

General Specification of Basic Safety Assessment for

**Domestic Gas Appliances
Connected to a Flue**



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EMSD/GU05/GS/TA2/CTF

Basic Safety Assessment of
Domestic Gas Appliances Connected to a Flue

Contents

1.	Scope.....	2
2.	Definitions	2
3.	Basic Requirements	4
3.1	Gas Connections	4
3.2	Gas Pressure Regulating Device	4
3.3	Ignition Devices	4
3.4	Overheat Protection Devices	4
3.5	Flame Failure Devices.....	4
3.6	Marking and Instructions.....	4
3.7	Electric Connection	6
4.	General Construction.....	7
4.1	Gas Components and Related Parts.....	7
4.2	Ease of Cleaning	7
4.3	Soundness of the Appliance	7
4.4	Flue Terminals	7
5.	Requirements and Associated Test Methods	8
5.1	General	8
5.2	Gas Soundness Test.....	8
5.3	Water Soundness Test	9
5.4	Ignition	9
5.5	Flame Stability	10
5.6	Heat Input	10
5.7	Gas Pressure Regulating Performance.....	12
5.8	Combustion Test	12
5.9	Flame Failure Devices.....	14
5.10	Surface Temperature	14
5.11	Overheating of Water (for Instantaneous Water Heaters)	15
5.12	Electrical Insulation Resistance	15
5.13	Soundness of Combustion Circuit of Room-sealed Appliances.....	16
5.14	Combustion Products Discharge Failure Devices of Fan Powered Appliances	16
	Table 1 – Test Pressures	17
	Table 2 – Specifications of town gas and LPG	17
	Figure 1 – Bubble Leak Indicator	18
	Annex A – Precaution of Testings.....	19

FOREWORD

This specification applies to domestic gas appliances which are intended to burn either town gas or LPG normally distributed in Hong Kong. The specifications of the town gas and LPG are given in Table 2.

This specification covers Basic Safety Assessment tests (TA2) listed in the Code of Practice GU05 issued by the Gas Authority.

Enquiry on this specification can be made to the following contact:

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1. Scope

This specification defines the scope and requirements of the Basic Safety Assessment and associated testing methodology for domestic gas appliances connected to a flue.

2. Definitions

For the purposes of this standard, the following definitions apply.

Ambient temperature	Temperature of the Laboratory which is controlled at 20 °C ±5 °C.
Burner	A component which effects the gas/ air mixing and ensures the gas combustion.
Flame failure device	Means to incorporate an integral control device responsive to flame properties which by means of detecting the presence of a nominated flame will cause the gas supply to the appliance burner(s) to shut off safely in the event of ignition failure or inadvertent flame extinction.
Flame lift	A phenomenon characterized by the total or partial separation of the base of the flame from the burner port.
Flame stability	The state of the flames resting in a stable manner on the burner ports with no danger of flame lift or light-back.
Gas pressure regulating device	A device which automatically controls the pressure of gas in a gas pipe downstream of the device and/or maintains the downstream pressure between fixed limits independent of variations, within a given range, of the upstream pressure and the gas rate, such as integrated gas regulator.
Gas supply pressure	The relative static gauge pressure measured at the gas inlet connection of the appliance.

Light-back	The combustion of a flame in the body of a burner.
LPG	A liquefied petroleum gas consisting of butane (about 70 %) and propane (about 30 %). The specifications are given in Table 2.
Overheat protection device	Means a non-adjustable temperature actuated device designed to protect an appliance and its surroundings in the event of failure of the normal means of temperature control.
Pilot	A small burner which ignites a main burner by means of a flame.
Thermostat	A device to maintain automatically a selected constant temperature. It includes a graduated scale for the selection of the temperature.
Tap	A device to isolate the gas supply to the various burners and to adjust their rate during use.
Town gas	A combustion gas supplied to the public by the Hong Kong and China Gas Company Limited. The specifications are given in Table 2.
Yellow tipping	A phenomenon characterized by the appearance of yellow coloration at the top of the blue cone of aerated flames.

