SRI LANKA STANDARD 451 : 1979
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SPECIFICATION FOR DOMESTIC (LOW-PRESSURE) COOKERS FOR USE WITH LIQUEFIED PETROLEUM GASES

BUREAU OF CEYLON STANDARDS

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SLS 451 : 1979

Gr. 10

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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This Standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD

SPECIFICATION FOR DOMESTIC (LOW PRESSURE) COOKERS FOR USE WITH LIQUEFIED PETROLEUM GASES

FOREWORD

This Sri Lanka Standard Specification has been prepared by the Drafting Committee of the Bureau on Liquefied Petroleum Gas Cookers. It was approved by the Mechanical Engineering Divisional Committee of the Bureau of Ceylon Standards and was authorised for adoption and publication by the Council of the Bureau on 1979-01-16.

This standard covers cookers that use liquefied petroleum gas as fuel, designed to operate on low pressure supply of gas, intended for domestic use. It will be extended to cover ovens, hot plates, and grillers as and when the necessity arises. A separate standard will cover cookers that use liquefied petroleum gas at high pressure supply used commercially like in hotels, hospitals etc. where cooking is done on a large scale.

SI units have been adopted with alternate metric units within brackets wherever relevant.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test or observation shall be rounded off in accordance

with CS 102*. The number of figures to be retained in the rounded off values shall be the same as that of the specified value in this standard.

Assistance gained from the publications of the British Standards Institution, the Indian Standards Institution and the South African Bureau of Standards in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This standard covers the safety, the performance, and the constructional requirements for cookers that use liquefied petroleum gas (at low pressure) as fuel and intended for domestic use.

2 DEFINITIONS

For the purpose of this specification the following definitions shall apply:

2.1 defective: A cooker that fails in one or more respects to comply with the requirements of the standard.

2.2 domestic (low pressure) cooker: A cooker that which is designed to operate on a normal supply pressure of 2.75 kPa** (280 kgf/m^2).

2.3 normal test pressure: The gas pressure of 2.75 kPa** (280 kgf/m^2) measured at the inlet to the cooker.

2.4 reduced test pressure: The gas pressure of 1.96 kPa** (200 kgf/m^2) measured at the inlet to the cooker.

2.5 upper test pressure: The gas pressure of 2.94 kPa** (300 kgf/m^2), measured at the inlet to the cooker.

**CS 102 Presentation of numerical values.*

***1 kPa = 10^3 Pa (pascal) = 10^3 N/m^2*

3 CONSTRUCTIONAL REQUIREMENTS

3.1 General

3.1.1 Cookers shall be constructed to operate safely on liquefied petroleum gas (LPG). It shall be designed for a normal working pressure of 2.75 kPa* (280 kgf/m^2).

3.1.2 Cookers shall comprise one or more burners, but shall not incorporate a pressure regulator.

3.1.3 The construction and the assembly of a cooker and of all its components shall be acceptable and in accordance with all reasonable concepts of safety, substantiality, and durability.

3.1.4 All components that may require regular cleaning, replacement, or adjustment by the user shall be readily accessible, and no special tools shall be required for their removal and replacement.

3.1.5 Parts that are not permanently secured or that are intended to be removed for cleaning, replacement, or adjustment shall be such that they are easily replaced correctly but difficult to assemble incorrectly, and that they cannot be replaced or adjusted in a way that could cause operation of the cooker to become dangerous.

3.1.6 Burners and parts of burners (other than jets of different capacity) may be interchangeable, provided that the performance of the cooker is unaffected by any such change.

3.1.7 Cookers shall be so designed that, when installed correctly, it is not easily overturned and removable parts are not liable to be inadvertently dislodged in normal use.

3.1.8 No non-metallic material normally in contact with gas shall deteriorate in use or shall, when tested

in accordance with 7.10, swell to more than 120 per cent of the original volume.

3.2 Gas supply lines

3.2.1 The gas supply lines shall be so located that they are not subjected to excessive heat, and shall be acceptably supported. In the case of supply lines to which connections are made for burners, the support shall be such as to prevent turning or displacement (or both) when outside connections are made.

3.2.2 Concealed tubes and fittings shall be of an inherently corrosion resistant material or shall be so coated as to render them corrosion resistant. Metal tubing such as aluminium shall not be used in any position in which corrosion due to contact between dissimilar metals might occur.

3.2.3 Jointing compounds and supply line gaskets shall be resistant to the action of the gas.

3.2.4 Bends in tubing shall be smooth and without any appreciable reduction in the cross-sectional area. The tubing shall be free from defects caused by bending, welding, or other manufacturing processes. It shall have been annealed (where necessary) to remove internal stresses, and shall be free from flux.

3.2.5 Cookers shall be provided with flexible tubing of sufficient length fitted to the inlet to the cooker for connecting the cooker with the gas supply. Hose clips shall be provided at both ends of the tubing to enable the ends to be fastened tightly on to the gas supply and inlet connections. The tubing shall be homogeneous and substantially free from odour and shall be resistant to outdoor exposure. The wall shall be clean and free from all visible defects as lumps, blowholes, cracks, etc., and the bore shall be clean and free from

loose particles which might be carried forward by the gas. The bore shall be 8 mm in diameter subject to a tolerance of ± 0.4 mm. The tubing shall be capable of passing the following tests:

a) When tested in accordance with **7.11**, shall show no signs of splitting, excessive cracks or leakage when exposed to a temperature of 70 °C for 168 hours and then subjected to an air pressure of 70 kPa* (0.71 kgf/cm²) at room temperature.

b) When tested in accordance with **7.12**, under an internal air pressure of 350 kPa* (3.6 kgf/cm²) for 5 minutes the increase in outside diameter shall not be more than 15 per cent and there shall be no sign of leakage.

c) When tested in accordance with **7.13**, the gas pressure shown on the manometer shall not drop by more than 1 kPa* (100 kgf/m²).

d) When tested in accordance with **7.14**, the tubing shall not burn to either of the outer marks within the test period of 45 s.

e) When tested in accordance with **7.15**, after removal of the force 125 N (12.7 kgf), the tubing shall not show subsequent deformation or collapse nor shall it leak when subjected to an internal air pressure of 75 kPa* (0.77 kgf/cm²).

