SECTION 3.0 TECHNICAL SPECIFICATION

3.9 PRESSURISATION SYSTEM

Table of Contents

SECTION 3.9 PRESSURIZATION SYSTEMS

1.0 PRESSURIZATION SYSTEMS (Where specified)

A pressurization system consists of three main components:

(a) Supply Air (where air is injected into the area that is to be protected)

(b) Pressure Relief (to avoid overpressure when doors are closed)

(c) Air Release (air and smoke is released from the adjoining fire area).

Combining these elements creates a positive pressure difference which prevents lobbies and staircases from filling up with smoke.

A pressurization system for smoke and fire ventilation should meet the recommendations of Approved Document B and BS EN 12101-6 "Specification for Pressure Differential Systems" or BS 5588-4- "Code of practice for smoke control using pressure differentials".

Pressurization is normally carried through up to the final door to the accommodation, with air release provided from the accommodation. Therefore stairs and lobbies are usually pressurized with air release from the corridor.

System device shall be to move smoke and hot gases out under conditions of fire. Fan shall be aero foil bifurcated fans conforming to BS EN170 : 2002 and BS 2613 / BS EN 60068-2-2:2007 with motor insulation in accordance with Class ‘H’ Specification of BS EN 2757 : 2011.

The fan motor shall be Ingress Protection 65(IP65) which complete protection against contact with live or moving parts inside the enclosure and against the ingress of dust

1.1 The System Comprises:

1.1.1 Fans

Inlet Fans for introducing air into the designated area. The run and standby fans and control equipment should be housed in a separate plant room or outdoors and the inlet should be protected from smoke. Dual inlets with automatic smoke dampers are required for high level inlet.

Fans shall be of the type, size, arrangement and capacity as indicated in the schedule and/or as shown on the drawings. Fans and motors shall be selected to provide air flow rates of 10% more than that specified against the corresponding increase in system resistance.

All motor/blade rotors shall be statically and dynamically balanced to International Standard I.S.O. "Balance Quality of Rotating Rigid Bodies" and shall be free from vibration at all operating speeds and during starting and stopping cycles.

Fan motors shall comply in all respects with the "Motors" clause in the section on Electrical Works of this specification. Motor bearings shall be of the ball or roller type, sealed for life or grease packed fitted with lubricant retaining and dust excluding seals extended through the casing, and shall be selected for an operating life of not less than 150,000 hours.

Fans shall not be operated in a partially completed system for any purpose whatever and before start up, all connected ductwork and equipment must be cleaned.

1.1.2 Type of Fans

Selection of fan equipment shall be as per Schedule of Design Requirements.

(a) Centrifugal fans

Centrifugal fans shall be backward curved, aerofoil blade, limit load type complete with V belt drives, drive guards, motors, steel bases and anti vibration mountings.

Fan discharge velocity at design air flow shall not exceed 9 m/s.

Fan casings shall be hot dipped galvanized steel plate braced with hot dipped galvanized steel angles. Scrolls shall be not less than 3mm thick and side plates not less than 5mm thick. Casings shall be provided with angle flanged outlets, curved inlet rings, sealed access panels and 40mm diameter screwed and plugged drain connections. Access panels shall provide full access to the fan interior and shall be fitted with wedge type clamps to provide air tight sealing. Curved inlet rings shall be removable to allow removal of fan impeller. Casings on fans over 500mm diameter shall be fitted with lifting lugs.

Blade shall be hot dipped galvanized steel all welded construction with die formed aero foil blades and front plates. The impeller hub shall be securely keyed to the drive shaft. Drive shafts shall be machined high tensile steel and shall be stepped to facilitate easy impeller removal. All fan and motor shaft ends shall be countersunk at the shaft centers to take the tachometer.

The fan shall be driven by not less than, two metric vee-belts via taper lock pulleys. Drive guards shall be braced open mesh construction to completely enclose the drive and be readily removable. Guards shall be drilled at the fan shaft and motor shaft positions to allow measurement of shaft speeds with a tachometer.

Fan and motor bases shall be fully welded hot dipped galvanized heavy steel construction complete with anti vibration mountings.