3. Basic Requirements

- 3.1 Gas Connections *CF3*
- 3.1.1 Gas inlet connection and screwed water inlet and outlet connections should be suitable for connection to a thread to BS 21* (ISO 7-1).
- 3.1.2 Compression joints may also be used for connection to copper tubes conforming to EN 1057[#].
- (*BS 21: Pipe threads for tubes and fittings where pressure-tight joints are made on the threads.)
([#]EN 1057: Copper and copper alloys, seamless, round copper tubes for water and gas in sanitary and heating applications.)
- 3.2 Gas Pressure Regulating Device *CF1*
- For town gas appliances, gas pressure regulating devices shall be integrated with the appliances.
- 3.3 Ignition Devices *CF1*
- Appliances shall incorporate with automatic ignition devices.
- 3.4 Overheat Protection Devices *CF1*
- Room-sealed heaters shall incorporate with overheat protection devices.
- 3.5 Flame Failure Devices *CF1*
- 3.5.1 Appliances shall be provided with flame failure devices controlling the burner and the adjacent pilot, (if fitted).
- 3.5.2 The flame failure device shall be designed to fail safe. Failure of any components of the flame failure device indispensable to its performance shall cause the supply of gas to the burner and any pilot to be cut off automatically.
- 3.6 Marking and Instructions *CF1 &*
- 3.6.1 Data Plate *CF2*
- An appliance should carry, in a position visible to the installer,

a data plate in English and/or Traditional Chinese giving at least the following:-

- a. Brand's name and/ or trade mark of the appliance;
- b. Model of the appliance;
- c. Type of flue (e.g. Back-flued; Top-flued)
- d. Type of gas to be used in Hong Kong (e.g. HK town gas or HK LPG)
- e. Operating gas pressure of appliance (in kPa or mbar);
- f. Rated heat input (in kW);
- g. Name of Recognized Certification Authority (RCA) of TA1 approval;
- h. TA1 approval certificate no; and
- i. Appliance serial number.

Warning Labels having regard to user safety shall be durable, legible and clearly printed in English and Traditional Chinese.

The characters in the data plate should be indelible to common solvents such as water and kerosene. It shall be checked by rubbing with cotton cloth soaked separately with water and petroleum spirit and each for 15 seconds. Afterwards, the marking shall still be legible, and the plate shall show no curling and shall not be easily removed.

3.6.2 Operating Instructions

These instructions, printed in both Traditional Chinese and English, should be supplied with every appliance, advising the user on how to operate and maintain it.

3.6.3 Installation and Servicing Instructions

- a. These instructions shall be printed in Traditional Chinese. Other language versions may also be supplied with the appliance.
- b. When applicable, installation instructions should comply with the Gas Safety (Installation and Use) Regulations.
- c. The installation instructions should not contain any

information that is irrelevant to use of such gas appliance in Hong Kong.

3.7 Electric Connection

CF2

An appliance designed for use with power supply shall be suitable for 220 V single phase, 50 Hz a.c.

4. General Construction

4.1 Gas Components and Related Parts

CF1

4.1.1 Gas components and related parts should be connected securely by mechanical joints such as welding, screw threads, by bolt and nut, etc.

4.1.2 Burners, pilots, igniters and their mountings shall be so designed that they can only be located correctly in relation to every component with which they are designed to operate.

4.2 Ease of Cleaning

CF1

Any part of the appliance requiring cleaning by the user shall be easily accessible without having to move the appliance or use a tool for dismantling. It shall be possible to replace such parts correctly and without difficulty, and difficult to reassemble incorrectly.

4.3 Soundness of the Appliance

CF1

4.3.1 For room-sealed appliances, the soundness of the heating body and of the connection of an appliance to the combustion air inlet and products outlet ducts shall be effected by mechanical means only. However, those parts of the assemblies which do not require to be dismantled for routine maintenance may be jointed using mastics or pastes in such a way that soundness is assured in continuous service under normal conditions of use.

4.3.2 For room-sealed appliances, the construction of the whole assembly shall guarantee soundness in relation to the room in which an appliance is installed.

4.4 Flue Terminals

CF12

The terminal should, in general, have the following characteristics:-

4.4.1 Effective protection against the entry of birds, leaves, rain, etc. The external surfaces of the terminal shall have no opening which could permit the introduction of a 16 mm (5/8 in) diameter ball into the ducts; and

4.4.2 The flame cannot be seen from the outlet openings of the terminal.

5. Requirements and Associated Test Methods

5.1 General

Tests are to be carried out with town gas or with LPG at nominal pressure given in Table 1 unless otherwise specified.

