इंटरनेट मानक

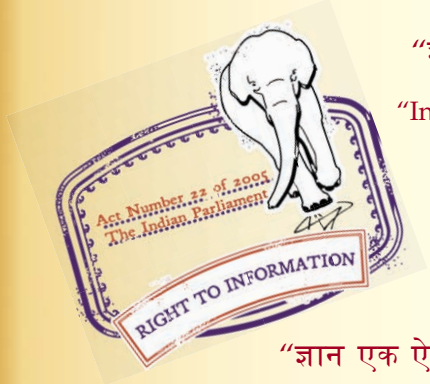
Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 13152-1 (1991): Solid bio-mass chulha, Part 1: Portable (metallic) [MED 4: Non-Conventional Energy Sources]



"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

IS. 13152 (Part 1) : 1991
(Reaffirmed 2008)

भारतीय मानक

ठोस जैवभार चूल्हा – विशिष्टि

भाग 1 सुवाह्य (धात्विक)

Indian Standard

SOLID BIO-MASS *CHULHA* — SPECIFICATION

PART 1 PORTABLE (METALLIC)

UDC 683.943 - 182.4

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 1991 **Price Group 9**

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the Oil Burning Appliances Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council

This standard has been prepared in line with the national approach towards fuel conservation and better environment, mitigating the health hazards and drudgery and the loss of forest cover caused by burning wood as cooking fuel.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values *(revised)'*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 2 JANUARY 1993
TO
IS 13152 (Part 1) : 1991 SOLID BIO-MASS *CHULHA* — SPECIFICATION
PART 1 PORTABLE (METALLIC)

(*Page* 1, *clause* **8.1**, *last line*) — Delete.

(Page 1, *clause* **8.2**) — Substitute the following lor existing clause:

'Dimensional tolerances shall be ± 3 percent, wherever not specified. However, for Casted components if the value comes less than 1 mm then the tolerance shall be ± 1 mm.'

(*Page* 1, *clauses* **9.3, 9.4, 9.5** *and* **9.6**) — Delete.

(Page 10, *clauses* **11.3, 11.3.1** *and* **11.3.2**) — Delete.

(Page 10, *Annex* A, *clause* **A-2.1.1**, *last sentence*) — Substitute the following for the existing:

'The room temperature shall be 25 ± 5°*C* at the beginning of test.'

(*Page* 13, *clause* **B-2.2**, *line* 2) — Substitute the following for the existing line:

'a balance having an accuracy of 0.1 mg'.

(*Page* 13, *clause* **B-2.3**, *line* 13) — Substitute the word 'balance' *for* 'electronic balance'.

(*Page* 15, *Annex C*) — Delete.

(HMD 4)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 1 APRIL 1992

TO

IS 13152 (Part 1) : 1991 SOLID BIO-MASS *CHULHA* — SPECIFICATION

PART 1 PORTABLE (METALLIC)

(*Page* 1, *clause* **2**, *line* 1) — Substitute the words 'have been referred in' *for* 'are necessary adjuncts to'.

(*Page* 1, *clause* **5**, *last line*) — Insert 'Type 4 Mild steel'.

(*Page* 1, *clause* **7.1**, *line* 2) — Insert the words 'col 2 of' before 'Table 1'.

(*Page* 1, *clause* **7.1**) — Insert the following new clause after **7.1**:

'**7.2** Relevant Indian Standards referred in col 3 of Table 1 are for guidance only.'

(*Page* 1, *clause* **8.2**) — Substitute the following for the existing clause:

'**8.2 Tolerance**

8.2.1 Dimensional tolerances for cast iron components shall be ± 1 mm, where not specified.

8.2.2 Dimensional tolerances for other components shall be ± 3 percent where not specified.'

(*Page* 1, *clause* **9.6**) — Insert the following new clause after **9.6:**

"**9.7** Having removed the rust, all mild steel and cast iron components excluding aluminium lining shall be painted preferably with 'Black Board Paint'."

(*Page* 2, *Fig.* 1, *Notes*) — Insert the following new Note after *Note 2:*

'3 Legs of *chulha* and the legs of cast iron grate shall be 120° apart.'

(*Page* 3, *Fig.* 2A) — Substitute the figure given on page 4 for the existing figure.

(*Page* 4, *Fig.* 2B) — Substitute the figure given on page 5 for existing figure.

(*Page* 5, *Fig.* 3, *table line* 6 against Part No. 1) — Substitute 'Outer Jacket' *for* 'Barrel'.

(*Page* 6, *Fig.* 4A) — Substitute '8 holes on 20 diameter EQUALLY SPACED at 40°' *for* '8 ϕ 20 HOLES EQUALLY SPACED'.

(*Page* 8, *Fig.* 4D, *caption*) — Substitute '4D Door and Fuel support (Material - Mild steel) *for* '4D Door and Fuel Support'.

(*Page* 9, *Table* 1) — Substitute the following for the existing table:

Gr 1

'Table 1 Materials of Different Parts of Solid Bio-Mass (Metallic) *CHULHA* — Portable

(Clause 7.1)

Part Name	Material	Relevant Indian Standards
(1)	(2)	(3)
Top Plate	Cast Iron 6 mm, *Min,* Thick Stainless Steel, 10 mm, *Min*, Thick (*see* Note 1) Mild Steel, 3 mm, *Min,* Thick	IS 210 : 1978 IS 5522 : 1978 IS 513 : 1986
Grate	Cast Iron 6 mm, *Min,* Thick Mild Steel 3 mm, *Min,* Thick	IS 210 : 1978 IS 513 : 1986
Barrel	Mild Steel, 1.6 mm, *Min,* Thick (*see* Note 2) Cast Iron, 6 mm, *Min,* Thick Stainless Steel 1.0 mm, *Min*, Thick	IS 513 : 1986 IS 210 : 1978 IS 5522 : 1978
Bottom Plate	Mild Steel, 1.6 mm, *Min*, Thick Cast Iron, 6 mm, *Min,* Thick Stainless Steel 0,63 mm, *Min,* Thick	IS 513 : 1986 IS 210 : 1978 IS 5522 : 1978
Lining	Aluminium, 0,71 mm, *Min,* Thick	IS 737 : 1986
Perforated Sleeve	Mild Steel, 1.0 mm, *Min,* Thick	IS 513 : 1986
Handles	Mild Steel Wire, 3.15 mm, *Min,* Thick Mild Steel Sheet, 1.0 mm, *Min*, Thick	IS 280 : 1978 IS 513 : 1986
Pan Support	Mild Steel Sheet, 1.6 mm, *Min,* Thick Mild Steel Flat, 4.0 mm, *Min,* Thick Mild Steel Rod, 8.0 mm, *Min,* dia Cast Iron, 6.0 mm, *Min,* Thick Stainless Steel, 1.0 mm, *Min,* Thick	IS 513 : 1986 IS 226 : 1975 IS 226 : 1975 IS 210 : 1978 IS 5522 : 1978
Legs	Mild Steel Rod, 80 mm, *Min,* dia Mild Steel Sheet 1.6 mm, *Min,* Thick Cast Iron, 6.0 mm, *Min,* Thick (*see* Note 3)	IS 226 : 1975 IS 513 : 1986 IS 210 : 1978
Outer Jacket	Mild Steel, 1 mm, *Min,* Thick	IS 513 :1986

NOTES

1 Stainless steel is permitted at places where it is not in direct contact with the fame.

2 Where the perforated sleeve/*jally* is provided inside the barrel, the thickness may be reduced to 1.0 mm.

3 The legs of cast iron shall be made by extending the barrel to form legs.'

[*Page* 10, *clause* **10.1** (d)] — Insert '(*see* Notes given below)' after 'of the *chulha'.*

[*Page* 10, *clause* **10.1** (e)] — Insert the following notes after **10.1** (e):

'NOTES

1 For the reference design given in this standard minimum mass should be as follows:

Size of *Chulha*	Design 'A'		Design 'B'	
	Type 1	Type 2	Type 1	Type 2
Medium	5.5 kg	10.0 kg	4.4 kg	—
Large	8.5 kg	—	—	—

2 For any other type the minimum mass shall be as declared by the manufacturer.'

(*Page* 10, *clause* **11.5**) — Insert the following new clause after **11.5:**

'11.6 Strength Test

When tested according to **11.6.1,** it shall show no deformation or welding cracks.

11.6.1 The *chulha* shall be put on a flat surface. A weight (W_1) as given below shall be placed on the top of the *chulha* on a rigid flat steel/wood plate. The mass shall remain on the *chulha* for a period of 30 min. After the test, the *chulha* shall show no sign of damage or deformation.