(b) Axial flow fans

Axial fans shall have flanged hot dipped galvanized tubular casings extending over the length of the fan and motor (unless specified otherwise) complete with an airtight access door suitably placed for easy fan inspection. Fans 300 diameter or less may have casings without access doors. Open fan intakes and discharges which are accessible to personnel shall incorporate heavy gauge galvanized or bronze wire mesh guards.

Non overloading aero foil fans shall have adjustable pitch cast aluminum alloy impellers or may have adjustable pitch polypropylene impellers on fans up to 300 diameter and glass reinforced polyester resin impellers on fans up to 765 diameter.

(c) Roof mounted fans

Roof mounted units shall be totally weatherproof and shall comprise centrifugal, mixed flow or axial flow fans housed in a compact base fitted with a weathering skirt and surmounted by a bird proof cowl with a curved contour.

The units shall be of all welded construction and shall be hot dipped galvanized after fabrication. All rotating parts of the units shall be isolated from the unit casings by approved resilient mounting.

Access to motor and fan shall be via a hinged cowl or a service door in the cowl. Fan motors shall be positioned above impellers to allow servicing from above the roof.

(d) Propeller fans

Propeller fans shall be of approved manufacture of the in duct diaphragm, wall mounting or roof cowl mounting type.

Fans shall have die cast aluminum, hot dipped galvanized steel or pressed aluminum blades mounted in hot dipped galvanized steel, cast iron or die cast aluminum hubs and complete with hot dipped galvanized steel or aluminum brackets.

Wall mounted fans shall be of the ring mounted type complete with hot dip galvanized ring mountings, wire mesh guards and aluminum louvre shutters. In addition, hot dip galvanized external wall cowls shall be provided on externally located fans.

(e) Bifurcated fans

Bifurcated fans shall be able to handle air at temperatures of up to 232'C and shall withstand moisture laden atmosphere, smoke or airborne dust. The motor shall be isolated from the main air stream in a tunnel which extends to one side of the casing. It shall be cooled by ambient air drawn into the tunnel and passed over the motor carcass by an impeller mounted on a shaft extension at the tail end of the motor.

The casing and external terminal box shall be hot dipped galvanized.

1.2 Automatic air release

Automatic air release to prevent unwanted pressure build up in the adjacent spaces. This may be automatic vents, natural shafts or mechanical extract systems.

1.3 Control System

The control system should operate automatically from the smoke detection system with a manual on/off switch also provided within either the pressurization plant room, near the building entrance (to suit fire service), or within the central building services control room.

1.4 PRESSURIZATION DUCTWORK

All ductwork shall be constructed and installed in accordance with Sheet Metal and Air Conditioning Contractors National Association Inc. HVAC Duct Construction Standards Metal and Flexible, or HVCA DW 142 standards and guidelines, and the following clauses.

1.4.1 Schedule of Ductwork Classification

Pressure Classification is specified in SMACNA HVAC Duct Construction Standards Metal and Flexible Tables 1. 1 to 1.9 inclusive for rectangular duct, Tables 3.1 to 3.3 inclusive for circular duct, or the relevant clauses in DW 142.

1.4.2 Low Pressure Ductwork Specification

Construct and install all sheet metal in accordance with latest ASHRAE, or SMACNA or DW 142 recommendations. Provide variations in duct size and additional duct fittings as required to clear obstructions and maintain clearances, as approved by the Engineer at no extra cost.

Ductwork, including fittings, shall be made of commercial grade galvanized sheet of the following minimum thickness:

Size of Duct (mm)	**Galvanized Sheet**
Up to 400	0.6 mm
401 to 1000	0.8 mm
1001 to 2500	1.0 mm
Above 2500	1.2 mm

Smoke spills ducts are commonly used in smoke and heat control systems. Ductwork shall be 2 hours fire rated duct. Provide perforated grille at the inlet.

Smoke spills duct sections are intended for use in smoke control ducts to limit leakage in a fire and smoke control situation. Ductwork shall be maintain stability, integrity and insulation of fire rating to EN1366-8 for the same period of the compartment. Ductwork shall suitable for clearing smoke.

