

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 on-site chlorine generation plant rooms, chlorination plant rooms and chlorine drum/cylinder stores.

The equipment supplied shall comply with the latest editions and amendments of the relevant standards listed below:-

BS EN 10346 Continuously Hot-dip Coated Steel Flat Products For Cold Forming - Technical Delivery Conditions

IEC 60529 Degrees of Protection Provided by Enclosures (IP Code)

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 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**

The ventilation arrangement shall be in compliance with the recommendations stated in the "Guidance Notes on Ventilation and Maintenance of Ventilation Systems" issued by the Labour Department.

Unless otherwise specified, natural ventilation shall be adopted if the minimum ventilation capacity can be 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. The inlets and outlets shall be installed on the building wall not facing to the public and away from any contaminated air as far as practicable.

For plant rooms 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 and combustible materials in any form shall not be used in the ventilation duct system.

For plant rooms served by ductwork system not contained within the same compartment or for Dangerous Goods (DG) stores, the ventilation arrangement shall comply with the latest recommendations given by FSD.

3.2. Ventilation Fans and Ancillary Equipment

Ventilation fans and ancillary equipment for plant room ventilation shall comply with relevant WSD Standard Specifications. 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 chemical fumes in the plant room shall be protected with suitable chemical resistant coating.

3.3. Ventilation Ducts

Fabrication and testing of ventilation ductworks and its accessories shall comply with the latest edition of the "CIBSE Guide B2 - Ventilation and Ductwork" issued by the Chartered Institution of Building Services Engineers," and "Specification for Sheet Metal Ductwork - low, medium and high pressure/velocity air systems (DW/144)", "Guide to Good Practice - Ductwork Air Leakage Testing (DW/143)" issued by the Building Engineering Services Association (BESA).

Ventilation ducts shall be fabricated from good quality full sized zinc coated hot dipped galvanised flat steel sheet to BS EN 10346, Grade DX51D+Z, coating type Z275. The ducts shall be so constructed that pressure losses due to eddies or vortices are minimised. Face panels of ducts shall be stiffened according to DW/144.

For installations below ground level or susceptible to chemical attack, the ventilation ductworks and accessories shall be made of stainless steel grade 316 and designed according to Appendix D of DW/144. Stiffening of ventilation ducts is required.

All ductworks shall be secured by hangers, brackets, steel rod, angle bar, U-channel or other appropriate means of support as detailed in DW/144. Flexible ductwork shall not be used unless otherwise approved by the Engineer. Flexible joints shall be provided as connections between vibration generating equipment, such as fan inlet and outlet connection, and where air duct passing across building expansion joint. 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 only some of the fans are running.

3.4. Inlets and Outlets

316 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 72°C 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 IEC60529.

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

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°C.

5. VENTILATION DESIGN

5.1. Air flow requirement based on heat gain

The heat gain shall comprise 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 (m³/s)

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

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

- (d) Solar intensity kW/m² - 0.71 kW/m² for vertical surfaces
1.03 kW/m² 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
- 80% rated watts for LED lightings
 - (h) Heating load - 100% rated watts
 - (i) Electrical machinery load - (1-efficiency) x rated watts
 - (j) Temperature rise - 5°C
 - (k) Specific heat of air - 1.180 kJ/m³/°C

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 recommendations stated in the latest edition of the "Good Practices on the Control of Noise from Electrical & Mechanical Systems" for Ventilation Systems published by the Environmental Protection Department shall be followed and 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 m².

Q = required air flow rate in m³/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 louvres, ventilation rates, number of air changes for the plant room, maximum air flow speed at the louvres etc., shall be submitted for the acceptance by the *Project Manager*.

The design shall also make reference to the latest ASHRAE Standard 62.1 for specifying the minimum ventilation rates for plant rooms designed for human occupancy to ensure the indoor air quality is acceptable to human occupants with minimum adverse health effects.

- End of this Specification -