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IS 12368 (1988): Guidelines for Design and Construction of Hot Air Generators [MTD 26: Industrial Fuel Fired Furnaces]



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“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

GUIDELINES FOR DESIGN AND CONSTRUCTION OF HOT AIR GENERATORS

1. Scope — Covers general guidelines for design and construction of direct fired forced draft hot air generators.

2. Design Parameters — The following basic performance parameters need to be specified for designing the hot air generator:

- a) Heat release in kcal/h;
- b) Temperature of hot air at the outlet of the generator in K (°C);
- c) Quantity of hot air in m³/h at K (°C);
- d) Pressure of hot air at the outlet of the generator in mm WG;
- e) Ambient temperature in K (°C);
- f) Estimated fuel consumption in kg/h or m³/s;
- g) *Fuel to be Used* — Furnace oil/LDO/Gas; and
- h) *Electric Supply Characteristics* — 440 V, 3-phase, 4 wire, 50 cycles, a.c. supply for electric oil preheaters and motors; or
220 V/110 V single phase, a.c. supply for control equipment.

3. General Construction — The hot air generator shall consist of three segments, that is, combustion chamber, conical venturi mixing chamber and outlet chamber. The circular combustion chamber will have the burner wall at one end. The burner shall be fitted on to the burner wall at one end of the combustion chamber which will fire directly into the chamber. The combustion chamber shall be made of two concentric shells wherein the inner shell lined with refractory material, will work as combustion chamber and the dilution air will be forced through the annular gap available between the two concentric shells. Dilution air is forced into the air heater with the help of a forced draught centrifugal fan which will mix with the products of combustion in the conical venturi mixing chamber, also lined with insulation material. Hot air at desired temperature and quantity will emanate from the outlet chamber which is also normally lined with insulation material. The outlet chamber will be provided with an access door for inspection and maintenance. The air heater should be horizontal type and should be complete with an outlet flange with suitable bolt holes for connecting it to the plant equipment with the help of connecting duct.

4. Constructional Details

4.1 For constructional features for steel casing and lining with refractory/insulation material, the following guidelines are suggested:

- a) Dimensionally the combustion chamber should meet the following requirement:
 - 1) *Length* — Not less than the maximum flame length at the highest firing rate of the burner, and
 - 2) *Nominal Diameter* — Not less than 2 times the maximum possible flame diameter;
- b) Minimum thickness of mild steel shell plated for the combustion chamber (both inner and outer shells), conical venturi mixing chamber and the outlet chamber should be 5 mm;
- c) Minimum thickness of mild steel shell plate for the burner wall should be 8 mm;
- d) Minimum thickness of connecting mild steel flanges between segments/sections should be 10 mm;
- e) Inside of combustion chamber shell should be lined with dense quality refractory bricks having total minimum lining thickness of 230 mm. End burner wall should be lined with 230 mm dense quality brick backed with 115 mm thick layer of light weight insulation brick; and

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IS 12368 : 1988 GUIDELINES FOR DESIGN AND CONSTRUCTION OF HOT
AIR GENERATORS

[Page 1, clause 2(f)]— Substitute the following for the existing:

‘Estimated fuel consumption in kg/hour for fuel oil or Nm³/hour for fuel gas’.

[Page 1, clause 4.1(e), line 1] — Substitute the following for the existing:

‘Depending on the temperature inside of combustion chamber, the shell should be lined with dense quality refractory bricks having’.

(Page 2, clause 5.3, last sentence) — Substitute the following for the existing:

‘Blower will be arranged with direct/V-belt drive through a suitable motor. Following details shall be’.

(Page 3, clause 6, Title) — Substitute the following for the existing:

‘Accessories’.

[Page 3, clause 6.4(b)] — Substitute the word ‘PID’ for ‘pl’.

(Page 3, clause 6.5) — Add the following new clauses:

‘6.5.1 Auto ignition equipment (for gaseous fuel) — It consists of:

- a) Spark ignitor,
- b) HT Cable,
- c) Transformer, and
- d) Gas solenoid valve’.

6.5.2 Fuel oil – It consists of:

- a) Pilot gas burner
- b) Regulated LPG supply (through plant LPG supply or LPG cylinder banks,
- c) Gas solenoid valve,
- d) Oil solenoid valve,
- e) Spark ignitor;
- f) HG cable,

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- g) Ignition transformer,
- h) Adjustable valve for Gas flow,
- i) Adjustable valve for Pilot air; and
- j) Pilot air & gas pipelines.

[Page 3, clause 6.7(c)] — Add the following at the end:

- 'd) Gas pressure switch or contact type gas pressure gauge with isolation valve.

(Page 4, clause 6.9, Title) — Add the following words at the end:

'for Fuel Oil Tank'.

(Page 4, clause 6.10) — Add the following new clause:

'6.11 Gas Train Equipment — It consist of the following:

- a) Manual shut-off valve
- b) Gas governor
- c) Safety shut-off valve
- d) Low gas pressure switch
- e) High gas pressure switch
- f) Pressure gauge with 2-way cock.

[Page 4, clauses 7.1(a) and 7.1(b)] — Substitute ' $\pm 10^{\circ}\text{C}$ ' for ' $\pm 5^{\circ}\text{C}$ ' and ' ± 5 percent' for ' ± 2 percent'.

(Page 4, Explanatory Note, second and third para) — Substitute the following for the existing:

'Hot air generators are also used for central heating systems based on oil/gas/solid fuel firing.

Hot air generators are oil/gas/solid fuel burning appliances fitted with combustion air blowers, dilution air blowers and fuel firing equipment such as burners and accessories. In case of oil firing system, it also includes oil pumping and heating units and atomizing air blowers.'