5.2 Gas Soundness Test

CF4

5.2.1 Requirements

The test consists of three parts:

- a. Soundness of gas circuit upstream of the gas tap of the appliance.
- b. Soundness downstream of the gas tap and of valves other than the tap; and
- c. Leakage external to gas circuit.

Soundness test is deemed to be satisfactory if, the leakage in (a) is less than 0.07 l/h, in (b) does not exceed that observed in (a) by more than 0.07 l/h and in (c) no leakage is detected.

5.2.2 Test Method

In test (5.2.1.a), the gas tap and other gas valves, e.g. flame failure valve are closed. In test (5.2.1.b), the gas tap is opened and other gas valves are in closed position.

To determine the soundness in (5.2.1.a) and (5.2.1.b), a bubble leak indicator as shown in Figure 1 may be used. The leakage rate is measured in terms of the number of bubbles produced over, say, one minute in the indicator. Calibration shall be done on the indicator before use to determine the equivalent leakage rate.

For tests (5.2.1.a) & (5.2.1.b), the tests are carried out with gas at a pressure of 3 kPa (12" W.G.) for town gas and 4.5 kPa (18" W.G.) for LPG upstream of the appliance.

Before each reading, at least 5 minutes is allowed for thermal equilibrium to be reached.

In test (5.2.1.c), the appliance is put into operation, a

combustible gas detector or leak detection fluid can be used to detect any leakage from the gas circuit, especially the gas carrying parts downstream of gas valves.

5.3 Water Soundness Test

CF4

5.3.1 Requirements

There shall be no permanent distortion or water leakage when subject to a water pressure of 1,500 kPa (217.5 psi), or, if a pressure relief valve is fitted, 90% of the nominal set pressure of the valve, whichever is the smaller.

5.3.2 Test Method

Fill the appliance with water, close the outlet valves. Apply a pressure that specified in 5.3.1 from the water inlet connection for 15 minutes.

5.4 Ignition

CF5

5.4.1 Requirements

- a. With gas supply pressure at both minimum and maximum (see Table 1) and in still air, ignition shall be assured at all operational rates. It shall be smooth with no light-back and prolonged flame lift.
- b. For electric ignition, out of 10 ignition trials, there should be 8 or more successful ignitions and with no successive ignition failures.
- c. Successful ignitions shall be smooth with no light-back and the flame shall carry over to all ports within 5 seconds.

5.4.2 Test Method

a. Ignition by permanent pilots

- i. Ignite the pilot, if the pilot rate is adjustable, reduce it to the minimum required to keep the supply to the burner open.
- ii. Operate the appliance, check ignition of the main burner and the pilot. Turn the main burner, quickly from ON to OFF three times. The appliance shall continue to operate satisfactorily.

- b. Electric ignition
 - i. Connect the appliance to 200 V a.c. if it is operated at mains voltage and to 70 % of the rated voltage if by dry cell.
 - ii. Ignition is carried out in accordance with manufacturer's instructions. The ignition tests shall be carried out with both individual burners and any possible combination of burners.
 - iii. For continuous spark ignition, the duration of each ignition trial should be less than 2 seconds.

5.5 Flame Stability

CF8

5.5.1 Requirements

The flame shall be stable, free from light-back, flame lift and yellow tipping for the whole operating range from full rate to reduced rate.

5.5.2 Test Method

- a. General
 - i. The test shall be done with the gas pressure at both minimum and maximum (see Table 1).
 - ii. Ignite the burner. Check the flame stability of the burner after ignition and ensure that the flame remains stable throughout the cycle of the operation.

- b. Burner with Thermostat

Set the thermostat to the highest setting. Allow the appliance to heat up until the thermostat cuts down the gas rate. Then set the thermostat to lowest setting. Allow time for the temperature to be lowered and set the thermostat back to the highest setting. Check that the flame remains stable throughout the test.

5.6 Heat Input

CF6

5.6.1 Requirements

The heat input shall be within ± 10 % tolerance of the rated

input declared by the manufacturer.

5.6.2 Test Method

Measurements are taken when the burner is set at the full rate and heated to thermal equilibrium*, except for burner provided with a thermostat.

(* Volume rates at thermal equilibrium will be regarded as steady if they do not vary by more than 1% over a period of 5 min.)