Size of Chulha	*Weight* (W_1)
Small	30 kg
Medium	50 kg
Large	80 kg
Extra Large	100 kg

(*Page* 12, *clause* **A-5.1.1,** *last entry*) — Substitute

'Thermal efficiency, percent (H) $= \frac{[(0{\cdot}896W + 4{\cdot}186\ 8w)\{(n-1)(t_2-t_3)+(t_3-t_1)\}] \times 100}{4{\cdot}186\ 8\ [X c_1 + xdc_2/1\ 000]}$'

for

$$= \frac{[(n-1)(W \times 0{\cdot}896 + w \times 4{\cdot}186\ 8)(t_2-t_1) + (W \times 0{\cdot}896 + w \times 4{\cdot}186\ 8)(t_3-t_1) \times 100}{4{\cdot}186\ 8\ [(X \times c_1) + xdc_2/1\ 000]}\ ,$$

(*Page* 12, *clause* **A-5.1.2,** *last entry*) — Substitute

'Thermal efficiency, percent (η) $= \frac{[(0{\cdot}214W + w)\{(n-1)(t_2-t_1)+(t_3-t_1)\}] \times 100}{[(X C_1 + xdc_2/1\ 000)]}$

for

$$= \frac{[(n-1)(W \times 0{\cdot}214 + w)(t_2-t_1) + (W \times 0{\cdot}214 + w)(t_3-t_1) \times 100}{[(X \times c_1) + (xdc_2/1\ 000)]}\ ,$$

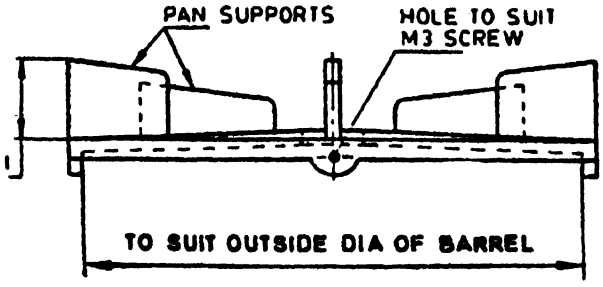
(*Page* 13, *clause* **B-1.2.2,** *line* 3) — Substitute 'carbon monoxide indicator' *for* 'co-indicator'.

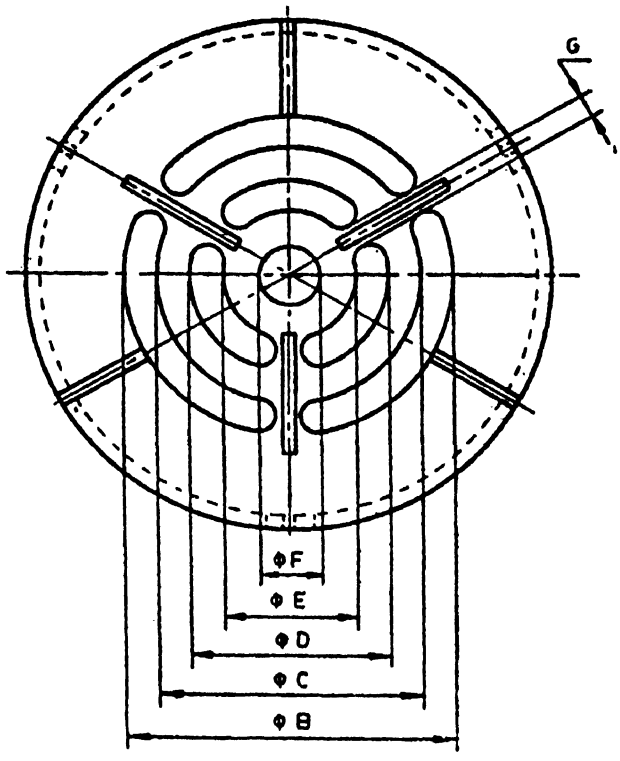
(*Page* 13, *clause* **B-2.4**) — Substitute

$$= \frac{(Y - X) \times 1\ 000}{\frac{60\ Z}{1\ 000}}$$

for

$$= \frac{(Y - X) = 1\ 000\ \text{mg}}{\frac{60\ Z\ \text{m}^3}{1\ 000}}$$



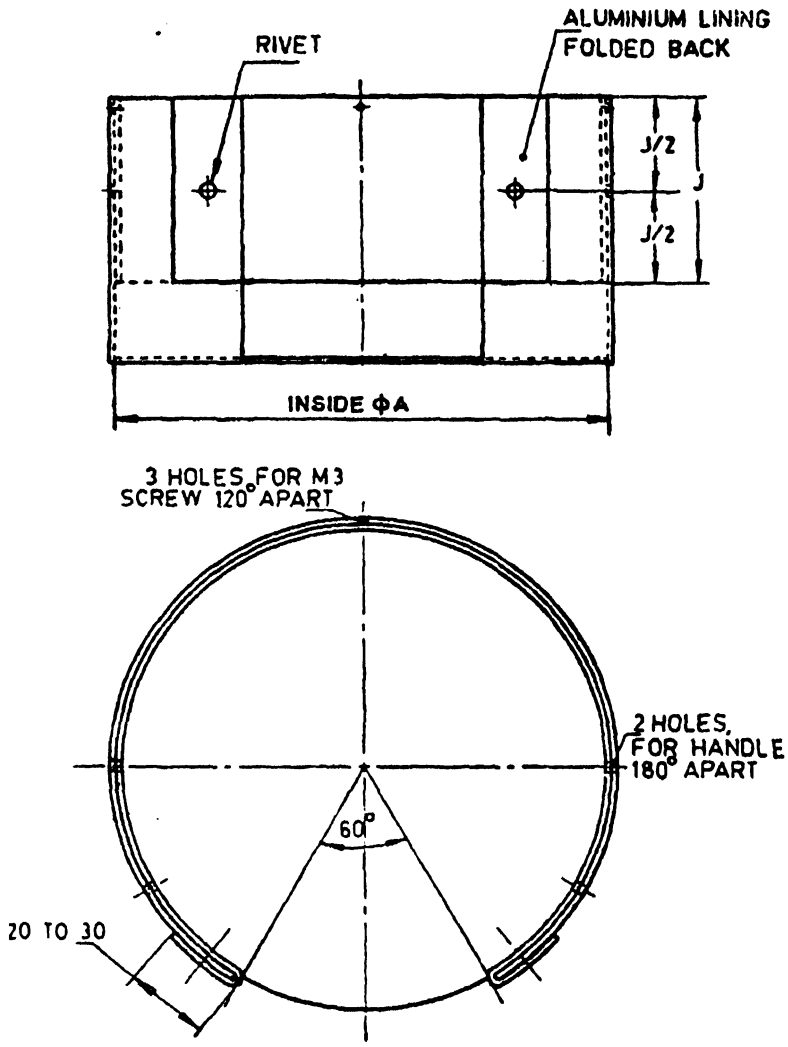


Dimension	*B*	*C*	*D*	*E*	*F*	*G*	*I*
Medium Size Type 2	160	128	96	64	28	12	40
Type 1	160	128	96	64	28	12	40
Large Size Type 1	200	160	120	80	35	16	50

2A Top Plate

All dimensions in millimetres.

FIG. 2 SOLID BIO-MASS *CHULHA* — DESIGN *'A'* PARTS — *Contd*



Dimensions	*A*	*J*
Medium Size Type 2	240	88
Type 1	240	88
Large Size Type 1	300	110

28 Barrel

All dimensions in millimetres.

FIG. 2 SOLID BIO-MASS *CHULHA* — DESIGN 'A' PARTS — *Contd*

(HMD 4)

Printed at Printwell Printers, Aligarh, India.

Indian Standard

SOLID BIO-MASS *CHULHA* — SPECIFICATION

PART 1 PORTABLE (METALLIC)

1 SCOPE

This standard covers requirements of different designs and types of solid bio-mass portable metallic *chulha* for family applications.

2 REFERENCES

The following Indian Standards are necessary adjunts to this standard:

IS No.	*Title*
210 : 1978	Grey iron castings (*third revision*)
226 : 1975	Structural steel (standard quality) (*third revision)*
280 : 1978	Mild steel wire for general engineering purposes (*third revision)*
513 : 1986	Cold rolled low carbon steel sheets and strips (*third revision*)
737 : 1986	Wrought aluminium and aluminium alloy sheet and strip for general engineering purposes (*third revision*)
2480 (Part 1) : 1983	General purpose glass thermometers: Part 1 Solid stem thermometer (*second revision*)
5522 : 1978	Stainless steel sheets and coils *(first revision)*

3 TERMINOLOGY

For the purpose of this standard the nomenclature of different parts of the *chulha* shall be as given in Fig. 1 to 4.

