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**domestic gas stoves for use with liquefied
petroleum gases —requirements**

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Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 461 was prepared by Technical Committee RSB/TC 026, *LPG and Natural gas equipment and accessories*

In the preparation of this standard, reference was made to the following standard:

- 1) IS 4246 (2002): Domestic Gas Stoves for use with Liquefied Petroleum Gases

The assistance derived from the above source is hereby acknowledged with thanks.

Committee membership

The following organizations were represented on the Technical Committee on *LPG and Natural gas equipment and accessories* (RSB/TC 026) in the preparation of this standard.

SAFE GAS

Ministry of Infrastructure (MININFRA)

Energy Development Corporate Limited

Rwanda Mines Board

University of Rwanda / College of Science and Technology

SULFO Ltd

Rwanda Utility Regulatory Authority

Societe Petroliere

MOTA ENGIL

ALMAHA Group Ltd

HASHI Energy

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Domestic gas stoves for use with liquefied petroleum gases — requirements

1 Scope

This draft standard provides requirement for construction, operation, safety and tests methods for domestic gas stoves with metallic bodies intended for use with liquefied petroleum gases at 3000 kN/m² (30 gf/cm²) gas inlet pressure.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply

3.1

Burner

device for the final conveyance of the gas or a mixture of gas and air to produce a suitable flame which is maintained on or in it.

3.2

Flame Failure Device (Flame Safeguard)

A control responsive to flame properties, detecting the presence of a nominated flame and, in the event of ignition failure or subsequent flame failure, causing safety shut down.

3.3

Grill (Griller)

An appliance for cooking food by means of radiant heat.

3.4

Gas Injector (Injector Jet)

A jet removable and/or adjustable by means of which a calibrated amount of gas is allowed to pass through an orifice.

3.5

Knob

A gripping component attached to a control (gas tap, thermostat, etc.) for manually rotating it.

4 Requirements

4.1 General

4.1.1 The appliance, including all the component parts, shall be easy to clean and maintain in good working order, there shall be easy access to the accessories and controls for maintenance and adjustment.

4.1.2 Parts, which are intended to be removable by the user, shall be easy to replace correctly, and difficult to assemble incorrectly.

4.1.3 All nuts, bolts and fittings shall be easily accessible to appropriate tools.

4.1.4 The appliance shall be so designed that it remains stable and shall not be easily overturned.

4.2 Material

4.2.1 The material used in the construction of gas cooker components shall be made of non-corrosive material or appropriately treated to resist corrosion.

4.2.2 The main body of the burner (including mixer head, mixing tube and burner head) shall be of substantial and durable construction, metals having a melting point below 510°C shall not be considered acceptable for top burners.

4.2.3 The burner parts shall not melt or distort when the stove burner is operated with flames flashed back for half an hour in the mixing tube.

4.2.4 Plastic components which are liable to heating (for example, tap handles, push buttons, etc) shall be free of fissures, distortion, blemishes and discoloration

4.3 Gas taps

4.3.1 The appliance shall have at least one tap for each burner.

4.3.2 The 'ON', 'OFF' and any fixed position of tap handles shall be clearly and durably indicated or shall be obvious by design or position. Each gas tap shall indicate on its knob the burners it operates. All taps shall close in the same direction. The direction of rotation of a tap knob (handle) from off-on-simmer shall be anti-clockwise. Taps shall be designed so that when placed in any position and viewed from a distance of 3 m, will definitely indicate whether the valve is open or closed or in intermediate position.

4.3.3 Where taps are fitted with adjustable stops, there shall be means for locking the stops in position. If screws are used for this purpose, they shall not lead into gas passages.

4.3.4 Preferably all taps (excluding pilot taps) should lock in the 'OFF' position but in all cases it shall be impossible for any handle or tap to move accidentally, for example, by the weight of plugs or handles or when caught by clothing. If this requirement is satisfied by means of an automatic locking device, the tap shall be easy to operate with one hand.