3.3 Gas valves

3.3.1 All valves shall, when viewed from the valve handle, rotate in a clockwise direction to close, and shall be readily removable from the gas supply line for servicing. They shall be so designed and constructed that (a) in normal operation, it is impossible for

**1 kPa = 10^3 Pa(Pascal) = 10^3 N/m²*

the valve stem to be completely withdrawn inadvertently and (b) with reasonable application of lubricant, for the gas passage to become blocked.

3.3.2 For valves of the "high-low" type that embody a single jet orifice the "OFF" position of the handle shall be at one end of the full arc of its rotation.

3.3.3 Valves with adjustable stops shall be permitted, provided that the stops cannot inadvertently become unadjusted.

3.3.4 In valves that are fitted with helical springs, the springs shall have squared ends.

3.3.5 The design of valves that are provided with means of adjustment to ensure gas tightness shall be such that the adjustment cannot be affected by normal operation of the valve.

3.3.6 Each burner shall have a separate valve.

3.3.7 The identity of the valve that controls each burner shall, unless obvious, be clearly indicated.

3.3.8 When tested in accordance with 7.9, valves shall show no sign of breakage, jamming, binding, excessive wear, or leakage.

3.4 Valve handles

3.4.1 Each valve handle shall be clearly and durably marked in such a manner that the mark(s), by virtue of their position relative to fixed, durable marks on the casing behind the handle, clearly indicate the "fully open" and "fully closed" settings of the valve. These markings shall be easily distinguishable from a distance of 3 m.

3.4.2 In all, handles the cavity for the valve stem shall be so designed that the handle cannot be fitted incorrectly.

3.4.3 Valve handles shall be so designed that they cannot move accidentally, either under their own weight or when caught by clothing. When this is achieved by means of an automatic locking device, the device shall be easily operated by hand.

3.5 Burners and burner supports

3.5.1 The body of a burner (including the mixer head, mixer tube, and burner head) shall be of acceptable and durable construction and suitable for its purpose. Primary air ports shall not be covered by a filter medium.

3.5.2 Burners shall be so designed and constructed as to effectively prevent incorrect assembly and installation, leakage, and deformation, and loosening of parts in service.

3.5.3 When a cooker is fitted with two or more burners at least one burner shall allow simmering.

3.5.4 Burners shall be readily removable from their supports without the use of tools.

3.5.5 Burner supports shall be of rigid construction and shall be held securely in place. When a gas supply pipe is used as part of a support, bolt holes shall not enter the gas way unless adequate provision is made to ensure permanent gas-tightness. Supports shall be such that the burner is permanently and rigidly maintained in a horizontal position and is not easily tilted or displaced.

3.6 Ignition of burners

It shall be possible to ignite all burners easily and without danger with a lighted match stick.

3.7 Cooking tops, top covers, grids, etc.

3.7.1 Removable cooking tops that have integral aeration bowls shall be so designed as to prevent incorrect placement of the air openings with respect to the burners.

3.7.2 Grids shall be so designed that they cannot be firmly placed in any other than the correct position.

3.7.3 On a cooker that has three or more burners, at least one grid shall be so designed that it will support a 100-mm diameter utensil when placed centrally over the burner.

3.8 Finish

3.8.1 All metal parts of cookers shall be of an acceptable corrosion resistant material or shall have a corrosion resistant finish. Tests for finishes in Appendices A to H are recommended for the appropriate case and are given for purpose of guidance.

3.8.2 The finishes shall, on visual examination, show no defects such as pinholes, blisters, or exposed area of metal which might give rise to unduly rapid deterioration in use.

3.8.3 Ornamental trimmings shall be substantial, (that is: shall not easily break, buckle, dent, or warp) and shall be fitted in a neat manner.

3.8.4 All edges and corners shall be smooth, and all exposed surfaces shall be easily cleanable.

4 OPERATIONAL REQUIREMENTS

4.1 General

4.1.1 When tested in accordance with 7.4, the heat input rate of burners shall be as follows:

4.1.1.1 *Burners*

a) At least 8.0 MJ/h*for at least one burner.

b) Not less than 85 per cent and not more than 115 per cent of the value specified by the manufacturer (see 5.3.3).

4.1.1.2 *Simmering*

Such as to allow the burner to pass the test given in 7.4.1.2 a).

4.1.2 When tested in accordance with 7.3, the gas supply lines and all components (valves etc.) that are subjected to normal working pressure shall show no sign of leakage.

4.2 Burners

4.2.1 During any test carried out in accordance with 7 and involving the burning of burners.

a) all the burners shall ignite, operate, and extinguish without undue noise,

b) no soot shall be deposited on a utensil used in a test.

4.2.2 When tested

4.2.2.1 In accordance with 7.4.1.2 b) simmering burners shall show no objectionable lifting, floating, blowing or snapping back, or sign of being otherwise adversely affected.

*$1MJ = 10^6 J$

4.2.2.2 In accordance with 7.4.1.2 c) the flame of no burner shall be extinguished.

4.2.2.3 In accordance with 7.4.2.2 b) the flame of no burner shall be extinguished.

4.2.3 When burners are tested in accordance with 7.6, flame travel shall be complete.

4.2.4 When tested in accordance with 7.5, the time taken for lighting (and relighting after extinguishing) every burner shall be 4 s, max.

4.2.5 When tested in accordance with 7.7, the thermal efficiency of burners shall be not less than 50 per cent.

4.3 Surface temperatures

When tested in accordance with 7.8, the surface temperatures of the different parts of a cooker shall not, after 2 hours of operation, exceed the appropriate values given in Column 2 of Table 1.