Where a horizontal duct exhausts into a common protected vertical shaft that requires installation of a fire damper, a sub-duct may be installed. Such sub-duct shall be constructed of sheet metal ductwork of minimum 2 mm thickness.

1.5 TYPE OF DUCTWORK

1.5.1 RECTANGULAR SHEET METAL DUCTWORK

All rectangular sheet metal ductwork shall be fabricated from full size galvanized steel sheet specifically manufactured for roll forming. Galvanizing shall remain unbroken after fabrication and installation and, in all cases, long runs of ducts up to 2400mm in length shall be fabricated from continuous sheets unless broken by transitions, bends and fittings. Patched ductwork fabricated from small pieces shall not be used. All ducts shall be adequately stiffened to prevent "drumming/paneling".

Wherever possible full radius bends shall be used unless available space and structural limitations preclude their use, in which case, bends with splitters may be used. Details and dimensions of splitters shall be shown on all construction drawings.

Where shown on the drawings, acoustic type air turns shall be of the double thickness type in accordance with the following:

1.6.1.1 Vanes shall be fabricated from 0.8mm thick perforated galvanized or zinc anneal sheets, having 5mm diameter holes and approximately 10% free area and shall be filled with semi rigid fiberglass or mineral wool having a density of not less than 48 kg/m3. Insulation shall be treated with a fire retardant plastic spray to prevent exfoliation and leading edges of vanes shall be felt tipped.

1.6.1.2 Where special acoustic splitters are shown on drawings or separately specified they shall be fabricated from not less than 1.6mm thick G.I. covered both sides with 25mm thick acoustic material and perforated metal as for air turns. The leading edge of each splitter shall be formed into an aero foil shape. Splitters shall be rigidly fixed to side ducts and shall be completely free from vibration. Complete details of all splitters and air turns shall be shown on construction drawings.

1.5.2 EXPOSED RECTANGULAR SHEET METAL DUCTWORK

All exposed rectangular air conditioning and mechanical ventilation ductwork shall be specially constructed to provide a neat aesthetic appearance.

In general the ductwork shall be constructed with heavy gauge drive cleat Joints, false drive cleat cover strips mid way between joints and internal stiffeners.

All corners of drive cleat Joints shall be fitted with a sheet metal closing piece and shall then are filled with an approved body sealing compound and be ground smooth after setting.

Under no circumstances will exposed fittings such as rivets, pop rivets, bolts or welds be accepted and any damage to ductwork such as dents or buckles will be rejected.

All support hangers shall be located on the top of the ducts and shall be concealed wherever possible.
Longitude joints in pieces of duct other than corner Joints will not be acceptable.

Corner Joints shall 'u c of the Pittsburg lock type with each piece of duct installed such that the joints match in a continuous run. On the smaller size ducts the joint shall be located on a concealed side wherever possible.

All exposed air conditioning ductwork shall be internally insulated to the specified requirements.

1.5.3 CIRCULAR SHEET METAL DUCTWORK

All circular sheet metal ductwork for low pressure application shall be fabricated from full size galvanised sheet steel specifically manufactured for roll forming. Galvanising shall remain unbroken after fabrication and, in all cases, long runs of duct up to 2400mm in length shall be fabricated from continuous sheets unless broken by transitions, bends and fittings. Patched ductwork fabricated from small pieces shall not be used. In particular, preference will be given to the use of pressed metal bends in lieu of lobster back bends.

All straight ducts shall be fabricated in lengths as long as possible consistent with transport, access and site requirements, to minimise site joints. Spiral duct of the outside locked seam formed from galvanised sheet metal is acceptable and shall be 0.5mm thick for duct up to 200 mm dia. and 0.6 mm for duct 230 mm. and above.

All longitudinal seams in shop fabricated rolled ductwork shall be of the grooved lock or snaplock seam type. All site joints shall be of either the beaded sleeve or flanged type.