4.3.5 Taps shall be so made that in normal use and with reasonable application of lubricant, the gas passages do not become blocked.

4.3.6 Taps shall be lubricated with a suitable grease, resistant to the action of the gas and capable of operating at the maximum temperature of 110°C.

4.3.7 Each taper plug tap shall be spring-loaded to maintain a gas-tight fit. Helical springs fitted in taps and valves shall have flattened ends, which shall be rounded before fitting.

4.3.8 All controls or taps shall be easy to operate at all temperatures normally attained in use.

4.3.9 Screws, nuts, etc, which regulate the tension of taps valve or springs, shall not loosen in operation of the appliance. It shall not be possible to cause a leak during normal manual operation of tap.

4.3.10 Screw-down valves shall be so designed that it is impossible to withdraw completely the valve stem in the normal operation of the tap.

4.3.11 Taps having an 'OFF' position shall have positive stops at the 'OFF' and simmer position except that special purpose taps (for appliance incorporating auto or self-ignition device), for example, taps with simmering position in between 'OFF' and 'ON' may have a movement beyond the simmer position with a positive stop.

4.3.12 Simmer flame shall be obtained by fixed simmer orifice.

4.3.13 the niting means adopted shall be sufficiently robust to withstand normal use without distortion or damage.

4.4 Injector jets

4.4.1 The injector Jets shall be fixed calibrated type and it shall not be possible to loosen them without the use of tools. The dimensions of the injector Jet shall conform to the following requirements:

S/N	Items	dimensions
1	Across flats	6 mm, Min
2	Projection from the face of mounting	6 mm. nominal
3	Threads	M 5 or 1BA

4.4.2 Injector Jet shall be made of metal, with or without ceramic tip. The melting point of the metal shall not be less than 650°C.

4.4.3 The size of the Jet in liters per hour of flow of LPG at STP conditions shall be impressed upon it.

4.5 Burners

4.5.1 The construction of the burners and the assembly shall allow their dismantling from the supports easily with or without the use of tools

4.5.2 The burner supports shall be rigid and shall be fixed in their place. Their construction shall ensure the stability of the burners and shall prevent their undue movement in a horizontal plane.

4.5.3 The lightness of the joints in the burner assembly shall not depend upon adhesives or any kind of packing.

4.5.4 For burners having centre flame, provision shall be made to protect the centre flame from pans resting directly on burner top and smothering the centre flame.

4.5.5 The appliance comprising two or more burners shall include one burner having a rating of at least 1 490 kcal/h, based on net calorific value of the gas (when using commercial LPG).

4.5.6 The parts of the burner shall not become disconnected during operation of the appliance. The burners should be so spaced that the relative distance between the centers of the adjoining burner shall not be less than 180 mm.

4.5.7 Burner ports shall be so designed and located that in normal use spillage of food shall not cause internal fouling of mixing tube and/or blockage of injector jet.

4.5.8 Only the same rating model and make of burners and parts of burners, shall be interchangeable or replaceable without effecting performance.

4.6 Burner pan supports

4.6.1 The design of the pan supports shall be such that it is practicable to support a pan of 100mm diameter, over at least one top burner without the use of loose rings, and such that 125 mm diameter vessel remains stable over each burner. Prongs of the support shall have suitable taper to accommodate round bottom pans.

4.6.2 Loose pan supports shall be so designed that it is not possible to place them firmly in other than proper position.

4.7 Gas inlet connections

4.7.1 Nozzles shall be machined from free cutting brass or mild steel.

4.7.2 Where nozzles for flexible tubing are fitted, they shall be so positioned as to facilitate fitting of the tubing and also to prevent heating of the tubing to more than 60°C.

4.7.3 The pipe/tube used for main gas rail shall be of mild steel. The wall thickness of main gas rail shall be 1.6 mm + no Limit /-0.15 mm. The external surface of the gas rail shall be treated to resist corrosion. Any other connection made from the main gas rail shall be only metallic.