TABLE 1 Surface temperature limits

Parts (1)	Rise above original ambient temperature, °C max. (2)
Exterior of sides, top, and back	100
Manually operated knobs, handles and buttons	45

4.4 Convection temperatures

When tested in accordance with **7.8**, the temperature measured below the cooker and on the wall behind the cooker shall not exceed 100 °C.

5 MARKING AND INSTRUCTIONS

5.1 Marking

In addition to the markings required in terms of **3.3.7** and **3.4**, each cooker shall be legibly and durably marked with the following:

a) the manufacturer's name or trade name or trade mark and address;
b) the normal working pressure, in kilopascals (or in kgf/m^2);
c) the type of gas for which it is intended;
d) the maximum gas consumption of cooker in kilograms per hour for each burner;
e) any instructions necessary for its safe operation.

5.2 Grouping of marks

The markings specified in **5.1** shall be grouped together either on the cooker itself or on a name plate securely fixed to it.

5.3 Instructions

Each cooker shall be accompanied by the following instructions and information (on cards or in a booklet).

5.3.1 Instructions for the correct and safe installation of the cooker.

5.3.2 Instructions for the correct, safe operation and maintenance of the cooker.

NOTE - These instructions shall convey to the user the possible hazards in the handling, operations, and

maintenance aspects, shall be concise and unambiguous, shall have the danger points indicated (preferably in red).

5.3.3 The maximum heat input rate (at normal working pressure and based on the test gas) in megajoules per hour for each burner.

5.3.4 The information required in terms of 5.1 a), b), c) and d).

6 SAMPLING

6.1 Lot

Not more than 500 cookers of the same type and construction, from one manufacturer, submitted at one time for inspection and testing.

6.2 Scale of sampling

From the lot take at random a sample of the size shown in Column 2 of Table 2 relative to the appropriate lot size shown in Column 1. To ensure random selection of samples random number tables shall be used.

TABLE 2 Sampling scheme

Lot size (1)	Sample size (2)
Less than 51	1
51 to 100	3
101 to 200	6
201 to 500	10

7 INSPECTION AND METHODS OF TEST

7.1 Inspection and sequence of tests

7.1.1 *Inspection*

Inspect the sample taken in accordance with 6.2 for compliance with all the requirements that are not tested in 7.3 to 7.15 (inclusive).

7.1.2 *Sequence of tests*

Carry out the tests specified in 7.3 to 7.15 with the tests in 7.3 to 7.10 being carried out in the order in which they are given (see also 7.2.5).

7.2 Conditions of test

To prevent overheating during any test in which burners are required to operate, a utensil containing water may be placed over the burner(s), provided that this will not interfere with the test procedure or affect the test results.

7.2.1 *Ambient temperature and pressure*

Unless otherwise specified by the purchaser, the test shall be carried out at an ambient temperature of 27 ± 5 °C and an ambient atmospheric pressure of 101.3 ± 2.0 kPa* (1.01 ± 0.02 kgf/cm²).

7.2.2 *Test gas*

Unless otherwise specified, the tests shall be carried out with liquefied petroleum gas, in which

a) Content of (C_1 + C_2) hydrocarbons shall not exceed 5.0 per cent by mass.

b) Content of (C_3 + C_4) hydrocarbons shall not be lower than 93 per cent by mass.

*1kPa = 10^3 Pa(pascal) = 10^3 N/m²

c) The calorific value shall be within 49.0 and 55.0 MJ*/kg (gross) and the relative density shall be 1.50 to 2.00 (air = 1).

7.2.2.1 The test gas supply to the cooker shall be equipped with a water manometer.

7.2.3 *Test room*

The room shall be adequately ventilated but free from perceptible draughts. The carbon dioxide and carbon monoxide contents of air in the room shall not, during the test given in 7.6, exceed 0.2 per cent (v/v) and 0.002 per cent (v/v) respectively.

7.2.4 *Test pressure*

During a test the supply pressure shall not vary by more than $\pm$ 0.025 kPa* (2.5 kgf/m^2) from the specified value.

7.2.5 *Test conditions*

The cooker under test shall be set up in accordance with the manufacturer's instructions and be at test temperature at the start of each test and before testing, be operated for long enough to remove any temporary finish that might interfere, with observations, and to dry thermal insulation.

7.3 Gas-tightness test

Connect the inlet of the cooker (with a bubble-type leak indicator in series in the line) to an air supply at a pressure of 15 kPa** (0.15 kgf/cm^2). Close all gas valves and check the leak indicator for signs of leakage. Securely seal all gas outlets and air inlets on each burner. Open (and, after the completion of each check, close) individual gas valves in turn and

**1MJ = 10^6 J*

***1kPa = 10^3 Pa(pascal) = 10^3 N/m^2*

check the leak indicator for signs of leakage.

After each operation allow an interval of approximately 1 minute for pressure surges to die away.

NOTE - The use of other acceptable methods of testing for compliance with 4.1.2 *shall be permissible.*

7.4 Heat input rate and stability of flames of burners

7.4.1 *Simmering (burners)*

7.4.1.1 *Apparatus*

A flat-bottom, straight-side aluminium cooking utensil of nominal base thickness 1.60 mm and of height and diameter as shown in Fig. 1.

7.4.1.2 *Procedure*

a) Put 3.5 litres of boiling water into the utensil, place the utensil on the simmering burner under test and if, at normal test pressure, a setting of the burner (between its maximum and minimum operational positions) can be found that keeps the water in the utensil just boiling, deem the simmering burner to have passed the test. Then, if relevant and without extinguishing any previously tested burner, repeat the test on each of the other simmering burner on the cooker. Then remove the utensil but do not extinguish any simmering burner before completing the procedure given in b) and c) below.

b) Quickly open and close the gas valve to any other burner and check for compliance with 4.2.2.1.

c) Light the remaining burners, put 2 kg of water into the utensil (see 7.4.1.1), drop the utensil from a height of 50 mm on to the lighted burner, and check all flames for compliance with 4.2.2.2.

