WATER SUPPLIES DEPARTMENT

STANDARD SPECIFICATION E-98-01

PLANT ROOM VENTILATION

1. GENERAL

The ventilation system specified in this Specification applies to mechanical and electrical plant rooms except chlorination plant rooms and chlorine drum stores.

2. VENTILATION CAPACITY

The minimum capacity of the ventilation system shall be sufficient to limit the temperature rise in the plant room to an acceptable level, to provide air circulation for the prevention of undesirable fumes and to minimize condensation. It shall be determined in accordance with the criteria set out in Clause 5 of this Specification. The capacity, materials used, method of construction and layout of the ventilation system shall meet the statutory requirements and the approval of the Fire Services Department (FSD).

3. VENTILATION ARRANGEMENT

3.1. General

Unless otherwise specified, natural ventilation shall be acceptable provided that the minimum ventilation capacity is achieved. Fresh air inlets and exhaust air outlets shall be at low and high levels respectively. Air inlets, outlets and ventilation ducts, if any, shall be so arranged that no stagnant air pockets or short-circuiting path shall be created inside the plant room and no exhaust air shall be re-circulated.

For plant room in which gases or hazardous fumes are likely to be released, a forced ventilation system with naturally aspirated intake and forced exhaust shall be provided. Asbestos materials in any form shall not be used in the ventilation duct system.

3.2. Ventilation Fans and Ancillary Equipment

Ventilation fans and ancillary equipment for plant room ventilation shall comply with relevant WSD Standard Specification. All electrical equipment shall be suitable for 380V 3 phase or 220V single phase 50 Hz supply.

Equipment such as fan motor enclosures, fan blades, fan housings, louvres and ventilation ducts which are susceptible to attack by the chemical flumes in the plant room shall be protected with suitable chemical resistant coating.

3.3. Ventilation Ducts

Ductwork provided shall comply with the latest edition of the Specification for Sheet Metal Ductwork issued by the Heating and Ventilating Contractors' Association (HVCA) (DW/144).

Ventilation ducts shall be fabricated with hot dip galvanized steel sheet to BS EN 10143, Grade 22 and of thickness not less than 1.5 mm. The ducts shall be so constructed that pressure losses due to eddies or vortices are minimised and no noise or vibration is created or transmitted. Face panels shall be stiffened and creased to prevent "drumming".

All ductwork shall be secured by hangers, brackets or other appropriate means of support. All mild steel components shall be hot dip galvanized to BS EN 10143, Grade 22. Flexible joints shall be provided in fan inlet and outlet connections. Access/maintenance openings shall be provided at appropriate locations to facilitate inspection, cleaning and disinfection of the interior.

The nominal air speed inside the duct shall not exceed 10 m/s. Multiple duty and standby fans may share a duct provided that the specified air speed and the sound level are not exceeded when the designed maximum number of fans are running and that no short circuit paths are created when not all fans are running.

3.4. Inlets and Outlets

Stainless steel fixed louvres with removable wire mesh screens shall be provided for the air inlets and outlets.

The nominal air speed through the air intake louvres shall not exceed 2.5 m/s.

3.5. Fire Dampers

Fire dampers shall be provided in air ducts at the following locations for fire compartmentation and to comply with the requirements of FSD:

(a) where a duct passes through a floor slab or a fire resisting wall which is expressly built for the purpose of preventing the spread of fire; and

(b) other locations as required by the Building (Ventilating Systems) Regulations and FSD.

The fire damper shall have a fire rating not less than that of the wall or floor slab in which it is situated. The damper shall be held in open position and shall be closed automatically at a temperature of 72ºC unless otherwise specified.

4. CONTROL AND MONITORING

4.1. Control Panel

A control panel for the ventilation fans shall be provided inside the plant room. The panel shall have a degree of protection of IP 54 or above to BS EN 60529.

The following equipment shall be provided in the ventilation control panel:

(a) 3-position operation mode selector (Auto / off / Manual) (where applicable)

(b) 2-position duty selector (Fan 1 duty / Fan 2 duty or Low / High as applicable)

(c) Fan starters with overload protection units

(d) 'Start' and 'Stop' pushbuttons (individual controls for each fan / fan stage / fan speed as applicable)

(e) 'On' and 'Tripped' indicator lamps for all fans

(f) Fan Speed controllers (where applicable)

(g) Temperature controller (where applicable)

(h) Repeat volt-free contacts for 'Ventilation Failed' remote alarm

4.2. Manual Control

When the operation mode selector is in the manual position, the ventilation fans shall be individually controlled by the start and stop pushbuttons.

4.3. Automatic Control

When the mode selector is in the automatic position, the ventilation fans shall operate subject to the room thermostat settings.

4.4. Room Thermostat

Ventilation fan control thermostat shall comply with Water Supplies Department (WSD) Standard Specification E-86-22. An adjustable thermostat or a temperature probe / monitor set with adjustable setting shall be provided for the automatic control of the ventilation system. The thermostat or probe shall be located at high level, not close to any hot or potentially hot surface. The adjustable range shall be 20 to 40^{o}C.

5. VENTILATION DESIGN

5.1. Air flow requirement based on heat gain

The heat gain shall be comprised of the following components:

(a) Solar = solar intensity x transmission factor x area

(b) Plant = lighting + electric heating + energy wastage from electrical machinery + heat generated in the process

(c) Metabolic = heat generated by personnel

Minimum air flow requirement (m^3/s)

$$= \frac{\text{Total Heat Gain (kW)}}{\text{Temperature Rise } (^oC) \times \text{Specific Heat of Air } (kJ/m^3/^oC)}$$

The following reference data shall be used for computation of the ventilation requirement :-

(d) Solar intensity kW/m^2 - 0.71 kW/m^2 for vertical surfaces
1.03 kW/m^2 for horizontal surfaces

(e) Transmission factor - 0.09 for 150mm concrete with asphalt covering
0.11 for 150mm concrete
0.08 for 250mm concrete
0.12 for 120mm brickwork
0.08 for 240mm brickwork
1.00 for open air
0.83 for single glazing
0.70 for double glazing

(f) Metabolic heat - 450W/person

(g) Lighting load - 60% rated watts for fluorescent fittings

(h) Heating load - 100% rated watts

(i) Electrical machinery load - (1-efficiency) x rated watts

(j) Temperature rise - 5^oC

(k) Specific heat of air - 1.180 $kJ/m^3/^oC$

5.2. Air Flow Requirement Based on Minimum Circulation

For rooms susceptible to build up of potentially hazardous fumes, a minimum of 6 air changes per hour shall be provided. Adequate mechanical ventilation shall be

provided in the plant rooms and the minimum ventilation rate shall meet the requirements of FSD.

5.3. Noise Level

The sound pressure level caused by the ventilation system, at any frequency, measured at 1 metre shall not exceed 75 dBA.

5.4. Louvre Openings for Natural Ventilation

Where natural ventilation is provided, the inlet and outlet openings for louvre installation shall be of equal effective area and shall be installed at low and high levels of the plant room respectively. The total area of openings shall be calculated using the following formula:

$$A = \frac{Q}{484\ K \sqrt{H}}$$

where, A = total area of openings in m^2.

Q = required air flow rate in m^3/hr.

H = mean vertical separation between inlet and outlet in metres.

K = ratio of effective area to total area of louvres

5.5. Design Calculations

The design calculations for the ventilation system including the sizing of ventilation fans, ducts, dampers and louvers, ventilation rates, number of air changes for the plant room, maximum air flow speed at the louvres, etc shall be submitted for the approval of the Engineer.

- End of this Specification -