4.7.4 The position of the gas inlet shall allow connection to a gas supply on either side of the appliance. Inlet connection at the rear is also permitted. It shall be possible to change gas inlet from one side to other side easily by standard tools.

5 Test methods

5.1 General conditions of test

5.1.1 During the tests the initial adjustment of appliance shall not be altered unless specifically required in the test procedure.

5.1.2 The appliance shall be adjusted and operated in accordance with the instructions given on or issued with the appliance.

5.1.3 Before any tests are made the appliance shall be operated at its full working temperature for a sufficient period to remove any temporary protective coating, which might interfere with observations.

5.1.4 The gas connections and system up to and including the burners shall be examined for leaks before and after test. The performance test results shall not be valid unless the system is sound.

5.1.5 The appliance shall be at room temperature at the start of each test unless otherwise stated.

5.1.6 The room in which tests are conducted shall be adequately ventilated but free from perceptible draughts.

5.1.7 The gas/air shall be supplied to the appliance through a control valve, an adjustable pressure regulator and an accurate meter with a pressure gauge on its inlet.

5.1.8 A pressure gauge shall be fitted to the inlet of the appliance and additional water manometer to any pressure test points on the appliance.

5.1.9 The gas/air pressure shall be measured correct to 2.5 mm water gauge at the inlet to the appliance and controlled so that any variation does not exceed 2.5 mm water gauge.

5.1.10 except where otherwise stated, the appliance shall satisfy the performance requirements using LPG.

5.1.11 wherever the combustion characteristics of burners are concerned, each burner shall be tested separately and in all possible combinations with other burners. This procedure shall be used for appliance with up to four burners.

5.1.12 For appliance with larger number of burners, the test procedure becomes impossibly long and discretion shall be exercised to eliminate tests on combinations of widely separated and which are fitted in appliance of open construction are unlikely to interfere with the combustion of each other.

5.2 Gas consumption

When tested for gas consumption, the apparatus shall be setup as given in Annex B.

- a) Each burner assembly under separate 'ON/OFF' control shall give + 8 percent of the manufacturers' specified gas consumption in l/h or heat input in kcal/h at 2942 kN/m² (30 gf/cm²) gas inlet pressure when measured by volumetric method with a wet gas meter using compressed air (27°C and 760 mm of mercury). Thereafter using 0.75 as multiplying factor, the value of airflow at STP so obtained to be converted to flow of LPG at STP.

NOTE for this test, one litre of LPG = 2.46 g.

- b) Multi burner appliances (namely, appliances having more than one burner) shall give within + 5 and -15 percent of the declared total gas consumption in g/h or heat input in kcal/h at 2 942 kN/m² (30 gf/cm²) gas inlet pressure with commercial LPG and with all the taps turned on.

NOTE The measurement of volume shall be made with a wet gas flow meter and with minimum consumption of 6 litres or volume displacement of two revolutions of the drum whichever is higher.

6 Strength and rigidity

When tested as specified in Annex A,

- a) the vertical resultant deflection of the top surface measured at the center of length of the body, shall not exceed 2 mm and
- b) the distance between the opposite sides (lengthwise and widthwise) shall not change by more than 5 mm combustion of each other.

7 Flame stability

7.1 It shall be possible to operate the appliance with taps fully open at gas inlet pressure from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²) without the flame extinguishing, blowing off or striking back and without the formation of soot.

7.2 When the gas consumption of a burner is reduced to simmer after operating for half an hour at full 'ON', the flame shall not extinguish, blow off, strike back or form soot when tested with commercial LPG at 2942 kN/m² (30 gf/cm²) gas inlet pressure.

7.3 Pilot flames shall be stable, without lifting or soot deposition, at gas inlet pressure from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²).

7.4 The fixed minimum pilot rate shall be sufficient to relight the main burner at 2452 kN/m² (25 gf/cm²) gas inlet pressure.