7.4.2 *Burners*

7.4.2.1 *Apparatus*

Stop-watch, weighing machine.

7.4.2.2 *Procedure*

a) Take a supply of gas from a bottle of liquid of low pressure type supplied commercially for domestic use and conforming to the requirements given in 7.2.2. Insert an ON/OFF gas valve in the gas-ways, upstream of the gas-way as near as possible to the gas bottle.

Open the gas supply and adjust the inlet pressure to the normal test pressure and then shut off all valves. Disconnect the bottle and weigh, re-connect and open the gas supply. Open the gas valve to any burner, record the time (accurately) and immediately light the burner. Allow the burner to burn for a period corresponding to at least the use of gas of mass given by 1 main scale reading of the weighing machine. Shut off the gas valve to the burner and record the time (accurately). Shut off gas supply and the ON/OFF valve, disconnect the bottle and re-weigh. Repeat the above procedure on every other burner on the cooker and calculate the heat input rate of each burner from the following formula:

$$\text{Heat input rate, MJ/h*} = \frac{C \times m}{H} \times 3\,600$$

where,

C = gross calorific value of gas by mass, MJ/kg*,

m = mass of gas used (difference in initial and final mass of bottle), kg

H = duration of test period (difference between the times recorded), s

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*$1MJ = 10^6\ J$

The gross calorific value of the gas if not determined experimentally, the value may be taken as 49.0 MJ/kg* for calculation purposes.

b) Re-adjust the gas supply to the cooker to the upper test pressure and, test each burner (in turn) as follows:

Adjust the gas flow to the burner to 50 per cent of the maximum input rate (see 5.3.3) and subject it to a current of air having a velocity of 1.8 ± 0.2 m/s (so varying the direction and the angle of the current that it is applied at all angles other than downwards onto the burner). During the test check for compliance with 4.2.2.3.

7.5 Time limits for ignition

Open the gas supply and adjust the inlet pressure to the normal test pressure. With the burners supplied with gas at a rate equal to the maximum input rate relevant to the burner under test, test each burner for compliance with 4.2.4.

7.6 Ignition of burners

Open the gas supply and adjust the inlet pressure to the reduced test pressure. Then test each burner as follows:

Adjust the gas flow to the burner to the maximum input rate, light a safety match, bring the flame in contact with one burner port only, and check the flame travel for compliance with 4.2.3.

7.7 Thermal efficiency of burners

7.7.1 *Apparatus*

A utensil as shown in Fig. 1, weighing machine.

**1MJ = 10^6 J*

7.7.2 *Procedure*

Determine the water equivalent of the utensil and then put enough water (at ambient temperature) into the utensil to bring the total mass to the equivalent of 3 kg of water in the case of burners having a heat input rating not exceeding 13.0 MJ/h* and 5 kg of water in the case of burners having a rating over 13.0 MJ/h*. Open the gas (conforming to **7.2.2**) supply and adjust the inlet pressure to the normal test pressure and shut off all valves. Disconnect the bottle and weigh, reconnect and open gas supply and ON/OFF valve. Light a burner and immediately place the utensil on the burner. Open the burner valve fully and heat the water to a temperature of 80 ± 2 °C. Shut off the burner and record the maximum temperature reached. Shut off the gas supply and ON/OFF valve, disconnect the bottle and reweigh. Repeat the above procedure on each other burner on the cooker, cleaning the outside of the bottom of the utensil thoroughly before every test. Calculate the thermal efficiency of each burner from the following formula:

$$\text{Thermal efficiency, per cent} = \frac{0.004\ 19\ W\ (t_2 - t_1)}{C \times m} \times 100$$

where,

W = total mass (as water), kg

t_1 = initial temperature of water, °C

t_2 = maximum temperature recorded, °C

m = mass of gas consumption (difference in initial and final mass of bottle), kg

C = gross calorific value of the gas by mass, MJ/kg*

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*$1MJ = 10^6\ J$

The gross calorific value of the gas if not determined experimentally, the value may be taken as 49.0 MJ/kg* for calculation purposes.

7.8 Surface and convection temperatures

7.8.1 *Apparatus*

7.8.1.1 *Temperature measuring apparatus*

Suitable thermocouples and/or other acceptable apparatus for determining surface temperatures.

7.8.1.2 *Test rig*

A test rig as shown in Fig. 2, the number, positions, and spacing of the thermocouples shall be such as to ensure that the maximum convection temperature of the cooker is determined, and the thermocouples shall be solidly secured to the steel plates of the rig.

7.8.1.3 *Utensils*

Enough cooking utensils, each of diameter approximately 200 mm and capacity at least 3 litres, to supply each burner with a utensil.

7.8.2 *Procedure*

Place the cooker on the rig with its back facing the vertical section and about 50 mm away from it. Light a burner. Put 2.5 kg of water into a cooking utensil and place it on the burner. Repeat the procedure with the remaining burner(s). As soon as the water in the utensil starts to boil, reduce the gas flow rate until the water is just maintained at boiling point.

**1MJ = 10^6 J*

Two hours after the burners have been lit, measure the surface and convection temperatures and check for compliance with 4.4 and 4.5.

7.9 Performance test for valves

7.9.1 *Apparatus*

An apparatus that will cause the normal opening and closing operation of a valve at a rate of 10 cycles/min (each cycle consisting of one opening and closing operation) and that incorporates a device for counting the number of cycles.

7.9.2 *Procedure*

Remove the valve from the cooker, mount it in the apparatus, and subject it to a 50 000 test cycles. Then subject the valve to a test pressure of 15 kPa* (0.15 kgf/cm^2) and examine it for compliance with 3.3.8.