For burner provided with thermostat, measure the gas consumption during the first 5 minutes of operation with the appliance initially at ambient temperature, the thermostat at highest setting, and door, if any, opened.

The volume flow rates V shall be measured with gas supply pressure at nominal pressure (see Table 1).

The heat input D_N is calculated as follows:

$$D_N = VP_P F$$

where:

D_N : Heat input in MJ/h

V : Volume flow rate m³/h

P_P : Gross C.V. in MJ/m³ (dry gas, 15°C, 101.3kPa)

F : Correction Factor, which is calculated as follow:

$$F = \sqrt{\frac{(P_a + P_m - W)d + 0.622W}{(P_a + P_m)d}} \sqrt{\frac{(P_a + P_m)}{101.3} \left(\frac{288}{(273 + T)}\right)} \sqrt{\frac{101.3 + P_m}{101.3}}$$

where:

d : *Relative density of dry gas*

W : Saturation vapour pressure of water at the dew point of the gas in kPa

P_m : Gas pressure at the meter in kPa

P_a : Atmospheric pressure in kPa

T : Gas temperature in °C

5.7 Gas Pressure Regulating Performance

SF1

5.7.1 Requirements

For town gas appliances (not LPG gas appliances), the gas rate should not change by more than +7.5 %, -10 % of the rate obtained at the nominal pressure when the supply pressure varies between 2 kPa and 1 kPa.

5.7.2 Test Method

The test described in 5.6.2 is repeated separately with the gas supply pressure at 2 kPa and at 1 kPa. The rates obtained are compared with that measured at nominal pressure.

5.8 Combustion Test

CF7

5.8.1 Requirements

The CO content in the dry, air-free products of combustion shall not exceed 0.2 %.

The CO content relative to the dry, air-free products of combustion can be calculated by the formulae below:

$$\%CO = \%CO_2 \text{ (Neutral Combustion)} \times \frac{CO}{CO_2} \text{ (in samples)}$$

where:

%CO₂ (Neutral Combustion) is the calculated carbon dioxide content in dry, air free products of combustion, (for both town gas and LPG, the value is 14.0 %).

5.8.2 Test Method

a. General

- i. Tests are carried out in still air condition.
- ii. Thermostat, if any, is set at maximum value.
- iii. Gas rate is set to full rate.
- iv. Gas supply pressure is adjusted to maximum value or to nominal value (see Table 1) whichever gives the higher heat input. For an underfired or pre-mixed burner, the test is to be repeated at the gas supply pressure of 0.75 kPa (3" W.G.) for

town gas and 2 kPa (8" W.G.) for LPG and where applicable at its turn-down settings.

- v. Sampling of flue gases is done when the appliance is at thermal equilibrium. For burner provided with thermostat, the measurements are taken during the first 5 minutes of operation with the appliance initially at ambient temperature. Sampling is collected where the composition of the sample is as near as possible, to the average composition of all the products of combustion.
 - vi. The measurement position should be selected such that the measured CO₂ concentration is at least 1%.
- b. Natural Draught Appliances
- i. The appliance is installed together with the terminal supplied by the manufacturer according to the manufacturer's instructions.
 - ii. The connecting ducts are adjusted, if applicable such that their lengths correspond to the maximum wall thickness for which the ducts are designed.
 - iii. Sampling will be at the outlet of the flue terminal.
- c. Fanned Draught Appliances
- i. The length of flue pipe shall be the maximum extension in accordance with the manufacturer's instructions, and the terminal supplied fitted at the end of the flue pipe.
 - ii. Sampling will be at the outlet of flue terminal.
 - iii. For open flue fanned draught appliance with draught diverter, the existence of spillage, i.e. flow-out of flue gas from the draught diverter, shall be examined by means of visual aids at not less than 15 minutes after igniting the burner. There shall be no spillage at the draught diverter.

5.9 Flame Failure Devices

CF10

5.9.1 Requirements

The delay time shall be as follows:

- a. Ignition delay time (opening time) shall be less than 20 s when manual intervention is required, otherwise, time limit shall be less than 60 s.
- b. Extinction delay time (closing time) shall be less than 60 s.