8 Noise control

The ignition of the burner flames, their operation and turning 'OFF' shall not give rise to undue or excessive noise during all the operations.

9 Flash back

9.1 A vessel having diameter suitable to cover the pan supports duly filled with water, shall be placed on the burner under test.

9.2 The tap of the burner shall be turned 'ON' and gas shall be allowed to flow through the burner at full rate, with taps fully opened and gas lighted.

9.3 After half an hour, the flame shall be immediately reduced to simmer and then brought back to full size. The operation shall be repeated five times.

9.4 No flash back shall occur during the test.

NOTE This applies for all pressures from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²),

10 Formation of soot

10.1 A vessel, 150 mm diameter, full of water, shall be placed on the burner and the burner lighted at 'ON' position of the tap for one hour.

10.2 After the test, no soot (unburned carbon) shall be deposited on the burner and on the bottom of the vessel.

NOTE This applies for all pressures from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²).

11 Resistance to draught

11.1 There shall be no extinction of the flames on any of the burners operating at maximum consumption when the appliance is placed in a general (not localized) current of air with a velocity of 2 m/s, as measured with a rotating vane anemometer.

11.2 The location of the appliance relative to neighboring walls and the direction of the draught shall be varied to correspond to likely conditions of appliance installation.

NOTE This applies for all pressures from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²).

12 Combustion

12.1 When tested according to the method laid down in Annex C, on no account the carbon monoxide carbon dioxide ratio of the exhaust gases of any burner. Operating at any consumption at which the burner is stable at gas inlet pressure from 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²), exceed 0.02.

12.2 It shall also be possible to obtain the required carbon monoxide/carbon dioxide ratio with the pan supports reversed or put in any other possible position or with a large skirted vessel placed over any burner.

NOTE This test need not be performed on burners with a gas rate of less than 20 l/h at 2942 kN/m² (30 gf/cm²) gas inlet pressure.

12.3 The carbon dioxide and carbon monoxide content of the products of combustion shall be determined by the methods capable of giving accuracy of 0.5 percent and 0.001 percent, respectively, of the volume of the sample.

13 Thermal efficiency

When tested as specified in Annex D,

- a) The thermal efficiency shall be at least 64 percent for each burner with the pan support correctly on the pan supports.
- b) For this test, the net calorific value of the gas shall be employed. Thermal efficiency may be declared, if it is 68 percent and above.

14 Workmanship and finish

14.1 The finish of exposed parts shall be durable, easy to clean and not subject to excessive deterioration in normal use.

14.2 Parts which come in contact with foodstuffs shall be capable of being hygienically cleaned.

14.3 The finish shall, on visual examination, show no defects, such as pinholes, blisters, roughness and exposed areas of metal, which might give rise to unduly rapid deterioration in the use.

14.4 The surface shall also be free from burrs and sharp edges, which might cause injury to the user with normal operation.

14.5 The external finished surfaces shall be easily cleanable.

14.6 Except for burners, all other parts, namely, springs, screws, bolts and nuts, pipes, pins, etc, which are visible can be removed for maintenance shall be of corrosion resistant material or treated to resist corrosion appropriate to the conditions of use.

15 Marking

Each appliance shall be legibly and indelibly marked with the following:

- a) Manufacturer's name and/or initials or registered trade-mark;
- b) Batch number and serial number
- c) Total gas consumption in g/h (with commercial LPG);
- d) Rating of the burners in kcal/h (with commercial LPG);
- e) The words 'For use with commercial LPG at 2500 - 3500 kN/m²
- f) Country of origin; and
- g) Thermal efficiency.

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Annex A (normative)

Strength and rigidity test

A.1.1 The rubber support (grommet) if any, shall be removed and replaced with identical metal supports. The pan support and burner shall be removed and the distance between the sides of the appliance body being tested shall be measured. A reference reading at the top surface of the body at the centre of the width shall be taken.