7.10 Resistance to swelling

Remove from the cooker a test sample (of suitable size) of each of the non-metallic materials that are in service, in contact with the gas. Determine the volume of each test sample and then immerse it in pentane or liquid N-butane at room temperature for 72 hours. Determine its volume again and calculate the swelling (if any) of each material.

7.11 Heat resistance test for supply tubing

Place a piece of the tubing in an ageing oven and leave it for 168 hours at 70 °C and inspect the tubing for signs of splitting or excessive cracks. Cool the tubing not rejected, to room temperature and inspect the assembly for signs of splitting, excessive cracks

*$1 kPa = 10^3$ Pa(pascal) = 10^3 N/m^2

or leakage at 70 kPa* (0.71 kgf/cm^2) air pressure under water for 5 min and for compliance with **3.2.5 a)**.

7.12 Resistance to pressure test for supply tubing

Immerse a portion of the test tubing in water for 5 min under an internal air pressure of 350 kPa* (3.6 kgf/cm^2), inspect increase in outside diameter and for signs of leakage and check for compliance with **3.2.5 b)**.

7.13 Resistance to kinking test for supply tubing

7.13.1 *Apparatus*

A jet which permits a flow of butane gas of 0.225 m^3/h at 2.6 kPa* (260 kgf/m^2).

7.13.2 *Procedure*

Connect one end of a straight length of the test tubing to a supply of butane gas and the other to a water manometer calibrated in 0.1 kPa* (10 kgf/m^2) and jet which will permit a flow of gas of 0.225 m^3/h at 2.6 kPa* (260 kgf/m^2) in such a way that about 0.6 m of tubing lies horizontally on the bench. Adjust the pressure of the gas to read 2.6 kPa* (260 kgf/m^2) on the manometer with the gas flowing through the orifice. Place a rule marked in millimetres on the bench alongside the tubing under test. Hold with the fingers two points on the tubing spaced 280 mm apart and bring them together so that the tubing takes the form of a loop (see illustration in Fig. 3). Hold the loop for 30 seconds and record any pressure drop shown on the monometer during this period and inspect for compliance with **3.2.5 c)**.

**1 kPa = 10^3 Pa(pascal) = 10^3 N/m^2*

7.14 Burning behaviour test for supply tubing when exposed to a small flame

7.14.1 *Apparatus*

Bunsen burner

7.14.2 *Procedure*

Support a length of not less than 150 mm of the test tubing horizontally. Make three marks on the tubing, the middle one approximately midway along the tubing with one on either side 50 mm from the middle mark. Direct a well aerated bunsen flame (approximately 1.8 MJ/h* and about 25 mm in diameter) on to the tubing so that the flame is horizontal, in the plane of the tubing and perpendicular to the axis of the tubing, the central mark being in the middle of the flame (see Fig. 4). Apply the flame for 5 seconds and then remove it for 1 second. Repeat the application of the flame until the material catches fire and continues to burn or until a total test period of 45 seconds has elapsed. If the material catches fire and continues to burn without further application of the flame, note whether the flame reaches either of the outer marks within 45 seconds of the commencement of the test and inspect for compliance with **3.2.5 d)**.

7.15 Resistance to crushing test for supply tubing

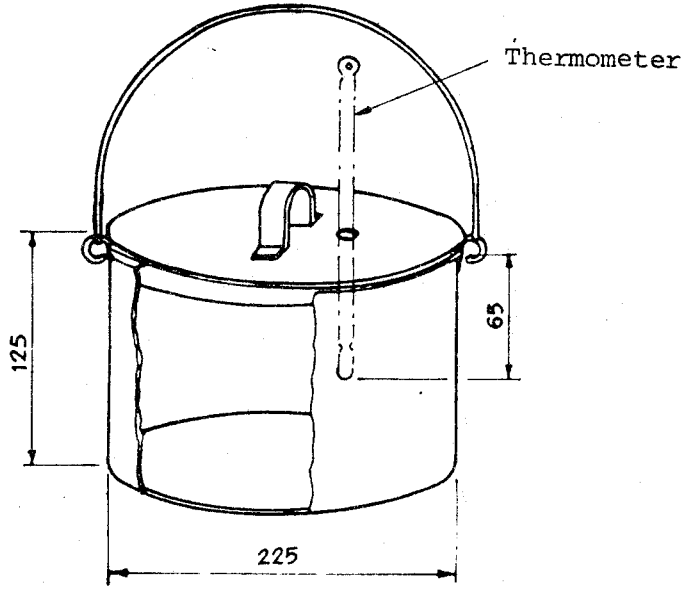
Subject the test tubing to a crushing force of 125 N (12.7 kgf) applied evenly over a length of 25 mm for 30 seconds and remove the force and subject it to an internal air pressure of 75 kPa**(0.77 kgf/cm^2) and inspect the tubing for compliance with **3.2.5 e)**.