4 DESIGNS

The commonly used designs of the solid bio-mass metallic *chulha* are given below for guidance:

a) Design A (*see* Fig. 1), and

b) Design B (*see* Fig. 3).

5 TYPES

The *chulha* may be of different types depending upon their material combinations with respect to top plate, grate, barrel and bottom plate, as given in **7.1**. Typical types are given below for guidance:

Type 1 Mild steel and cast iron

Type 2 All cast iron

Type 3 Mild steel, cast iron and stainless steel

6 SIZE

The *chulha* shall be of the following sizes based on the corresponding heat and power output rating:

Size	*Power Output Rating* kW
Small	Above 0.5 and up to 0.8
Medium	Above 0.8 and up to 1.3
Large	Above 1.3 and up to 2.5
Extra Large	Above 2.5

7 MATERIALS

7.1 Different parts of the *chulha* shall be made from the materials as given in Table 1 read with Fig. 1 to 4.

8 DIMENSIONS AND TOLERANCES

8.1 The dimensions of some typical designs of solid bio-mass *chulha* are given in Fig. 1 to 4 for reference only.

8.2 Tolerance

Dimensional tolerances shall be ±3 percent, where not specified.

9 MANUFACTURE AND WORKMANSHIP

9.1 Various components of the *chulha* shall be manufactured as per normal engineering practices.

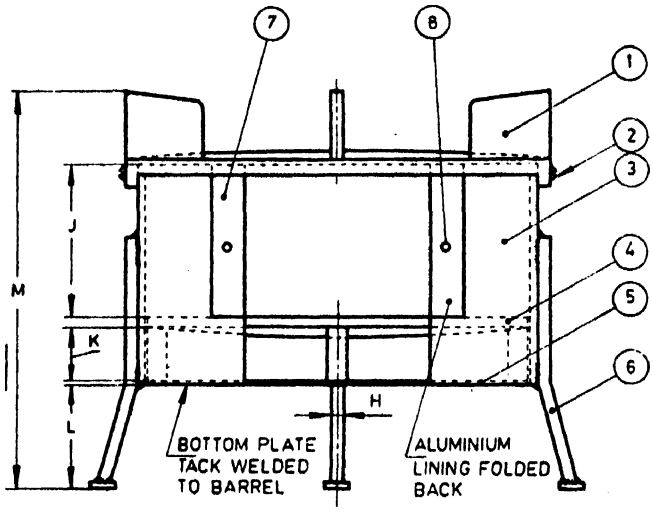
9.2 The construction of the *chulha* shall be sturdy so that while in actual use on level floor they cannot get shaky or yield at any point.

9.3 Stainless steel rivets shall be provided for stainless steel constructions. Spot welding can also be used wherever possible.

9.4 Top plates shall be made in the form of cups for fixing outside the barrel.

9.5 Ribbings should be provided on top plate and bottom plate for stiffness of stainless steel plates.

9.6 Appropriate pan support shall be provided in top plate casting to accommodate smaller/larger and round/flat shapes of pots.



Dimension	*H*	*J*	*K*	*L*	*M*
Medium Size Type 2	8	88	33	67	246
Type 1	8	88	33	67	242
Large Size Type 1	10	110	40	85	299

Part No.	No.	Description
8	2	Rivet
7	1	Aluminium Lining
6	3	Leg
5	1	Bottom Plate
4	1	Grate
3	1	Barret
2	3	Screw
1	1	Top Plate

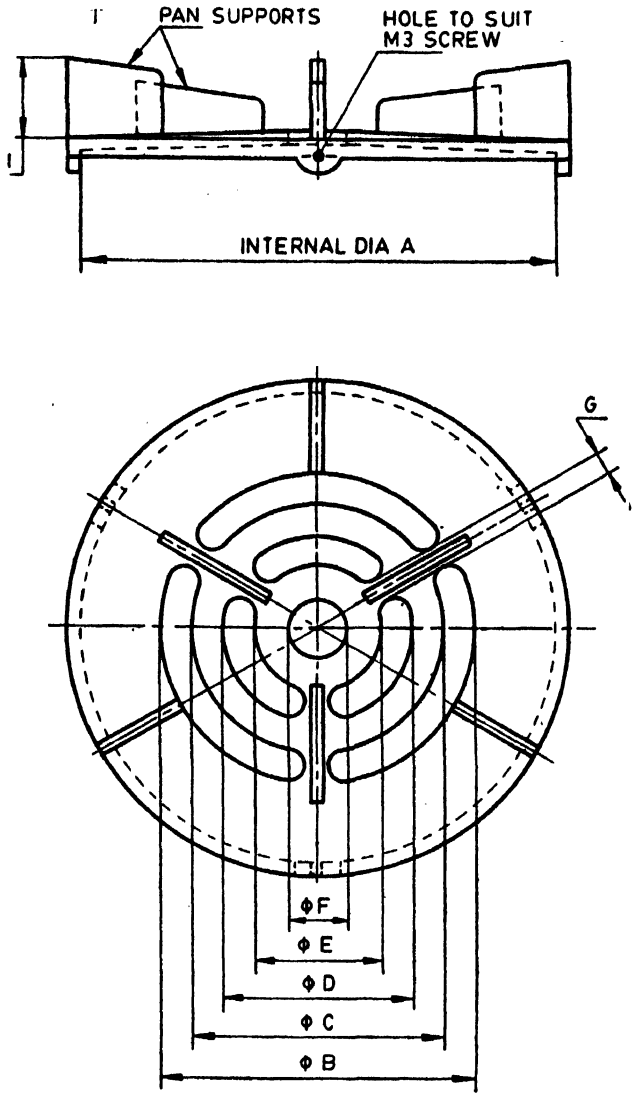
NOTES

1 Avoid sharp edges, slots should be rounded off suitably.

2 Cast iron top plate should be made in cup shape and should be fixed from outside to the barrel. Appropriate pan support should be provided in casting to accommodate smaller/larger and round/flat shapes of pots. The total area of slot opening should be kept overall height of the outer pot support to be kept as per dimensions.

All dimensions in millimetres.

FIG. 1 SOLID BIO-MASS *CHULHA* – DESIGN 'A'

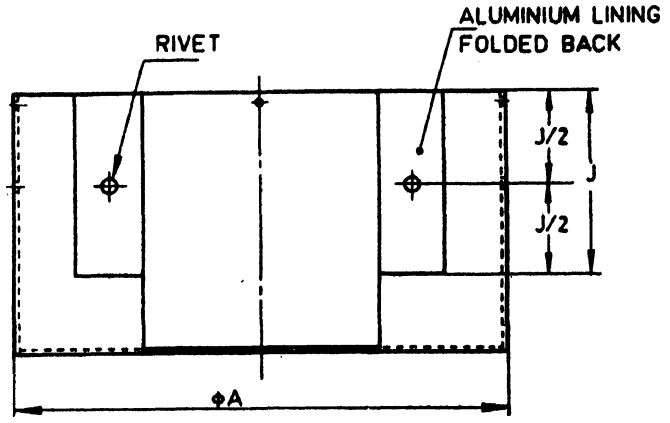


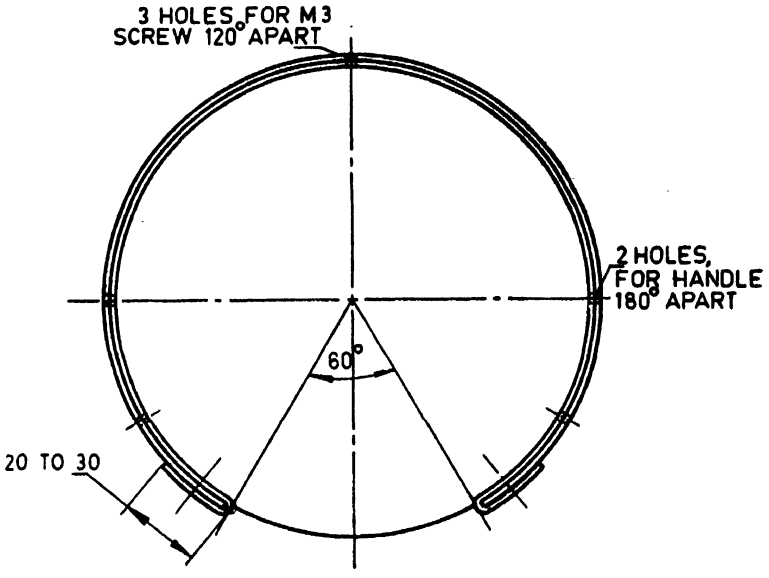
Dimension	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*I*
Medium Size Type 2	240	160	128	96	64	28	12	40
Type 1	240	160	128	96	64	28	12	40
Large Size Type 1	300	200	160	120	80	35	16	50

2A Top Plate

All dimensions in millimetres.