5.9.2 Test Method

- a. The ignition delay time (opening time) shall be measured with gas supply pressure at minimum (see Table 1).
- b. The ignition delay time (opening time) is that between the moment when the gas is lit at the pilot (or main burner, if there is no pilot) and that when the flame failure device acts.
- c. Measure the extinction delay time (closing time) at the end of combustion tests.
- d. The extinction time shall be measured with gas supply pressure at maximum pressure (see Table 1).
- e. The extinction delay time is measured between the moment when the pilot and burner are extinguished by shutting off the gas supply and the moment when, after turning on again, the gas supply is stopped through the action of the flame failure device.

5.10 Surface Temperature

CF9

5.10.1 Requirements

Temperatures of parts which have to be touched must not exceed the ambient by more than:

- a. 35 °C for metals or equivalent materials
- b. 45 °C for porcelain or equivalent materials
- c. 60 °C for plastic or equivalent materials

The temperature of the sides, front face and the top of the appliance shall not exceed the ambient by more than 80 °C. However, in the area limited by two parallel planes located

respectively 10 cm above and 10 cm below the plane of the burners ports, the temperature rise may be 100 °C, except that the area of the case within 5 cm of the edge of any lighting hole or viewing window is exempt from this requirement.

5.10.2 Test Method

- a. The appliance is operated at the full rate and thermostat, if any, is set at maximum value.
- b. The temperatures are measured after the appliance has been in operation for 20 minutes, using contact thermocouple.

5.11 Overheating of Water (for Instantaneous Water Heaters)

CF11

5.11.1 Requirements

The water shall not be overheated by more than 20 °C.

5.11.2 Test Method

The gas rate is set at full rate and the water rate is adjusted to give a temperature rise of 50 °C, or the maximum temperature rise, whichever is the lesser. With the appliance at thermal equilibrium, the hot water draw-off tap is shut quickly. After 10s it is re-opened quickly and the highest flow temperature is measured with a rapid-indicating thermometer. The appliance is allowed to operate until it has again reached thermal equilibrium. The same measurements are taken at intervals, increasing each time by 10s until the highest flow temperature is obtained. Two additional measurements are required to take at +5 s and -5 s on the time interval recording the highest flow temperature to obtain the final highest flow temperature.

5.12 Electrical Insulation Resistance

SF5

5.12.1 Requirements

The electrical insulation resistance of the appliance shall not be less than 1 MΩ.

5.12.2 Test Method

The insulation resistance between the live part and non-live metal part or the part connected to earthing is measured by the 500 V insulation-resistance tester.

5.13 Soundness of Combustion Circuit of Room-sealed Appliances

SF2

5.13.1 Requirements

The leakage rate shall not exceed 0.86 m³/h per kW of the rated heat input to the appliance when the combustion chamber is subjected to an air pressure of 0.1 kPa (0.4" W.G. or 10 mm W.G.). However, the maximum leakage rate shall not exceed 20 m³/h.

5.13.2 Test Method

Assemble the appliance according to the manufacturer's instruction. Seal the terminal. Connect the appliance to a source of compressed air and maintain an effective pressure of 0.1 kPa in the combustion products circuit. Measure the air flow rate (leakage rate).

5.14 Combustion Products Discharge Failure Devices of Fan Powered Appliances

SF3

5.14.1 Requirements

In the event of failure of discharge of combustion products, the gas supply to the main burner shall be shut off within 60 seconds.

5.14.2 Test Method

Operate the appliance at the full rate, block the products outlet at the flue terminal. Note the time required for the shut off of the main burner.