**1 MJ = 10^6 J*

***1 kPa = 10^3 Pa(pascal) = 10^3 N/m^2*

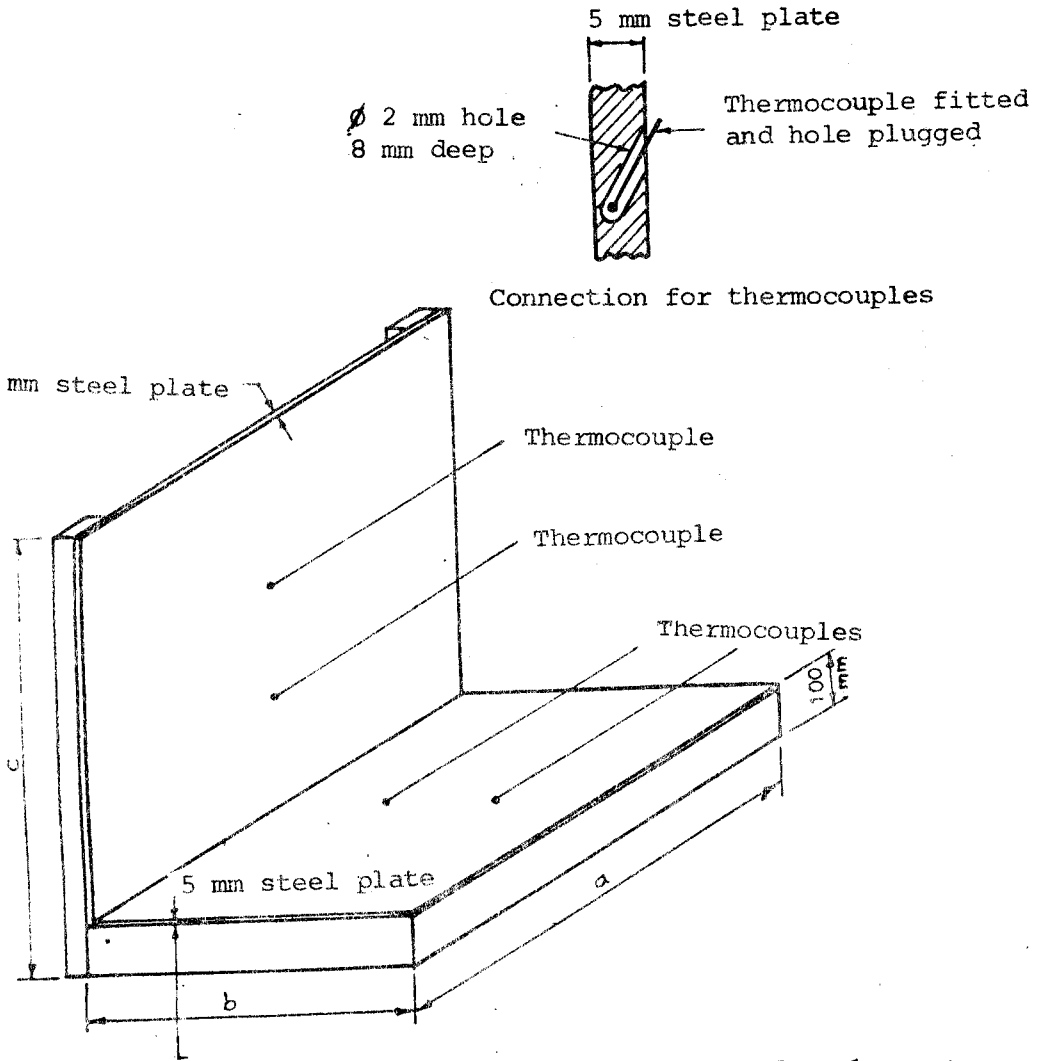
8 CONFORMITY TO STANDARD

The lot shall be deemed to comply with the requirements of this standard, if after inspection and testing as in **7**, of the samples drawn in accordance with **6.2** no defective is found.



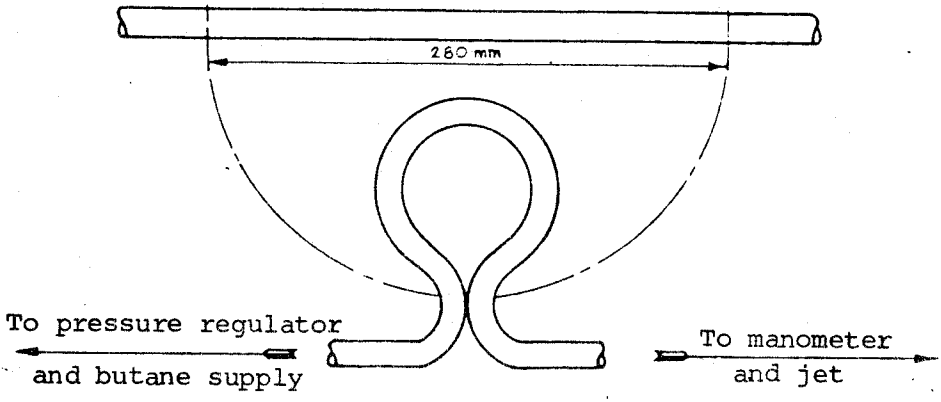
(Dimensions in millimetres)

FIG. 1 Cooking utensil



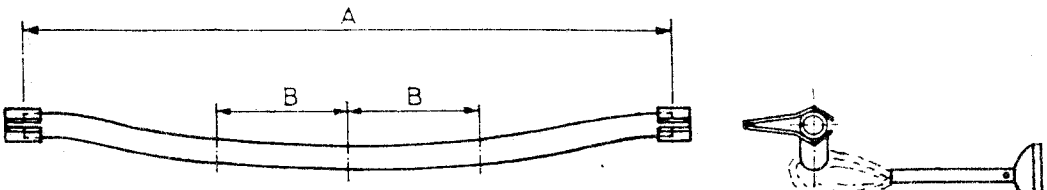
Dimensions a,b, and c such as to accomodate largest cooker under test

FIG. 2 Temperature measuring rig



(Dimensions in millimetres)

FIG. 3 Diagram illustrating kinking test



A - 150 mm

B - 50 mm

(Dimensions in millimetres)

FIG. 4 Test for burning behaviour

APPENDIX A

THICKNESS AND UNIFORMITY OF COATING OF GLAVANIZED FINISHES

The thickness and uniformity of coating of galvanized finishes is tested according to CS 121*. The coating shall be uniform and have a thickness not less than 44 μm** for all metal parts except in the case of nuts, bolts, screws, washers and threaded parts, in which case it shall be not less than 54 μm**. The uniformity of coating is tested for four one-minute and three one-minute dips for the respective categories.