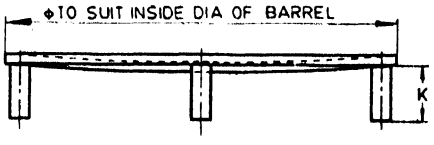
FIG. 2 SOLID BIO-MASS *CHULHA* — DESIGN 'A' PARTS — *Contd*

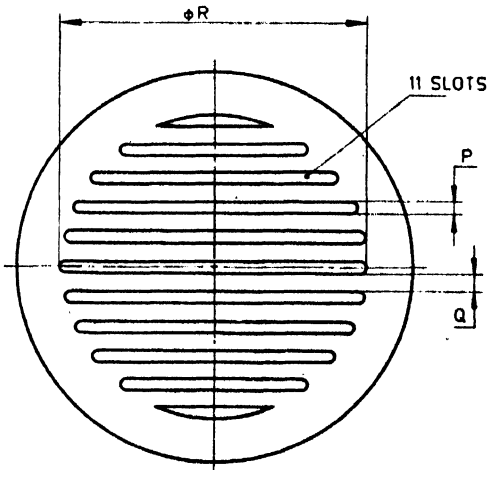




2B Barrel

Dimension	*A*	*J*
Medium Size Type 2	240	88
Type 1	240	88
Large Size Type 1	300	110



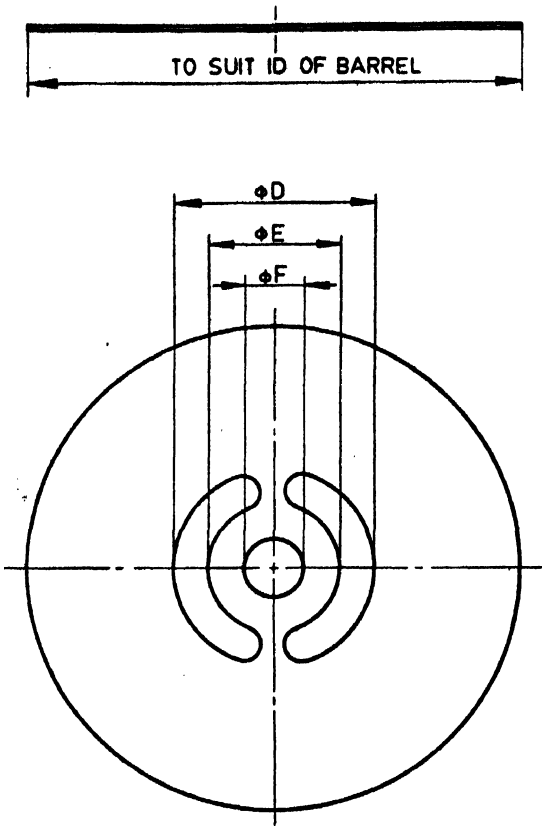


Dimension	*K*	*P*	*Q*	*R*
Medium Size Type 2	33	8.5	9.5	188.5
Type 1	33	8.5	9.5	188 5
Large Size Type 1	40	11	12	241

2C Grate

All dimensions in millimetres.

FIG. 2 SOLID BIO-MASS *CHULHA* — DESIGN 'A' PARTS — *Contd*

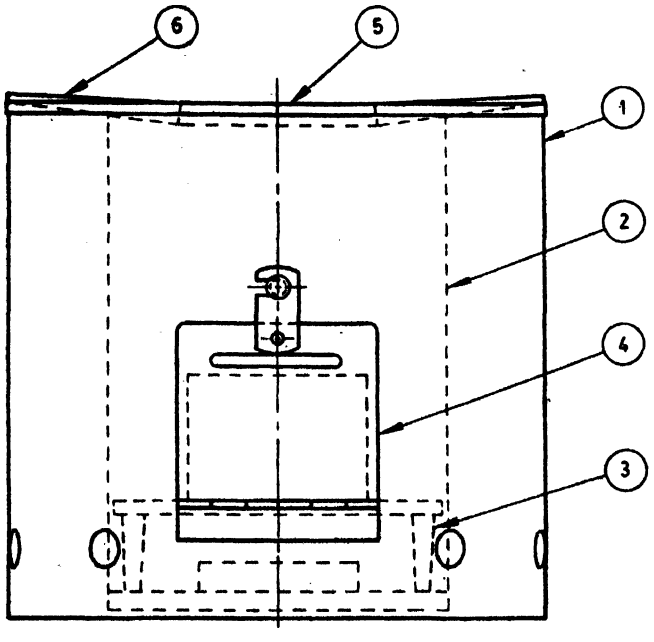


Dimension	*D*	*E*	*F*
Medium Size Type 2	96	64	28
Type 1	96	64	28
Large Size Type 1	120	80	35

2D Bottom Plate

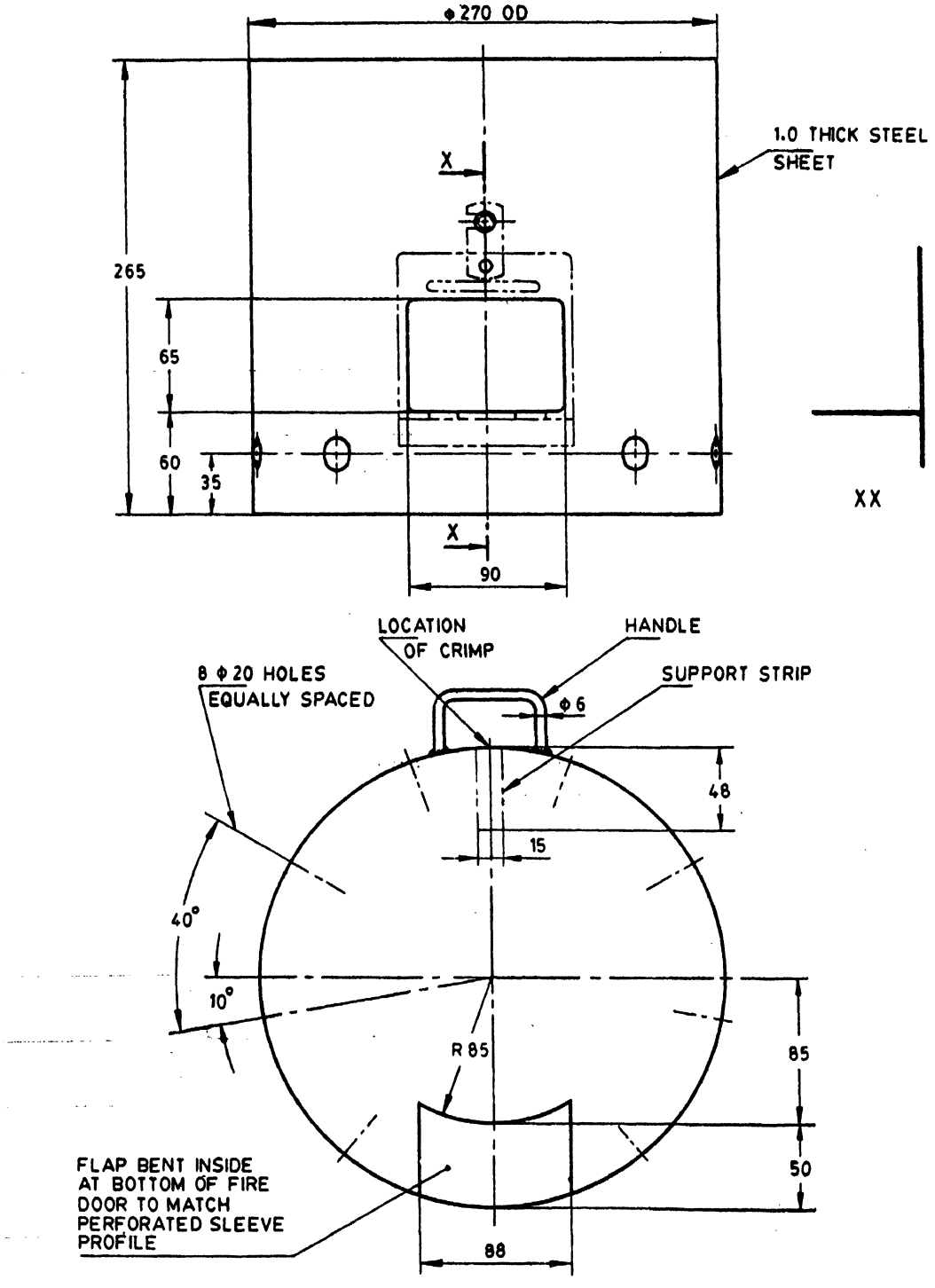
All dimensions in millimetres.

