 Provision shall be made for effective venting of the coil and connections and for draining of the coil header and tubes.

4.4.3 Refrigerant Direct Expansion Air Cooling Coils

1 The coils shall be provided with refrigerant distributors and the connections to the tubes shall be designed to ensure an equal flow of the refrigerant to each tube.

2 The suction connections shall be arranged so as to ensure complete drainage of any oil in the coil.

3 The coils shall be dehydrated and sealed after manufacture.

4 The coils shall be tested to 1.5 times their maximum working pressure.

5 The thermostatic expansion valve which shall incorporate an external equaliser line shall maintain the design degree of super heat at the evaporator outlet. The remote sensing bulb shall be securely fixed to the evaporator outlet piping in a position where the degree of superheat can be correctly sensed.

6 The design evaporating temperature shall not be less than -1 °C.

7 The coil shall be sized to be compatible with the associated refrigeration equipment.

4.5 ELECTRICAL DUCT HEATERS

4.5.1 General

1 The casing shall be of galvanized sheet steel no less than 1.2 mm thick with angle framing drilled and ready to receive the counter flange on the duct work. Alternatively, the construction shall be compatible to fit within the air handling unit where appropriate.

2 The electric heaters shall consist of a number of helically coiled nickel chromium alloy heating elements of the enclosed non-corrodible type mounted in the sheet steel casing.

3 The elements shall be so installed that they can be removed for cleaning or removal with minimum disturbance to other plant items.

4 The surface temperature of the elements shall not exceed 150 °C.

5 The control of electric air heaters shall be inter locked with the fan motor starter and air flow switch so that the heater cannot operate unless the fan is running and air flow is detected.

6 The heater shall be installed with a high temperature limit device with hand re-set button.

7 The control of the heater shall be by a thyristor type fully variable controller.

8 All heaters and heater sections greater than 3 kW loading shall be balanced over three phases and the complete heater bank shall be arranged for balanced operation on a 3-phase 4-wire system.

9 The connections from each element shall be taken to readily accessible terminal box arrange for conduit entry.

10 Each heater section shall be separately fused and the neutral point of a all 3 -phase star-connected section shall be brought out to a link in the terminal box.

11 The insulation of the wiring near any hot areas shall be of the appropriate quality.

12 The total resistance of the heater to air flow shall not exceed 25 Pa and the velocity through the free area shall not exceed 6 m/s.

13 The installation of electric heaters batteries shall comply in all respects with the requirements of the Civil Defence Department and QGEWC regulations.

4.6 FILTERS

4.6.1 General

1 Filters shall operate to at least the efficiencies specified in this section and not less than 73 % average synthetic dust weight or resistance in accordance with ASHRAE Standard 52-68.

2 Filters shall be complete with holding frames sufficiently robust to ensure that no distortion occurs in operation.

3 Filters shall be installed with edge seals which shall prevent air by passing the filters. The seal shall remain effective even though the cells are periodically removed and refitted.

4 Filters shall be arranged so that there is easy access for cleaning and/or removal.

5 A differential pressure gauge of the dial type or incline manometer type shall be provided for each filter bank and shall be fixed in such a position outside the AHU system that it is accessible and easily read. The gauge shall be marked to show maximum differential indicating a filter change requirement.

6 Filters shall also have a differential pressure switch installed when the system is to be monitored by a BMS system. The differential switch shall be calibrated to operate indicating a fitter change requirement.

7 The air velocity through filters shall be such that the clean resistance as indicated is not exceeded and that the filter fabric or oil is not carried over into the system.

8 Where a flame proof filter medium is specified the material shall comply with the following requirements when tested in accordance with the relevant standard.

(a) Duration of flaming. No test sample shall continue to flame for more than 8 seconds after the igniting flame has been removed

(b) Extent of after-glow. After glow shall not spread beyond the area of material damaged by fire

(c) Length of material which chars or melts. The average length of material which chars or melts on the specimen shall not exceed 85 mm and the maximum length of the charred or melted material in any one specimen shall not exceed 115 mm.

9 Where washable type flame proof filters are offered or specified the filter medium shall comply with the requirements of Clause (b) above both before and after the washing treatment prescribed in BS 3120 Appendix A. Washable type filters shall not be used without prior approval from QGEWC.

10 Where the filter medium is required to be flame proof the casing shall not be less than 1.6 mm thick for at least 1.8 m upstream and 1.8 m down stream of the filter. The immediate frames of cases of the filter elements shall be of material complying with BS 746 Part 1. Clause 7 Class 1.

4.6.2 Dry Replacement Media Type Filter

1 The filter shall be of the flat panel type continued in galvanized steel front or side removal frame.

2 Each cell shall comprise a pad of glass fibre or synthetic fabric filter media, 50 mm thick and retained within a rigid frame of durable cardboard.

3 The filters shall have an efficiency of not less than 92 % based on test specified in BS 2831 with test dust No. 2.

4 The maximum face velocity shall be 2.5 m/s.

5 The initial pressure drop shall not exceed 70 Pa.

6 Sufficient spare cells shall be provided to replace all of the filter bank.

4.6.3 Regenerative Filters

1 The filter medium shall be processed washable open cell foamed plastic or plastic bonded synthetic fibre.

2 The medium shall have a minimum thickness of 15 mm.

3 The element shall be supported on plastic coated steel wire formers with a metal frame.

4 The face velocity shall not exceed 2.25 m/s.

5 The initial pressure drop shall not exceed 100 Pa.

6 Fitters of this type shall have an efficiency of not less than 90 % based on the test specified in BS 2831 with test dust No. 2.