(MTD 26)

f) For mixing and outlet chambers the following lining pattern is suggested:

- 1) Up to 200°C hot gas temperature the inside face of steel shell may not be lined with insulation material. The outer surface of the steel shell should, however, be lagged with 50 mm thick mineral wool blanket;
- 2) Above 200°C but less than 500°C hot gas temperatures, the inner face of steel shell should be lined with minimum 115 mm thick insulation bricks; and
- 3) For 500°C and above, the lining thickness should be minimum 230 mm of insulation bricks.

5. Essential Equipment

5.0 The following equipments are required besides the mild steel shell and lining materials.

5.1 Combustion Equipment — It shall consist of an oil/gas burner having the size and capacity compatible for use with furnace. It shall be complete with accessories, such as cast iron front plate, flexible oil pipe, ratiotrol butterfly valves for combustion/atomizing air.

5.2 Combustion Air Blower — It shall be centrifugal steel plate blower complete with casing and impeller fabricated from mild steel sheets suitably reinforced, wherever necessary. The blower will be arranged for direct/V-belt drive through a suitable motor. Following details shall be indicated on the blower:

- a) Blower model,
- b) Capacity (m³/h),
- c) Pressure mm at H₂O (gauge),
- d) Motor rating (kW), and
- e) Type of drive.

5.3 Atomizing Air Blower — This type of blower is required only in case of liquid fuel and air atomizing type burner using low/medium pressure air. If fitted, it shall be a centrifugal steel plate blower, complete with casing and impeller, fabricated from mild steel sheets suitably reinforced, wherever necessary. The blower will be arranged for direct belt drive through a suitable motor. Following details shall be indicated on the blower:

- a) Blower model,
- b) Capacity (m³/h),
- c) Pressure mm H₂O (gauge),
- d) Motor rating (kW), and
- e) Type of drive.

5.4 Dilution Air Blower — It shall be a centrifugal steel plate blower complete with casing and impeller, fabricated from mild steel sheets and suitably reinforced, wherever necessary. The blower will be arranged for direct/V-belt drive through a suitable motor. Following details shall be indicated on the blower:

- a) Blower model,
- b) Capacity (m³/h),
- c) Pressure mm of H₂O (gauge),
- d) Motor rating (kW), and
- e) Type of drive.

5.5 Composite Pumping and Heating Unit — It is required only for heavy grade oil as fuel. It shall consist of the following:

- a) Rotary gear oil pumps complete with relief valve and motor but without starter,
- b) Electric oil preheater complete with thermostat,
- c) Suction side filter,
- d) Delivery side filter,
- e) Pressure regulating valve,
- f) Pressure gauge with cock, and
- g) Inter-connecting pipework between pump and preheaters, etc.

5.5.1 The pumping and heating unit shall be mounted on a fabricated frame work with drip tray. Switchgears for control of motors as well as heaters may not necessarily form a part of hot air generator supply.

5.5.2 The pumping and heating unit can be either of simplex or duplex type. In duplex type, two sets of pumps, heaters and filters have to be provided, and one set remains as standby.

5.5.3 In case light distillate oil is used as fuel, requiring no preheating for effective atomization, the compositing heating and pumping unit may be substituted with a composite pumping unit only (heater elements excluded).

6. Optional Accessories

6.1 Air Ducting — It may be fitted between the combustion air blower/atomizing air blower and the burner; and from the dilution air fan to the hot air generator.

6.2 Oil Pipework — It is required from composite pumping and heating unit/pumping unit to the burner.

6.3 Automatic Temperature Control Equipment — It consists of:

- a) Thermocouple with compensating cable,
- b) Controller (on/off or PI),
- c) Control motor with linkage,
- d) Air flow control valve, and
- e) Fuel flow regulating valve.

6.4 Over-ride Temperature Control Equipment — It consists of:

- a) Thermocouple,
- b) Controller (on/off or PI), and
- c) Solenoid valve with by pass assembly.

6.5 Gas/Electric Ignition Equipment — It consists of:

- a) Gas/electric ignitor,
- b) HT cable,
- c) Transformer, and
- d) 6 mm solenoid valve (gas).

6.6 Flame Failure Equipment — It consists of:

- a) Photo electric cell (UV type),
- b) Amplifier, and
- c) Solenoid valve.

6.7 Safety Device — It consists of:

- a) Oil pressure switch or contact type oil pressure gauge with isolation valve,
- b) Low oil temperature air pressure switch (temperaturestat), and
- c) Low combustion air pressure switch or contact type air pressure gauge.

6.8 Instrument Panel — It shall be fitted with relays and alarm system for the above safety devices and shall house controllers of automatic temperature control and over-ride temperature control. The panel may also be provided with multipoint alarm annunciator for audiovisual alarm in case of fault condition.

6.9 Outflow Heater with Thermostat and Thermometer

6.10 Oil Service Tank — Complete with oil level indicator, oil inlet, outlet, overflow and drains, vent and manhole.

7. Performance Guarantee

7.1 The following characteristics may be declared and guaranteed by the manufacturer towards performance of the hot air generator within the specified tolerances:

a) Hot Air

Temperature tolerance : $\pm 5^{\circ}\text{C}$

Volume tolerance : ± 2 percent

b) Specific Fuel

Consumption tolerance : ± 5 percent

(at rated capacity throughout considering a tolerance limit of ± 4 percent in the heating value of fuel).

EXPLANATORY NOTE

Hot air generators are used with industrial furnaces for supply of hot air to heat the furnace to enable it to burn the fuel efficiently.

Hot air generators are also used with oil burning/gas burning installations for central heating systems.

Hot air generators are primarily oil burning appliances fitted with air blowers, atomizing air blowers (in case of liquid fuels), dilution air blower, and pumping and heating unit.