FIG. 2 SOLID BIO-MASS *CHULHA* — DESIGN 'A' PARTS — *Concluded*



Part No.	Nos.	Description
6	3	Pan Support
5		Top Plate
4		Door and Fuel Support
3	1	Grate
2	1	Perforated Sleeve
1	1	Barrel

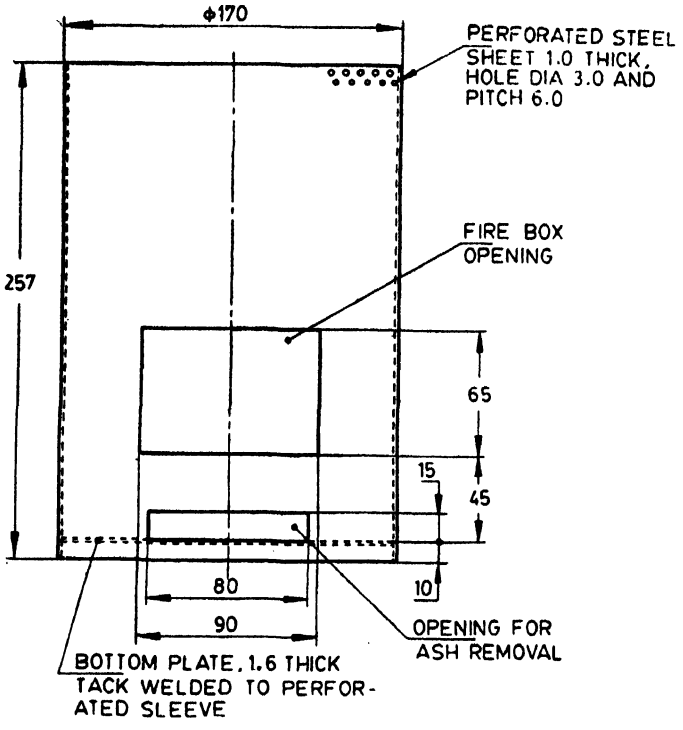
FIG. 3 SOLID BIO-MASS *CHULHA* — DESIGN 'B'

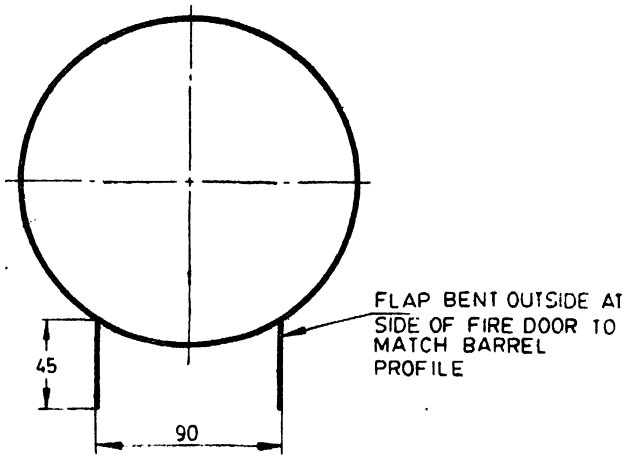


4A Barrel

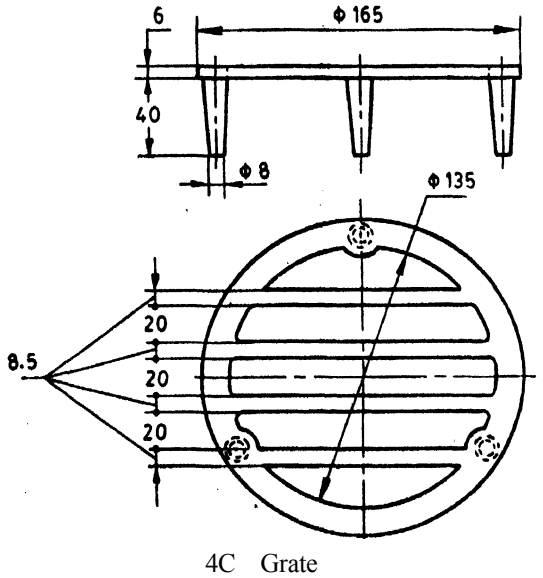
All dimensions in millimetres.

FIG. 4 SOLID BIO-MASS *CHULHA* — DESIGN 'B' PARTS — *Contd*





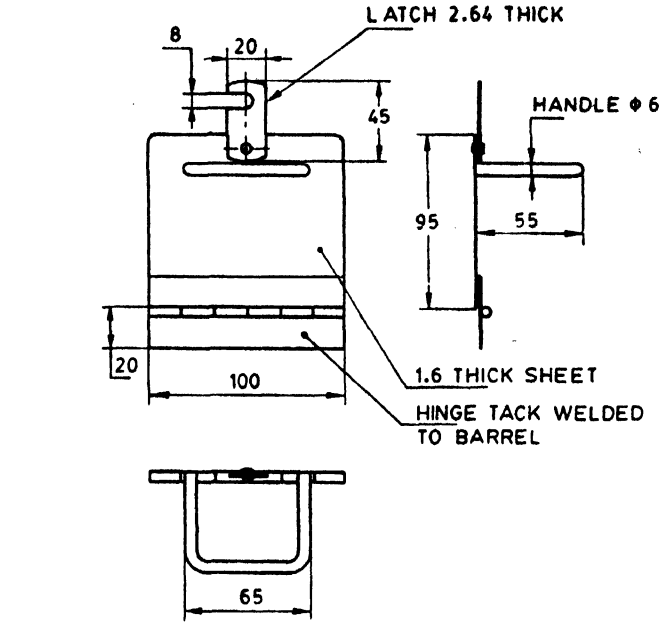
4B Perforated Sleeve



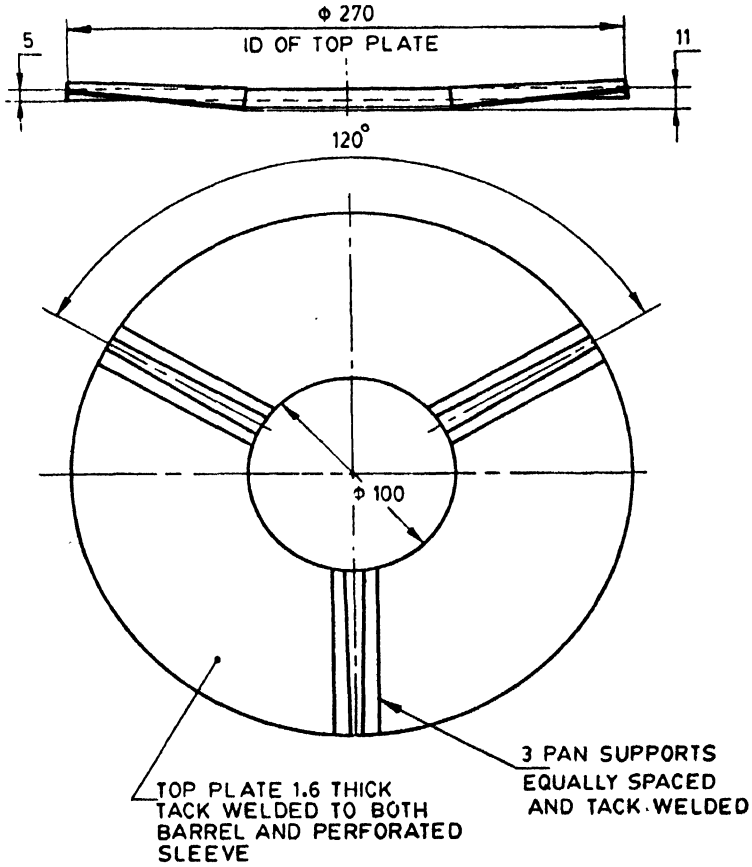
4C Grate

All dimensions in millimetres.