A.1.2 A load of 250 N (25 kg) per burner shall be applied at the top surface subject to a minimum load of 500 N (50 kg) for a single burner stove.

A.1.3 The load shall be applied without impact to a strip of steel having 20 mm thickness, 100 mm width and as long as the width of the appliance (see Fig. 1).

A.1.1 This strip shall be placed in the centre of the top surface of the appliance and its length parallel to the front. The load shall be maintained for five minutes after which the measurement for deflection at top surface of body (at the centre of the width just in front of the strip) shall be taken with the load in position.

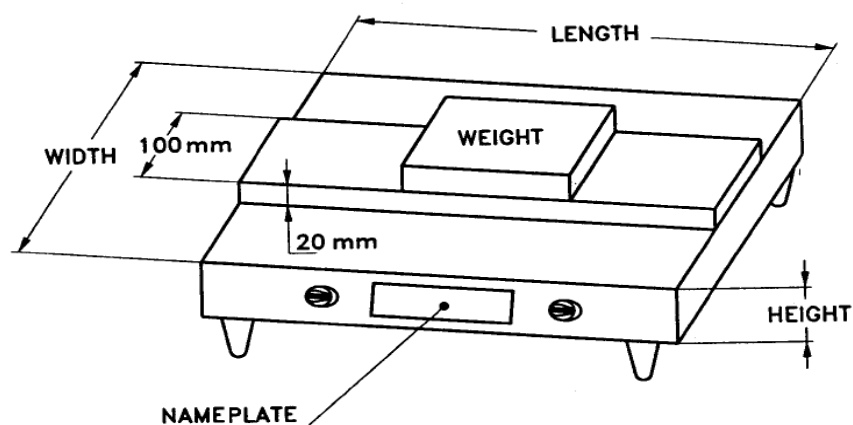


FIG. 1 STRENGTH TEST

Annex B (normative)

Gas consumption test

B.1 the stove shall be set in accordance with 16 with the addition of a suitable device for measuring gas consumption. The wet gas meter which is instrument commonly used for this purpose shall be set up in series with stove under test (see Fig. 2).

B.2 Clean and dry air shall be passed at 2942 kN/m² (30 gf/cm²) inlet pressure through the stove for a few minutes to purge the system of air and to establish the gas pressure required. Only one burner of the appliance shall be tested at a time and during the test all gas delivered to the stove shall flow through the jet of the burner being tested

B.3 Temperature of the room during the test shall be between 25°C and 30°C.