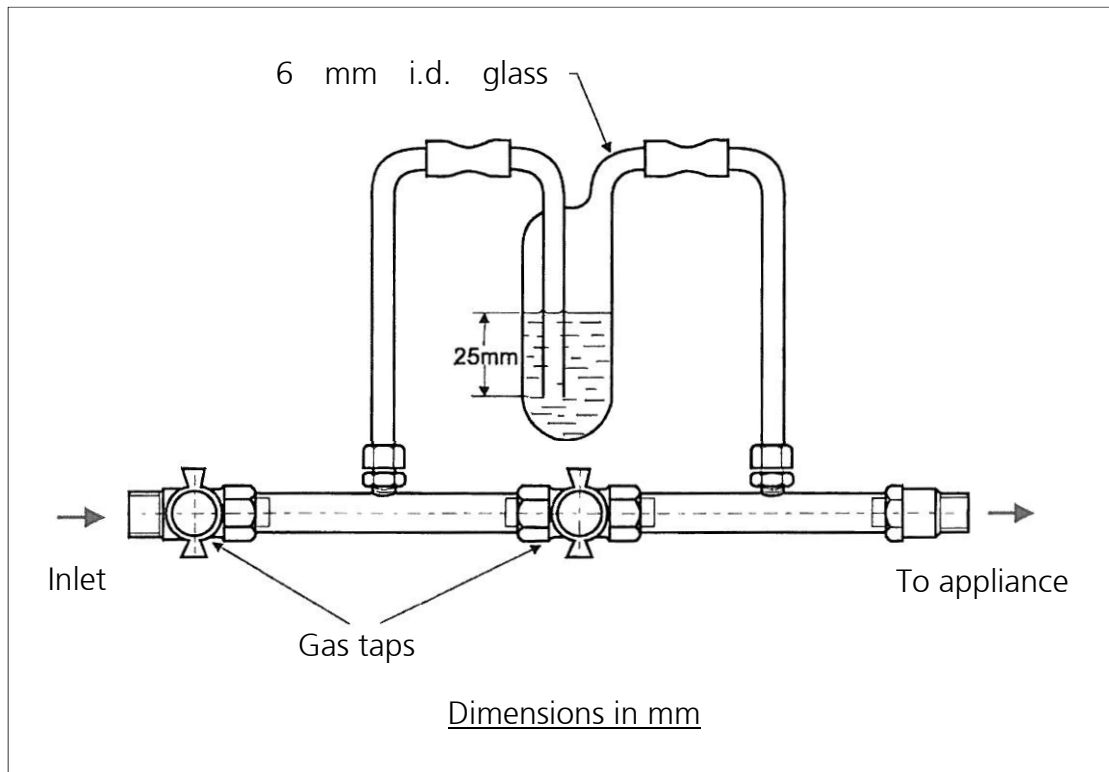
Table 1 – Test Pressures

Type of Gas	Test Pressure		
	Minimum Pressure	Nominal Pressure	Maximum Pressure
Town gas	0.75 kPa (3.0 in W.G.)	1.5 kPa (6.0 in W.G.)	2.0 kPa (8.0 in W.G.)
LPG	2.0 kPa (8.0 in W.G.)	2.9 kPa (11.5 in W.G.)	3.5 kPa (14.0 in W.G.)

Table 2 – Specifications of town gas and LPG

Properties		Town gas	LPG
1. Gross C.V.	Btu/ft ³ at 15.56 °C, 101.37 kPa, wet	455±1%	---
	MJ/m ³ at 15.00 °C, 101.32 kPa, dry	17.27±1%	116.76±1%
2. Specific Gravity (Air = 1)		0.480 - 0.537	1.893 - 1.935
3. Wobbe Index, MJ/m ³		23.2 - 24.8	83.8 - 84.6
4. Weaver Flame Speed Factor (H ₂ = 100)		34.0 - 37.0	16.01
5. Composition, % by Volume		Hydrogen : 46.3 - 51.8 Methane : 28.2 - 30.7 Carbon Dioxide : 16.3 - 19.9 Carbon Monoxide : 1.0 - 3.1 Air : 0 - 3.3	Butane : 66 - 74 Propane : 26 - 34

Figure 1 – Bubble Leak Indicator



Annex A – Precaution of Testings

All testing specification and procedures described in this method shall be carried out by competent laboratory workers. The safety precaution given does not purport to address all of the safety concerns associated with the method's use. It is the responsibility of the user of this method to follow appropriate safety and health measures applicable to chemical, physical and mechanical testing laboratories.

- I. Before using a gas pressure gauge (U-gauge), check its soundness.
- II. Before using a bubble leak indicator, check the water level in the glass bottle (see Figure 1).
- III. In carrying out the gas soundness test, check the soundness of connecting points between the bubble leak indicator and the gas appliance with gas detector or leakage detection fluid.
- IV. Before using a wet gas meter check the water level and the meter levelling.
- V. In using the 500 V insulation resistance tester, avoid touching the connecting junctions of the tester.
- VI. Unless otherwise stated, tests should be carried out with the front panel / casing / cover fitted.
- VII. After connection/ reconnection of a gas supply, check soundness of gas connections by a gas pressure gauge and ensure that the static pressure is maintained.