1.5.4. EXPOSED CIRCULAR AND OVAL SHEET METAL DUCTWORK

All exposed circular and oval supply air ductwork shall be fabricated from I mm thick heavy ribbed spiral joint.

Duct lengths shall be as long as possible with a minimum of site joints.

Site joints shall be reinforced with galvanised mild steel reinforced spigot and shall be arranged so that the spiral Joint matches in a continuous method. The joint shall be sealed with an approved mastic or sealer which shall be wiped clean after assembly to give a smooth Joint. Badly made and open joints will be rejected.

Any dents, blemishes or exposed fixings will be rejected if judged to be unsightly on completion of painting.

Bends shall be constructed using a minimum of eleven (11) pieces for each bend

Exposed pop rivets will not be accepted and shall be ground smooth and filled with body filler to approval.

Double ribbed ductwork will not be accepted.

The internal section of the ducts shall be reinforced to prevent sagging or distortion of the duct between hangers.

1.5.5 FLEXIBLE DUCTWORK

All flexible ductwork shall be aluminum duct of corrugated construction with triple locking seam. Flexible ducts for air conditioning supply air shall be patent factory pre insulated and wrapped with reinforced aluminum foil laminate and vapor sealed. Insulation and foil details shall be as specified herein.

Flexible metal ductwork shall be installed in all location indicated on the drawings and wherever else necessary to eliminate vibration transmission.

All bends made in flexible ducting shall be formed to manufacturer's recommendations and shall have a center line radius of not less than 1.5 times the diameter of the ducts. Bends shall remain at full diameter throughout the length of the bend and all bends deformed or damaged in any way during installation shall be replaced with new bends.

All fittings such as tee pieces, Y pieces and reducers shall be of galvanized sheet metal exactly as specified for circular sheet metal ductwork.

All joints between lengths of flexible ductwork shall be made with short spigots of galvanized sheet metal circular duct to form a slip joint.

Similarly all connections to fittings and terminal boxes etc. shall be of the spigotted slip joint type. Spigot outlets from ducts or spigot connections to grille and diffuser boxes shall be fitted with a galvanized steel butterfly type damper complete with coated mild steel shaft and a quadrant arm.

All Joints shall be made by sealing the flexible duct to the spigot with expedite duct sealant or duct sealing tape, following by the application of a metal band with worm drive hose clip. Self tapping metal screws and rivets shall not be used.

1.6 DUCT SEALANT

Sealants are often used to reduce the air/gas leakage from smoke and heat exhaust ventilation systems. Failure of these sealants whilst the smoke and heat exhaust ventilation system is operating in its emergency mode may result in the failure of the duct's leakage criteria.
The following general requirements for duct sealants shall apply.

(a) The sealants shall be suitable for the environment to which the smoke control duct is to be subjected to.
(b) The sealants shall be durable for the proposed life of the smoke control duct section.
(c) The sealants shall be resistant to mechanical damage during the installation of the smoke control duct section.
Any deterioration of the sealant shall not cause the smoke control duct section to fail the leakage criteria for the duct classification

1.7 PRESSURIZATION SYSTEM REQUIREMENTS:

There are two requirements to maintain within a pressurization system. These are:

(a) Maintaining a pressure difference for a closed door condition. The pressure difference is required to overcome buoyancy pressure generated by the hot smoke layer, expansion of the gases in the compartment due to heating, stack pressure and wind pressure. Airflow velocity of not less than 1 m/s through doors when all 3 doors are open (1 main exit door + 2 consecutive floors)

(b) Maintaining a velocity for an open door condition. Here maintaining a velocity for an opened door is required to hold back the smoke on the fire floor when the door onto the fire floor is open. Minimum Pressure Differential between staircase & adjacent accommodation space is 50 Pa when all doors are closed. Unlike BS EN 12101-6 , there is no pressure differential requirement when doors are in open conditions

The right balance for a pressurization system needs careful design in order for the system to work effectively. Insufficient pressure difference across a closed door will allow the passage of smoke into the protected space. Excess pressure will impede door opening and hence escape. Maximum force required to open any door at the door handle shall not exceed 110N.

---------- END OF SECTION 3.9 ----------