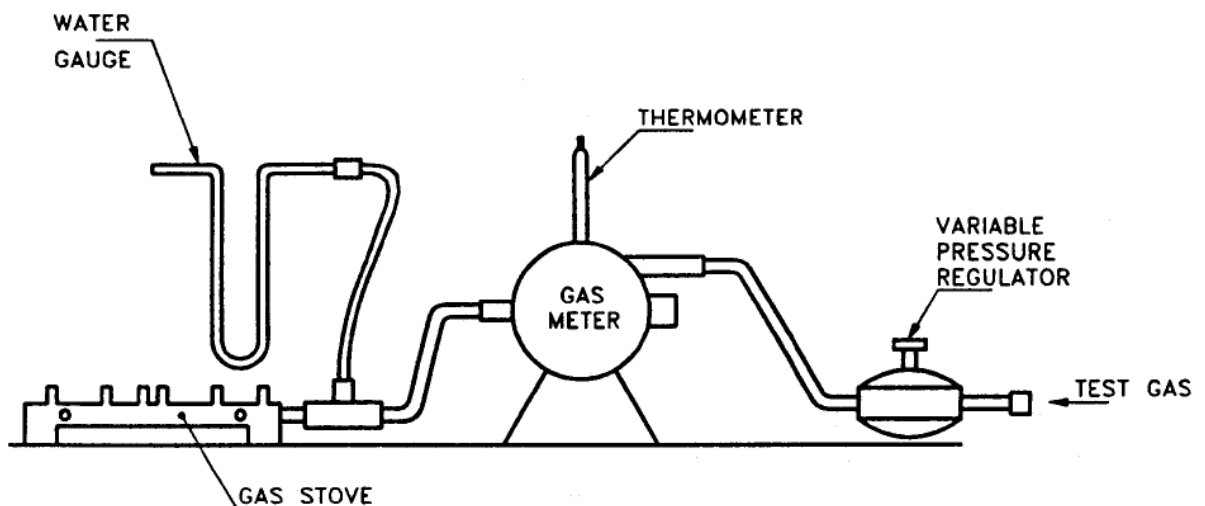


FIG. 2 TEST SET-UP FOR GAS CONSUMPTION

Annex C (normative)

determination of carbon monoxide/carbon dioxide ratio

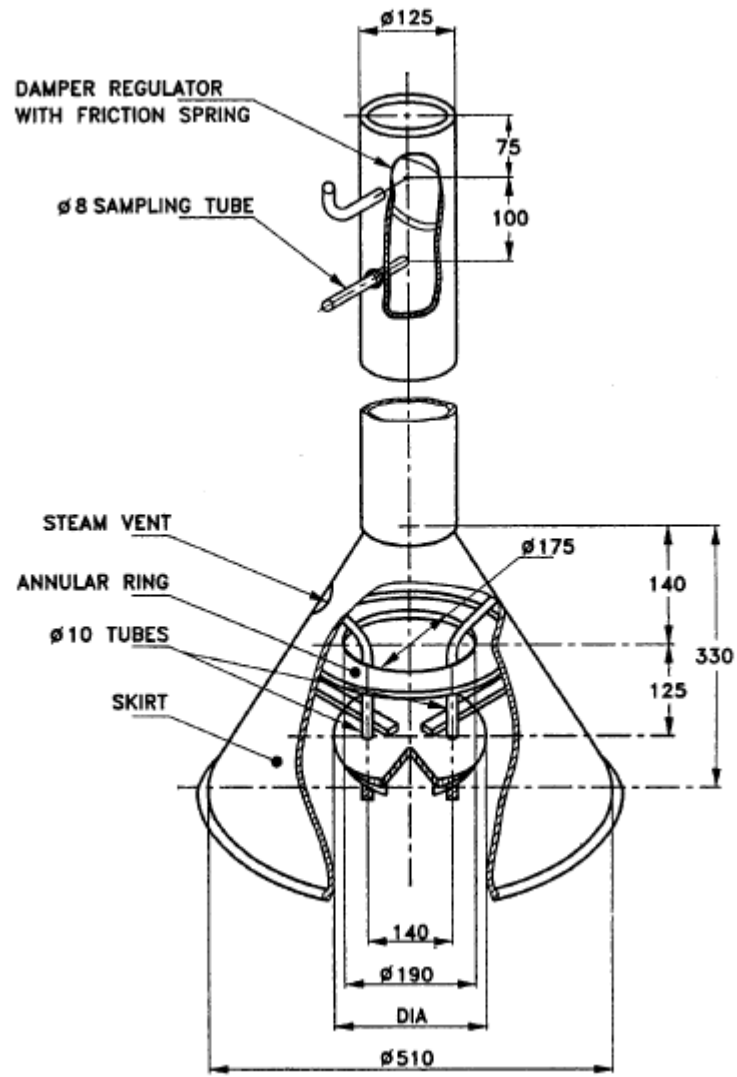
C.1 The appliance shall be set-up in accordance with 16 in addition, before starting the test, a pan of 190 mm Diameter and of suitable height and containing water sufficient for the test shall be placed over the burner. In addition, a collecting hood (see Fig. 3) suitable for the burners under examination shall be obtained

C.2 The hood shall be so designed that, while not interfering in any way with the normal combustion of the burner, it collects a fairly high proportion of the products of combustion. Also, it shall be such that the sample collected represents the whole of the combustion gases and not those from any particular point.