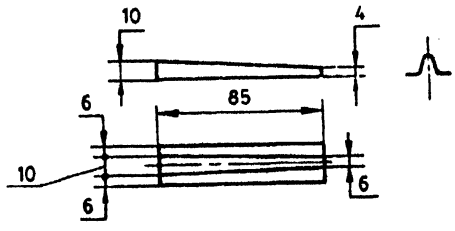
FIG. 4 SOLID BIO-MASS *CHULHA* — DESIGN 'B' PARTS — *Contd*



4D Door and Fuel Support



4E Top Plate



4F Pan Support

All dimensions in millimetres.

FIG. 4 SOLID BIO-MASS *CHULHA* — DESIGN 'B' PARTS — *Concluded*

Table 1 Materials of Different Parts of Solid Bio-Mass (Metallic) *CHULHA* — Portable
(Clause 7.1)

Part Name	Material	Conforming to
(1)	(2)	(3)
Top Plate	Cast Iron, 6 mm, *Min*, Thick Stainless steel, 10 mm, *Min,* Thick (*see* Note 1)	IS 210 : 1978 IS 5522 : 1978
Grate	Cast Iron, 6 mm, *Min,* Thick	IS 210 : 1978
Barrel	Mild Steel, 1.6 mm, *Min,* Thick (*see* Note 2) Cast Iron, 6 mm, *Min,* Thick Stainless steel 1.0 mm, *Min,* Thick	IS 513 : 1986 IS 210 : 1978 IS 5522 : 1978
Bottom Plate	Mild Steel 1.6 mm, *Min,* Thick Cast Iron, 6 mm, *Min,* Thick Stainless steel 0.63 mm, *Min,* Thick	IS 513 : 1986 IS 210 : 1978 IS 5522 : 1978
Lining	Aluminium, 0.71 mm, *Min,* Thick	IS 737 : 1986
Perforated Sleeve	Mild Steel 1.0 mm, *Min,* Thick	IS 513 : 1986
Handles	Mild Steel Wire 3.15 mm, *Min,* Thick	IS 280 : 1978
Pan Support	Mild Steel Sheet 1.6 mm, *Min,* Thick Mild Steel Flat 4.0 mm, *Min,* Thick Mild Steel Rod 8 mm, *Min,* dia Cast Iron 6.0 mm, *Min,* Thick Stainless Steel 1.0 mm, *Min,* Thick	IS 513 : 1986 IS 226 : 1975 IS 226 : 1975 IS 210 : 1978 IS 5522 : 1978
Legs	Mild Steel Rod 8.0 mm, *Min,* dia Mild Steel Sheet 1.6 mm, *Min,* Thick Cast Iron 6.0 mm, *Min,* Thick (*see* Note 3)	IS 226 : 1975 IS 513: 1975 IS 210 : 1978

NOTES
1 Stainless steel permitted at places where it is not in direct contact with the flame.
2 Where the perforated sleeve/*jally* is provided inside the barrel the thickness may be reduced to 10 mm.
3 The legs of cast iron shall be made by extending the barrel to form legs.

10 MARKING

10.1 Each *chulha* shall be marked by stamping with the following information:

a) Serial number,
b) Design,
c) Type and output rating,
d) Minimum mass of the *chulha,* and
e) Identification of the source of manufacture.

10.2 Identification of the source of manufacture of the *chulha* shall be embossed on all the cast iron components of the *chulha* also.

10.3 Each *chulha* may be marked with the Standard Mark.

11 PERFORMANCE TEST

11.1 Thermal Efficiency Test

Thermal efficiency for each *chulha* when tested in accordance with the method described in Annex A shall be not less than 25 percent for all types and designs of solid bio-mass *chulha.*

11.2 Combustion Efficiency

11.2.1 *CO/CO_2 Ratio*

When tested in accordance with the method described in **B-1** the carbon monoxide/carbon dioxide ratio of exhaust gases of *chulha,* while burning at optimum output (CO/CO_2) shall not exceed 0.04.

11.2.2 *Total Suspended Particulate*

When tested in accordance with the method described in **B-2**, the total suspended particulate shall not exceed 2.0 mg/m^3.

11.3 Surface Temperature Test

11.3.1 Surfaces, which in normal use have to be touched for short periods (for example, handles, etc), shall not have a temperature exceeding 60°C when measured in accordance with Annex C.

11.3.2 The temperature of synthetic rubber/plastic components, if used, shall not exceed 60°C.

11.4 Quenching Test of Cast Iron Components

When tested in accordance with the method described in Annex D, the grate and top plate should withstand the test without any crack or deformity.

11.5 Stability Test

Chulhas both when full of fuel and when empty, shall be capable of being tilted in any direction to an angle of 15° from the vertical, without overturning at that inclination or on being released.

ANNEX A

(*Clause* 11.1)

TEST FOR THERMAL EFFICIENCY

A-1 THERMAL EFFICIENCY

A-1.0 Thermal efficiency of a *chulha* may be defined as the ratio of heat actually utilized to the heat theoretically produced by complete combustion of a given quantity of fuel (which is based on the net calorific value of the fuel).

A-2 CONDITIONS FOR CARRYING OUT THERMAL EFFICIENCY TEST

A-2.1 Test Room Conditions

A-2.1.1 The air of the test room shall be free from draught likely to affect the performance of the *chulha.* The room temperature shall be maintained at 25±5°C.

A-2.1.2 At the start of the test, the *chulha* and the wood being used shall be at room temperature.

A-3 EQUIPMENT

A-3.1 Instruments and other Accessories:

a) Bomb calorimeter.

b) Mercury in glass thermometers (range 0-100°C) [*see* IS 2480 (Part 1) : 1983] with solid stem/other temperature measuring device with the accuracy of ±0.1°C.

c) Single pan balance 1 kg capacity (dial type with least count of 10 g).

d) Measuring jars; 1-1, 2-1 and 5-1 capacity.

e) Stop watch or time measuring device.

f) Pairs of tong, metallic tray and match sticks, etc.

g) Piece of clean cloth.

A-3.2 Fuel and Its Preparation

A-3.2.1 The fuel shall be *Kail/Deodar/Mango/ Accasta* cut from the same log into pieces of 3 cm × 3 cm square cross-section and length of half the dia/length of cumbustion chamber so as to be housed inside the cumbustion chamber. The fuel pieces shall be dried by the following method:

a) Weigh total quantity of wood (say *'M'* kg).
b) Pick up one piece and mark *'X'* by engraving and take its mass (say '*m*' g).
c) Raise the temperature of oven up to 105°C.
d) Stack the wood pieces in a honey comb fashion inside the oven.
c) Maintain the oven temperature at 105°C.
f) After 6 hours, remove the marked *'X'* piece, weigh it and note reduction in mass from '*m*' g, if any. If reduction is observed put the marked piece in the oven again and repeat the weighing of *'X'* marked piece after every subsequent 6 hours durations till the mass is constant and no further reduction in mass is observed.
g) At this, weigh the total quantity of wood and note loss of mass from '*M*' kg.
h) Determine the calorific value of the prepared wood with the help of bomb calorimeter.

A-3.3 Determination of Burning Capacity Rate

If the fuel burning rate per hour is not given by the manufacturer, the method described below shall be used to estimate the burning capacity of the *chulha.*

A-3.3.1 Stack the cumbustion chamber with test fuel as given in **A-3.2** in honey comb fashion up to 3/4 of the height or in a pattern recommended by the manufacturer.

A-3.3.2 Sprinkle 10 to 15 ml of kerosene on the fuel from the top of *chulha/*fire box mouth.

A-3.3.3 Weigh the *chulha* with fuel, let the mass be M_1 kg.

A-3.3.4 After half an hour of lighting weigh the *chulha* again and let the mass be M_2 kg.

A-3.3.5 Then calculate the burning capacity of the *chulha* as heat input per hour as follows:

$$\text{Heat input per hour} = 2 (M_1 - M_2) \times CV \text{ kcal/h}$$

where

M_1 = the initial mass of the *chulha* with test fuel in kg,

M_2 = the mass of the *chulha,* after burning the test fuel for half an hour in kg, and

CV = Calorific value of the test fuel in kcal/kg.

A-3.4 Vessels

The size of the vessel and the quantity of water to be taken for the thermal efficiency test shall be selected from Table 2 depending upon the burning capacity rating of the *chulha* as determined in **A-3.3**.