APPENDIX B

ABRASION RESISTANCE TEST FOR VITREOUS ENAMEL FINISHES

B.1 APPARATUS

B.1.1 *Microscope :* A microscope with a magnification of eight times, and of such design that its body can be placed flat on the enamel surface and that the portion of the surface under test can be illuminated.

B.1.2 *Powder :* Feldspar of particle size 210 μm to 250 μm**.

B.1.3 *Mass :* A 1 kg mass having a circular base of diameter 30 mm.

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*CS 121 : 1971 *Methods of testing mass, thickness and uniformity of coating on hot dipped galvanized articles.*

***1 μm (micrometre) = 10^{-6} m*

B.1.4 *Chamois leather.*

B.2 PROCEDURE

Sprinkle the powder lightly over an area of about 150 mm² on the test surface, cover the powder with a piece of chamois leather, and place the mass on top of the part of the leather that overlies the powder.

Without applying additional pressure draw the weighted chamois leather backwards and forwards (10 times in each direction and through a distance of travel of approximately 13 mm) across the portion of the enamel surface on which the powder was sprinkled. Lightly dust off the surface to remove the powder and with the aid of the microscope inspect the surface for scratches.

B.3 PERFORMANCE

The coating shall show no scratches.

APPENDIX C

ACID RESISTANCE TEST FOR VITREOUS ENAMEL FINISHES

C.1 TEST SOLUTION

An aqueous solution containing 0.1 kg of citric acid per litre of water, prepared not more than 48 hours before use and maintained at test temperature.

C.2 PROCEDURE

Wash the test surface with soap and water, rinse, and dry by blotting (not rubbing) with a clean cloth. On each of at least three areas of the test surface so

place (by means of a small pipette or medicine dropper) several drops of test solution as to form a pool, and invert a 25-mm diameter watch glass over each pool. (Use just enough solution to fill, except for a small air bubble, in each inverted watch glass).

After 15 min remove the watch-glasses and immediately thereafter rinse the solution from the treated areas. Dry the test surface by blotting (not rubbing) with a clean cloth, within 2 hours of treatment proceed as follows:

a) *Visual examination*

Use partially diffused daylight (not direct sunlight) supplemented by means of artificial lighting to illuminate the test surface so that the total intensity of illumination approximates to that at an indoor point about 1 m from an outside window.

View the test surface from all angles (relative to the surface and to the light source) and determine whether the treated areas differ in appearance from the untreated surface.

b) *Dry rubbing test*

Pressing firmly with a No. 1B pencil, make several marks across the treated and untreated areas. Then rub these marks with a clean dry cloth.

C.3 PERFORMANCE

The coating shall show no visible stain and does not retain any pencil marks more tenaciously on the treated areas than on the un-treated areas.

APPENDIX D

MAR AND SCRATCH RESISTANCE TEST FOR ENAMEL PAINT FINISHES

D.1 APPARATUS

D.1.1 Needle and arm

A needle with a hardened steel hemispherical point of 1-mm diameter, fixed vertically to the end of a counterpoised horizontal arm which is long enough to allow the needle to move across 9 cm of the test surface. The horizontal arm provides for the loading of weights directly above the scratching needle and it may be set in complete equilibrium on its fulcrum by adjusting the counterweight before weights are loaded above the needle.

D.1.2 Weights

A set of forty 50-g weights.

D.1.3 Base with sliding panel holder

The sliding panel holder to which the component under test can be attached, and which moves freely and automatically on its base under the loaded needle (which must be normal to the test surface) at a speed of about 3 cm per second.

D.1.4 Electrical current supply and ammeter

The scratching needle, component under test, and ammeter are connected in series with an electric current supply so that when the coating is penetrated the needle makes electrical contact with the underlying metal. This penetration is indicated by a flow of current through the ammeter.

D.2 PROCEDURE

Set the horizontal arm in equilibrium. Clamp the component under test to the sliding panel holder with the test surface upwards. Load the needle with 0.4-kg weight. Lower the needle carefully on to the test surface while starting to slide the holder. Alternatively, put the end of the needle on a razor blade so that the needle can slide off from the sharp edge of blade on to the test surface. Slide the panel holder at a uniform speed of approximately 3 cm per second for a distance of about 9 cm. Inspect whether the coating is penetrated and using a 10-power lens examine the edges of the groove to see whether they are ragged or smooth. Repeat the test on various other places on the component. Load the needle with 2-kg weight and repeat the above procedure.

D.3 PERFORMANCE

The enamel coating shall

a) not be marked under a load of 0.4 kg, and

b) withstand a load of 2 kg without the scratch so produced penetrating through to the underlying metal or having jagged edges.

APPENDIX E

DETERGENT RESISTANCE TEST FOR ENAMEL PAINT FINISHES

E.1 APPARATUS AND MATERIAL

E.1.1 *A water bath,* maintained at 74 ± 1 °C.

E.1.2 *Detergent solution*

A detergent solution containing 0.5 per cent (by mass) of the following detergents dissolved in distilled water:

	Mass, per cent
Sodium pyrophosphate ($Na_4P_2O_7.10\ H_2O$)	51.0
Sodium sulphate, anhydrous	16.0
Sodium alkylaryl sulphonate (100 per cent solids and 100 per cent active)	23.0
Sodium metasilicate, soluble	8.5
Sodium carbonate, anhydrous	1.5
	100.0

E.2 PROCEDURE

Place the detergent solution, contained in a suitable beaker, in the water bath and, after it has reached temperature equilibrium with the water bath immerse approximately 5.0 cm^2 area of the component under test in the hot detergent solution for 24 hours. Maintain the detergent solution at the correct strength during the test by adding distilled water when necessary. Remove the component, wash thoroughly with running water using a soft sponge, gently wipe dry with a chamois leather cloth, and examine the coating immediately and again after a 2-hour recovery period under standard conditions.