C.3 When using this hood, the damper provided shall be set or additional flue pipe added, so that spillage of the flue gases around the skirt is just prevented. With the sample hood in position over the burner under investigation, gas at inlet pressure of 2 452 kN/m² (25 gf/cm²) shall be admitted and the burner operated for a few minutes before sampling commenced. The reason for this being that during the first few minutes the burner is warming up and the proportion of carbon monoxide may be high. However, this is not dangerous provided the burner works satisfactorily after heating up.

C.4 Any of the recognized methods having the prescribed accuracy may be used for gas analysis. For carbon monoxide, it is recommended that co-indicator of prescribed accuracy or iodine pentoxide method or catalytic method, for example, Drager method, the Katz method or infra red analysis methods may be used. Carbon dioxide may be tested with an Orsat apparatus, the Haldane apparatus or by infra red analysis.

C.5 Each burner shall be examined with gas at 2452 kN/m² to 3432 kN/m² (25 gf/cm² to 35 gf/cm²) inlet pressure. It shall also be noted that each burner is tested separately or with all the possible combination of the other burners operating.



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Annex D (normative)

thermal efficiency Test

D.1 The test shall be carried out by weighing the gas used. The gas shall be taken from a small bottle containing LPG weighing 1 kg to 2 kg. The bottle shall be fitted with an 'On/Off' valve and shall be connected to a regulator which, in turn, shall be connected to a pressure gauge and to the appliance, a second 'on/Off' gas valve shall be inserted in the gas ways upstream of the regulator as near as possible to the gas bottle. A typical layout of set-up necessary for this test is shown in Fig. 4.

D.2 The gas shall be passed at 2942 kN/m² (30 gf/cm²) inlet pressure through the stove for a few minutes to purge the system of air and to establish the gas pressure required. Only one burner of the appliance shall be tested at a time and during the test all gas delivered to the stove shall flow through the jet of the burner being tested. The pan shall be selected and loaded in accordance with the requirements given in Table 1 and placed centrally over the burner being tested. The temperature of the water T_t contained shall be noted and recorded as long as it remains constant.

D.3 The bottle shall be disconnected, weighed. Reconnected and valves (1) and (2) opened. The gas control tap shall then be opened and the gas shall be ignited. The water shall be allowed to warm up to about 80 °C when stirring is commenced and continued until the end of the test. The burner shall be put off when the temperature of water reaches 90 °C + 1°C. The stirring shall be continued and the maximum temperature t₂ shall be noted.

D.4 Next, the valves on the bottle and the gas line shall be closed and the bottle shall be disconnected and reweighed. It is thus possible to estimate the mass of gas used during the period taken for the water to heat up. Thermal efficiency shall be calculated by the following formula:

$$E = \frac{100 (G + W) (t_2 - t_1)}{MK}$$

E = thermal efficiency of the burner in percent,

G= quantity of water in the vessel in kg,

W= water equivalent of the vessel complete with stirrer and lid

T₂ = final temperature of water in °C,

T₁ = initial temperature of water in °C,

M= gas consumption in kg,

K= calorific value of the gas in kcal/lcg.

Gas rate at STP l/h	Pan diameter (external) mm ± 5	Pan height (external) mm	Total pan mass with lid g $\pm 10\%$	Mas of water in pan Kg
up to 40	180	100	356	2.0
41-50	205	110	451	2.8
51-60	220	120	519	3.7
61-70	245	130	632	4.8
71-80	260	140	750	6.1
81-95	285	155	853	7.7
96-107	295	165	920	9.4

1 Distilled water (RS EAS 123) shall be used for test.
2 The pan shall be cylindrical with flat bottom.
3 The finish of the pan bottom from inside shall always be bright.
4 Above 107 l/h, pans shall be specially constructed to conform, as far as possible, with the principles used in formulating this table.