Table 2 Aluminium Vessels for Thermal Efficiency Test

(*Clause* A-3.4)

Sl No.	Heat Input Rate kcal/h	Vessel Diameter (Ext) mm (±5%)	Vessel Height (Ext) mm (±5%)	Total Mass with Lid g (±20%)	Mass of Water in Vessel kg
1.	Up to 2 000	180	100	356	2.0
2.	2 001 „ 2 800	205	110	451	2.8
3.	2 801 „ 3 200	220	120	519	3.7
4.	3 201 „ 3 800	245	130	632	4.8
5.	3 801 „ 4 200	260	140	750	6.1
6.	4 201 „ 4 800	285	155	853	7.7
7.	4 801 „ 5 400	295	165	920	9.4
8.	5 401 „ 6 000	320	175	1 100	11.4
9.	6 001 „ 6 600	340	185	1 200	12.50
10.	6 601 „ 7 200	350	195	1 310	14.00
11.	7 201 „ 7 800	370	200	1 420	16.00
12.	7 801 „ 8 400	380	210	1 530	18.00
13.	8 401 „ 9 000	400	215	1.640	20.00
14.	9 001 „ 9 600	410	225	1 750	22.00
15.	9 601 „ 10 200	420	230	1 860	24.00
16.	10 201 „ 10 800	435	240	2 000	26.50
17.	10 801 „ 11 400	450	245	2 130	29.00
18.	11 401 „ 12 200	460	250	2 240	31.00
19.	12 201 „ 12 800	470	255	2 320	33.00
20.	12 801 „ 13 600	480	260	2.440	35.00
21.	13 601 „ 14 400	490	265	2 520	38.00
22.	14 401 „ 15 400	500	270	2 650	41.00
23.	15 401 „ 16 400	510	275	2 720	44.00
24.	16 401 „ 17 400	530	280	3 050	47.00
25.	17 401 „ 18 600	540	285	3 190	50.00
26.	18 601 „ 19 800	550	290	3 330	53.00
27.	19 801 „ 21 000	560	300	3 480	57 00

A-4 PROCEDURE

A-4.1 Take the test fuel according to burning capacity rating for one hour. Divide the test fuel in 4 equal lots. Let the mass be '*X*' kg.

A-4.2 Stack the first lot of test fuel in the combustion chamber in honey comb fashion or as indicated by the manufacturer.

A-4.3 Put the vessel with lid and stirrer in accordance with Table 2. Minimum two such vessels sets will be required. Put the recommended quantity of water at 23 ± 2°C (t_1).

A-4.4 Sprinkle measured quantity '*x*' ml (say 10-15 ml) of kerosene for easy lighting on the test fuel and light. Simultaneously start the stop watch.

A-4.5 Feeding of fresh test fuel lot shall be done after every 15 minutes.

A-4.6 The water in the vessel shall be allowed to warm steadily till it reaches a temperature of about 80°C, then stirring is commenced and continued until the temperature of water reaches 5°C below boiling point at a place. Note down time taken to heat the water up to final temperature (less than 5°C below the boiling point) t_2°C.

A-4.7 Remove the vessel of **A-4.6** from the *chulha* and put the second vessel immediately on the *chulha*. Prepare first vessel for subsequent heating.

A-4.8 Repeat the experiment by alternatively putting the two vessels taken in **A-4.3** till there is no visible flame in the combustion chamber of the *chulha*. Note down the temperature of the water in the last vessel. Let it be t_3°C.

A-5 CALCULATIONS

A-5.1 Thermal efficiency of the *chulha* shall be calculated as follows.

A-5.1.1 (*In SI Units*)

If:

w = mass of water in vessel, in kg;
W = mass of vessel complete with lid and stirrer, in kg;
X = mass of fuel consumed, in kg;
c_1 = calorific value of wood, in kcal/kg;
x = volume of kerosene consumed, in ml;
c_2 = calorific value of kerosene, kcal/kg;
d = density of kerosene, g/cc;
n = initial temperature of water in °C;
t_2 = final temperature of water, in °C;
t_3 = final temperature of water in last vessel at the completion of test, in °C; and
n = total number of vessels used.
(Specific heat of aluminium = 0.896 kJ/kg°C).

NOTE : 1kcal = 4.186 8 kJ

Heat utilized = (n–1) ($W \times 0.896 + w \times 4.186\,8$) ($t_2 - t_1$) + ($W \times 0.896 + w \times 4.186\,8$) ($t_3 - t_1$) kJ

Heat produced = $4.186\,8\,[\,(X \times c_1) + (xd/1\,000 \times c_2)\,]$ kJ

$$\text{Thermal efficiency, percent } (\eta) = \frac{\text{Heat Utilized}}{\text{Heat Produced}} \times 100$$

$$= \frac{[\,(n-1)(W \times 0{\cdot}896 + w \times 4{\cdot}186\,8)(t_2 - t_1) + (W \times 0{\cdot}896 + w \times 4{\cdot}186\,8)(t_3 - t_1)\,] \times 100}{4{\cdot}1\,868\,[\,(X \times c_1) + xdc_2/1\,000\,]}$$

A-5.1.2 (*In Metric Units*)

If:

w = mass of water in the vessel, in kg;
W = mass of vessel complete with lid and stirrer, in kg;
X = mass of fuel consumed, in kg;
c_1 = calorific value of wood, in kcal/kg;
x = volume of kerosene consumed, in ml;
c_2 = calorific value of kerosene, kcal/kg;
d = density of kerosene, g/ml;
t_1 = initial temperature of water, in °C;
t_2 = final temperature of water, in °C;
t_3 = final temperature of water in last vessel at the completion of test, in °C; and
n = total number of vessels used.
(Specific heat of aluminium = 0.214 kcal/kg°C)

Heat utilized = (n–1) ($W \times 0.214 + w$) ($t_2 - t_1$) + ($W \times 0.214 + W$) ($t_3 - t_1$) kcal

Heat produced = $[\,(X \times c_1) + (xd/1\,000 \times c_2)\,]$ kcal

$$\text{Thermal efficiency, percent } (\eta) = \frac{\text{Heat Utilized}}{\text{Heat Produced}} \times 100$$

$$= \frac{[\,(n-1)(W \times 0{\cdot}214 + w)(t_2 - t_1) + (W \times 0{\cdot}214 + w)(t_3 - t_1) \times 100}{[\,(X \times c_1) + (xdc_2/1\,000)\,]}$$

A-5.2 Power Output Rating

The power output rating of *chulha* is a measure of total useful energy produced during one hour by fuel wood. It shall be calculated as follows:

$$\text{Power output rating} = \frac{F \times CV \times \eta}{860 \times 100} \text{ kW}$$

where

F = quantity of fuel wood burnt, kg/h;
CV = calorific value of fuel wood, kcal/kg; and
η = thermal efficiency of the *chulha*.

ANNEX B
(Clause 11.2)

TEST FOR COMBUSTION EFFICIENCY

B-1 CO/CO_2 RATIO MEASUREMENT

B-1.1 Equipment

B-1.1.1 The *chulha* shall be tested with its grate filled with fuel wood equivalent to 1/4 of the burning capacity of wood as determined in **A-3.3**. Before starting the test, a vessel of the type and size as described in **A-3.4** and containing water sufficient for the test shall be placed over the *chulha.* In addition, a collecting hood (*see* Fig. 5) suitable for *chulha* under examination shall be used.

B-1.1.2 The hood shall be so designed that, while not interfering in any way with the normal combustion of the *chulha,* it collects a fairly high proportion of the flue gases. Also it shall be such that the sample collected represents the whole of combustion gases and not those from one particular point. When using hood, the damper provided shall be set, or additional flue pipe added, so that spillage of the flue gases around the skirt is minimized.

B-1.2 Procedure

B-1.2.1 With the hood in position over the *chulha* under investigation, the wood shall be lit as given in **A-4.1** to **A-4.5** till a stable flame is achieved and the kerosene is completely burnt, then a sufficient number of samples shall be collected.

B-1.2.2 Any of the recognized methods may be used for gas analysis. For carbon monoxide, it is recommended that co-indicator of prescribed accuracy or the iodine pentaoxide method or catalytic method, for example the Drager method, Katz method, or infra-red analysis may be used. Carbon dioxide may be tested with Orsat apparatus, Haldane apparatus or by the infra-red analysis.

B-1.2.3 Each *chulha* shall be tested separately. The carbon monoxide and carbon dioxide contents of the product of combustion shall be determined by the methods capable of an accuracy of 0.001 percent and 0.05 percent, respectively of the volume of the sample.

B.2 TEST FOR TOTAL SUSPENDED PARTICULATE MATTER (TSP)

B-2.1 Equipment

B-2.1.1 To determine total suspended particulate in ambient air, Handy sampler is used as an instrument. Handy sampler consists of mainly impinger (transparent nozzle type), filter holder, filter paper (Gelman GN-4, 37 mm and 64678 or its equivalent Whatman) and motor unit (which involves rotameter and suction pump). These accessories of the instrument have been shown in the flow diagram (*see* Fig. 6).