E.3 PERFORMANCE

The coating shall after immersion in detergent solution for 24 hours show no blistering, wrinkling, or loss of adhesion and not more than a slight softening or colour change or both immediately after removal from the solution. After a two-hour recovery period the immersed portion of the coating shall show not more than a slight loss of gloss.

APPENDIX F

FOOD STUFFS AND RELATED CHEMICALS RESISTANCE TEST FOR ENAMEL PAINT FINISHERS

F.1 REAGENTS

F.1.1 *Citric acid solution*

A 10 per cent aqueous solution in distilled water.

F.1.2 *Ethyl alcohol*

A 50 per cent aqueous solution in distilled water.

F.1.3 *Beverages*

a) A cola type beverage complying with the requirements of CS 183*.

b) Orange squash complying with the requirements of SLS 214**.

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*CS 183 Carbonated beverages.

**SLS 214 Fruit syrups, squashes and cordials.

F.1.4 *Sauce*

Tomato sauce complying with the requirements of SLS 260*.

F.1.5 *Mustard*

Prepared mustard.

F.1.6 *Oil mixture*

A mixture containing equal proportions (by mass) of lard oil and oleic acid.

F.2 PROCEDURE

Place the test component in a horizontal position under standard conditions, and, using a separate test area on the component for each reagent, form a small pool of the reagent on the coating and cover it with a watch glass. Allow the reagent to remain in contact with the coating for the following periods:

a) Acid, alcohol, and beverages: 16 hours

b) Tomato sauce, and oil mixture: 6 hours

c) Mustard: 1 hour

Wipe off the reagents after the appropriate exposure period has expired and wash with mild soap under running water, using a soft sponge, and then gently wipe dry with a chamois leather cloth. Inspect the component immediately and again after a two-hour recovery period under standard conditions.

F.3 PERFORMANCE

The enamel coating after exposure to the action of acid, alcohol, beverages condiments and fat shall show no blistering, wrinkling, or loss of adhesion and not more

SLS 260 Tomato sauce (Ketchup)

than slight softening or change in colour. After the two-hour recovery period the exposed portions shall be indistinguishable from the un-exposed portions, except in the case of portions exposed to mustard where slight colour change shall be permitted and in the case of areas exposed to fat, where slight colour change, slight softening and slight swelling shall be permitted.

APPENDIX G

SALT SPRAY RESISTANCE TEST FOR ENAMEL PAINT FINISHES

G.1 APPARATUS

G.1.1 Exposure chamber

The chamber shall be made from, or coated with a corrosion-resistant material*, and shall be constructed in such a manner that the spray circulates freely and equally about all components under test.

G.1.2 Racks for supporting test component

The racks shall be made from or coated with, a corrosion-resistant material and shall be so constructed that the components under test are held at an angle of 15 degrees from the vertical, without touching each other or any other metal, and without any salt solution dripping from one component on another.

G.1.3 Salt solution sprayer

The sprayer shall be capable of producing a finely-divided salt solution spray (of at least to an extent

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**"Stainless" steel is normally not resistant to chloride solution.*

produced by a common hand operated household insecticide-sprayer type).

G.2 SALT SOLUTION

G.2.1 Salt

The salt used shall be sodium chloride which does not contain more than 0.1 per cent sodium iodide and not more than 0.3 per cent total impurities, calculated on the dry basis.

G.2.2 Water

The water used shall contain not more than 200 p.p.m. total solids.

G.2.3 Salt solution

The salt solution shall be prepared by dissolving 5 ± 0.5 parts by mass of salt in 95 parts by mass of water. The solution shall be kept free from solids by filtration. The condensate of the salt solution spray shall not be reused.

G.3 TEMPERATURE IN THE EXPOSURE CHAMBER

The temperature in the exposure zone shall be maintained at an ambient temperature of 27 ± 5 °C.

G.4 PROCEDURE

With a razor blade held at an angle of approximately 30 degrees to the component under test and with the plane of the blade perpendicular to the surface, immediately before testing, carefully cut two lines through the coating to the metal base to produce an X mark on the lower half of a test area 150 mm x 75 mm of the test component, making a single cut for each line, extending from about 15 mm from the opposite side and bottom edge of the rectangular area 150 mm x 75 mm of the test component.

Mount the test component in the exposure chamber by means of glass or plastic hooks on the supporting racks in the position described in G.1.2 and insert the racks in the exposure chamber. Close the chamber except for sufficient opening for introducing the salt spray into the chamber.

Using the sprayer, spray the salt solution directly without escape and without condensation into the chamber through the opening left in the chamber, without the salt fog striking the component under test directly until 100 ml of salt solution has been sprayed, and immediately close the chamber. Repeat this procedure every 2 hours consecutively until a period of 6 hours has lapsed and this cycle repeated 24 hourly for a period lasting 3 days.

After exposure to the salt spray for 3 days, rinse the component thoroughly with distilled water and inspect the test area immediately under 10 times magnification. Remove the coating from the unmarked test area without abrasion using a suitable solvent-type paint remover. Examine the underlying metal visually for signs of corrosion.

G.5 PERFORMANCE

The enamel coating after exposure to salt solution for three days shall show no blistering, wrinkling or loss of adhesion and corrosion either visible or under the coating, except along the X-mark where corrosion or blister creep or both shall not extend further than 1.60 mm on each side of the mark.

APPENDIX H

HEAT RESISTANCE TEST FOR ENAMEL PAINT FINISHES

H.1 APPARATUS

Air oven.

H.2 PROCEDURE

Keep the component under test at least 150 cm^2 in area in an air oven and raise the temperature to 150 ± 2 °C and maintain at this temperature for 6 hours. Remove the component under test thereafter from the oven and keep it at room temperature for one hour and then inspect the coating.

H.3 PERFORMANCE

The coating after exposure to heat and cooling, shall remain adherent and shall not turn brittle and show signs of cracking, blistering or show marked change of colour.

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