4.6.4 Bag Filters

1 The filter shall comprise of one or more 600 x 600 mm filter bag modules fitted into a purpose made galvanized steel side or front withdrawal frame.

2 Each module shall comprise a minimum of four separate bags bonded or clipped into a galvanized steel header.

3 The bags shall have a minimum length of 600 mm.

4 The medium shall be of a fine multi-layer type with high mechanical strength.

5 The maximum initial resistance shall not exceed 100 Pa.

6 Fitters of this type shall have an efficiently of not less than 99.6 % based on the tests specified in BS 2831 with test dust No. 2.

7 One complete set of spare bags shall be supplied.

4.6.5 Automatic Fibre Roll Type Filters

1 The filter shall comprise of the complete assembly of filter frame, motor and drive and filter medium.

2 The filter shall operate automatically, with provision for manual starting and stopping of filter movements.

3 Unless otherwise indicated automatic filter movement shall be controlled by the resistance across the filter.

4 Provision shall be made for visual warning that the end of the clean filter medium is approaching.

5 The driving motor shall be automatically switched off when the end of the filter medium is reached.

6 The air velocity through the fitter medium shall not exceed 2.5 m/s.

7 Filters of this type shall have an efficiency of 95 % based on the tests specified in BS 2831 with test dust No. 2.

8 Where the motor and/or gearbox is mounted in the air stream the electrical insulation and/or lubricants shall be suitable for the temperature range experienced.

9 A spare roll of filter medium shall be provided for every installed roll.

4.6.6 Grease Eliminators

1 Grease eliminators shall be of the impingement type comprising of fluropolymer coated adjustable vertical baffles contained within a stainless steel casing.

2 The bottom of the casing shall comprise a grease collecting trough from which a drain shall be provided into a removable stainless steel grease collector.

3 The baffles shall be supplied in modules with a maximum size of 500 x 500 mm.

4 The baffles shall be installed in a frame and shall be readily removable for cleaning.

5 Greese eliminators shall be installed where specified in the Project Documentation.

4.6.7 High Efficiency Filters

1 High efficiency filters shall consist of asbestos cellulose of glass fibre pleated Paper media in rigidly constructed case with a completely positive seal.

2 The efficiency of the filters shall be equal to or better than that indicated and in any case shall not be more than 0.5 % penetration based on the tests specified in BS 2831 with methylene blue or the sodium flame test specified in BS 3928.

3 Where fire protection is required or the air temperature may exceed 200 °C the filtering medium shall be glass fibre paper and the casing spacers and seals shall be of a fire resistant material.

4 The air velocity at the face of the filter shall not exceed 1.25 m/s.

5 Fitters changing arrangements must be such that dust is not released into the room during the changeover operation.

6 Two spare filters or 10 % of the total whichever is the greater shall be provided.

4.6.8 Activated Carbon Type Filters

1 The cell casing shall be manufactured of steel protected against corrosion.

2 The internal arrangement shall include a corrosion proof framework of supports to ensure an equal disposition of individual panels across the all.

3 There shall be seals installed between each panel.

4 Mechanical protection shall be provided on both the front and rear of the panels.

5 The carbon shall be of uniform thickness in the panels and shall be of sufficient density to ensure that no settling down or gaps occur in use.

6 The quantity of carbon shall be 20 kg for each rated 0.5 m^3/s.

7 The resistance to air flow shall not exceed 125 Pa.

4.7 HUMIDIFIER

4.7.1 General

1 Humidifiers shall be in accordance with ARI 610/ASHRAE equipment.

4.7.2 Water Type Humidifiers

1 The water type humidifiers shall be pan or atomiser type as specified in the Project Documentation.

2 The humidifier shall consist of the following:

(a) water pan or reservoir with a water feeder valve controlled with a float box

(b) the water pan, float box tubes, evaporator and all materials exposed to water shall be constructed of a non-ferrous corrosion resistant material

(c) the units shall include overflow and drain connections

(d) the water immersion heaters shall be copper sheathed

(e) the atomiser shall be of motor driven centrifugal type with directional dome and supporting brackets.

4.7.3 Steam Type Humidifiers

1 The steam type humidifier shall be of a factory assembled packaged type.

2 The humidifier shall consist of the following:

(a) packaged steam generator
(b) steam moisture separator
(c) water feeder
(d) pressure gauges
(e) thermometers
(f) controls
(g) all materials exposed to water shall be non-ferrous
(h) the heating element shall be copper sheathed
(i) the steam distribution pipe shall be stainless steel.

4.8 HEAT RECOVERY UNITS

4.8.1 General

1 Where specified in the Project Documentation heat recovery units shall be installed.

2 The heat recovery section shall be constructed to permit easy access.

3 The unit shall be equipped with a drain pan for moisture removal.

4.8.2 Static Rate Heat Exchanger

1 The static rate heat exchanger shall be of the cross flow type consisting of alternative passages.

2 The two air steams passing through the exchanger shall exchange sensible heat to achieve pre-heating or pre-cooling.

3 The heat exchanger material shall be as specified in the Project Documentation.

4.8.3 Rotating Matrix Heat Exchanger (thermal wheel)

1 The unit shall consist of a motor, rotating via a gear motor.

2 The heat exchanger material shall be as specified in the Project Documentation

END OF PART