B-2.2 Preparation Before Operation

Filter paper (very neat and clean) is weighed on an electronic balance having an accuracy of 0.01 mg, very carefully and is placed between filter holder. The filter holder and No. 1 surge tank (as shown in flow diagram) are connected to the impinger and the other arrangements of the accessories are checked out as per the flow diagram.

B-2.3 Procedure

Timer can be set for desired sampling time. It is set for one hour. Sampling time can be set to various times within 60 minutes by turning the knob toward clockwise. The flow rate of suction of ambient air is set by rotameter, which can be used up to 2.5 l/min, *Max,* for the purpose of this specification. The instrument maintaining the above said conditions is placed at a distance of 30 to 45 cm from the burning *chulha* and at a height of 30 to 37.5 cm from the ground level of the *chulha.* After the completion of one hour the filter paper is taken out and is again weighed on the same electronic balance, on which weighed initially.

B-2.4 Calculation

The total suspended particulate matter is computed by measuring the mass of collected particulates and the volume of air sampled in the ambient air, in the following manner:

If

Initial mass of filter paper in g = X
final mass of filter paper, in g = Y
flow rate of ambient air, l/min = Z
(*see* Note)

NOTE — Flow rate Z l/min is to maintained for 1 h.

Then the mass of collected particulate, in g
$= (Y - X)$
$= (Y - X) \times 1\,000$ mg

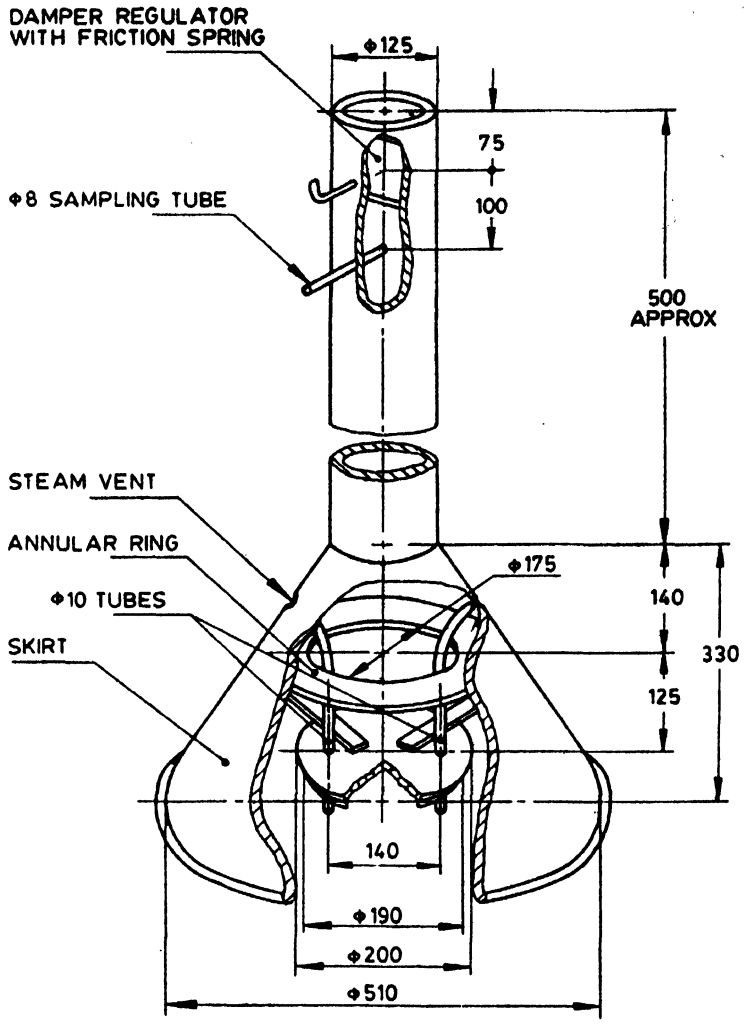
Total volume of air $= Z \times 60$ l $= 60\,Z$ l
$= \frac{60\,Z}{1\,000}$ m³ (since 1 000 l = 1 m³)

Total suspended particulate

$$= \frac{\text{Mass of collected particulates (mg)}}{\text{Volume of air sampled (m}^3\text{)}}$$

$$= \frac{(Y - X) = 1\,000 \text{ mg}}{\frac{60\,Z \text{ m}^3}{1\,000}}$$

$$= \frac{(Y - X) \times 10^6}{60\,Z} \quad \frac{\text{mg}}{\text{m}^3}$$



All dimensions in millimetres

FIG. 5 HOOD FOR *CHULHA*

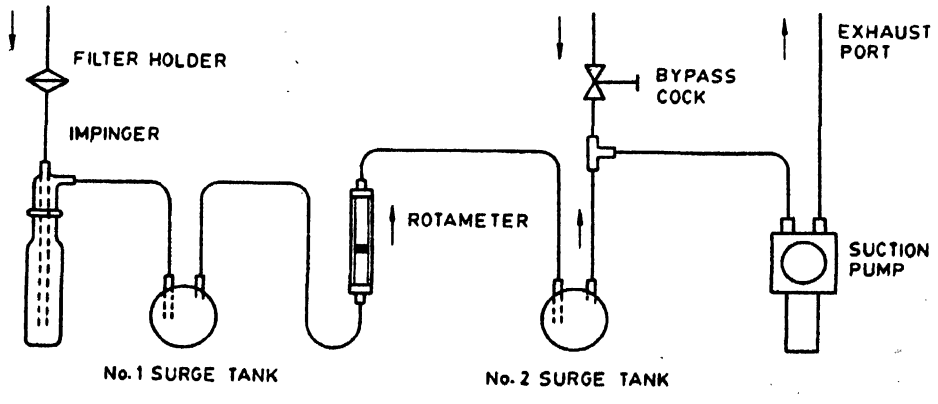


FIG. 6 FLOW DIAGRAM FOR HANDY SAMPLER

ANNEX C
(Clause 11.3.1)

METHOD OF MEASUREMENT OF SURFACE TEMPERATURE

C-1 PREPARATION OF *CHULHA*

C-1.1 The *chulha* shall be operated at the full output for one hour before starting the measurement of temperature, with the vessel containing water placed over it.

C-2 PROCEDURE

C-2.1 The temperature of all parts of the *chulha* which may be necessary to touch during its operation shall be measured by using a thermometer or any other suitable device for measuring the surface temperature. The temperature of each such parts shall be measured thrice every 30 minutes until equilibrium is reached. While measuring the temperature the thermometer shall be covered with a felt pad, asbestos or aluminium foil and kept in contact with that part for sufficient period of time until the maximum temperature is reached.

ANNEX D
(Clause 11.4)

PROCEDURE FOR QUENCHING TEST ON CAST IRON COMPONENTS OF PORTABLE *CHULHA*

D-1 PROCEDURE

D-1.1 Before each quenching, *chulha* will be burnt for 45 minutes duration and the feeding of fuel would be done at the rate of l/4th of the burning rate of wood every 15 minutes.

D-1.2 Quenching of grate and top plate only to be done. The top plate and grate will be de-linked from the *chulha* and put in water.

D-1.3 Top plate and grate will be put in water in separate vessels.

D-1.4 Water will be changed after every immersion.

D-1.5 Water to be taken should be in the temperature range of 20°C to 30°C.

D-1.6 Top plate and grate will be put in water in one stroke in horizontal position and submerged in the water.

D-1.7 Each vessel will contain 5 litres of water every time.

D-1.8 The cast iron components will be left in water for a duration of 10 minutes.

D-1.9 The cast iron components will be taken out of water after the duration given in **D-1.8** and then wiped and examined for any possible cracks.

D-1.10 The above process of beating and quenching shall constitute one cycle.

D-1.11 The above cycle shall be repeated for eight times first and further 2 times more (total 10 times). If there is no crack at the end of 10th cycle the sample may be considered to withstand the test. If a hairline crack develops at the end of eighth cycle and do not widen at the end of 10th cycle the part shall be further subjected to two more cycles and there shall be no further widening of the crack, otherwise the sample shall be considered not to withstand the test.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference :

Doc : No. MHD 26 (0030)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75 Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/l4 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16
Western : Manakaiaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	6 32 92 95

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. PATNA. SRINAGAR. THIRUVANANTHAPURAM.

Printed at Printrade, New Delhi, India