D.5 In performing the thermal efficiency test, the following points shall be noted:

- a) The set-up shall be carefully checked for leak, before and after the test. If a leak is found after the tests, the results should be cancelled and the test repeated.
- b) The room shall be free from draught.
- c) The initial temperature of the room shall be between 25 °C and 30 °C. The water temperature shall be within ± 2 °C of the actual room temperature.
- d) The net calorific value of gas is used. If this is not determined experimentally, the value may be taken as 10900 kcal/kg for calculation.
- e) At the start of the test, the burner shall be at room temperature.
- f) The temperature of the water shall be measured by means of a mercury-in-glass thermometer of accuracy of 0.5 C the bulb of which is immersed to half the depth of the water in vessel.
- g) Stirring shall be effected by means of a horizontal loop of 3 mm metal rod attached to an upright, which passes through a 6 mm, hole drilled in lid.
- h) This test need not be performed on burners with a gas rate of less than 20 l/h at 2942 kN/m² (30 gf/cm²) inlet pressure.
- i) Accuracy of weighing balance used shall be of 0.1 g for consumption measurement and 1 g for the other weights
- j) Specific heat of aluminium is 0.214.

- k) For conducting thermal efficiency test, gas from the commercial cylinder (bottle) of LPG, the first two-thirds of which has been allowed to evaporate (to waste or in vapor withdrawal use), the remaining one-third shall be used for test. The use of last 1 or 2 kg of gas shall be avoided as this may contain heavy ends.

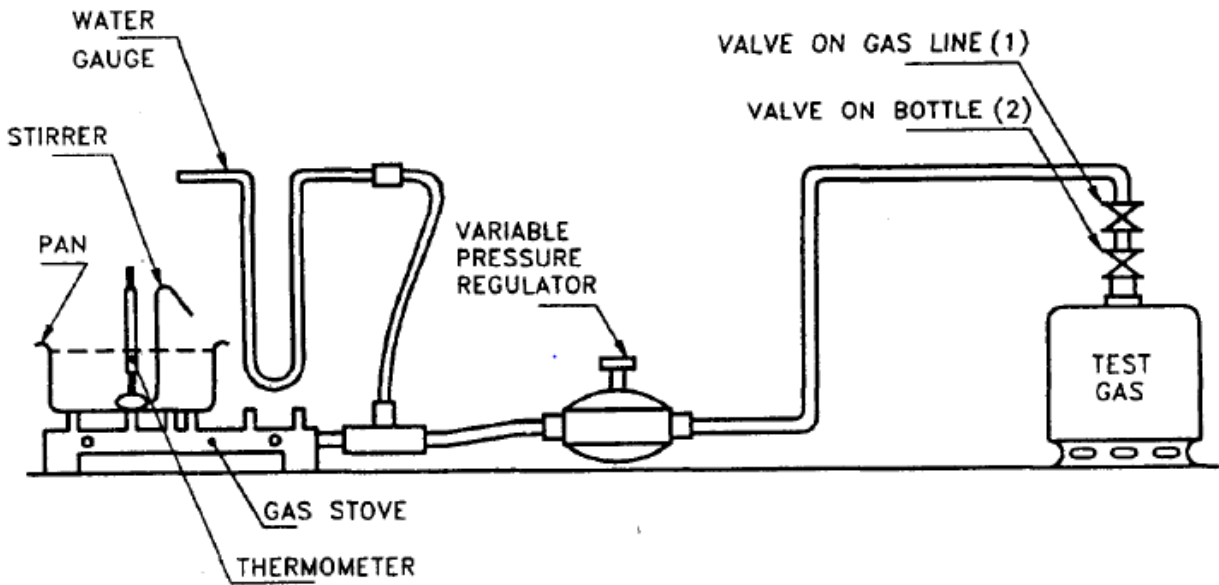


FIG. 4 TEST SET-UP FOR THERMAL EFFICIENCY BY WEIGHT

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