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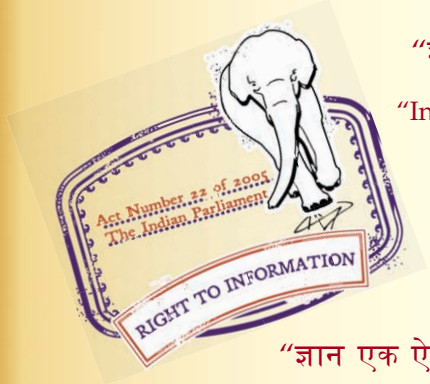

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IS : 5032 - 1983
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Indian Standard

RECOMMENDED SIZES OF CUPOLA FURNACE FOR FOUNDRY

(Second Revision)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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RECOMMENDED SIZES OF CUPOLA FURNACE FOR FOUNDRY

(Second Revision)

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Indian Standard

RECOMMENDED SIZES OF CUPOLA FURNACE FOR FOUNDRY

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 21 February 1983, after the draft finalized by the Foundry Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1969 and revised in 1975. As a result of experience gained during subsequent years, it has been decided to present more detailed data and to include cupola furnaces up to 2 100 mm internal diameter in the present revision. In this revision ' Wind Box ' shown in Fig. 1 has been designed with suitable taper at the top to avoid dust collection. Some of the dimensions given in Table 1 of the earlier version have also been modified, wherever found necessary.

0.3 Most of the small foundries have cupolas of traditional design, which do not take into account the various factors affecting efficiency, thus resulting in low quality metal and yield. This standard, which aims at the rationalization of sizes of cold-blast cupola, covering their salient dimensions, has been prepared in order to guide the designers of cupolas and to assist the small scale foundries in improving the quality of their castings and for achieving higher productivity.

0.4 This standard keeps in view the manufacturing and trade practices followed in the country in this field.

0·5 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers recommended sizes of the cold-blast cupolas for use in foundries.

2. SIZES, SHAPE AND CONSTRUCTIONAL DETAILS

2.1 The recommended sizes of cold-blast cupolas shall comply with nominal dimensions given in Table 1 (*see also* Fig. 1).

2.2 Shape and construction shall be as given in Fig. 1 read in conjunction with Table 1.

2.3 Tuyere area shall be large enough to provide easy delivery of combustion air to the coke bed. Tuyere ratio refers to the ratio of the sum of areas of individual tuyere openings to the cross-sectional area of the cupola after lining at the tuyere level.

2.3.1 The tuyere ratio may vary from 1 : 4 to 1 : 15. For Indian conditions, ratio of 1 : 6 or 1 : 7 is suitable.

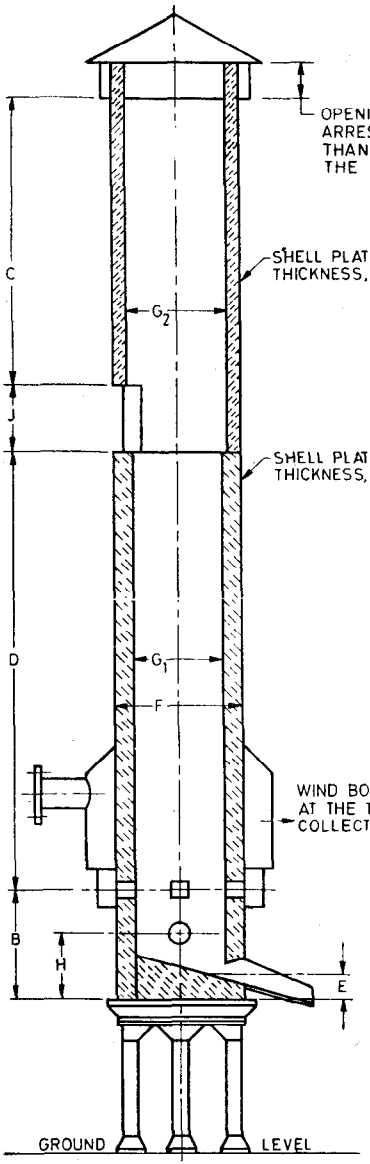
2.3.2 One of the tuyeres provided shall be of safety type, arranged at a distance of 25 to 50 mm below the normal tuyere level and having a fusible plate fixed in a small channel.

2.3.3 It is preferable to have two rows of tuyeres 900 mm apart on cupolas having diameter 1 050 mm and above. In such cases, two wind belts shall be used, however, the volume of air through the two wind belts and two rows of tuyeres shall be same as though a single row of tuyeres has been used (*see* Fig. 2).

2.3.4 Air inlet pipe shall be arranged tangential to the wind chamber (*see* Fig. 3). Each tuyere shall be provided with a valve for regulating the supply of air to the cupola. Fan type blower may be used for sizes up to 900 mm diameter. For larger sizes, centrifugal positive displacement type of blower is recommended.

2.4 It is essential to have proper control of air blast in order to operate the cupola at its optimum efficiency. For this purpose, the cupola shall be fitted with a blast pressure gauge and blast volume meter.

2.5 Depending on the quality of coke used, design of cupola and the operating conditions, the specific melting rate may vary from 4·8 to 10 (t/m^2)/h of cupola plan area. Under Indian operating conditions, specific melting rate of 8 (t/m^2)/h can be attained with superior variety of coke having ash content around 16 to 20 percent and proper control of operating parameters. With optimum selection of design and process parameters and good quality of raw materials it is possible to achieve still higher melting rates. Specific melting rate of 6·5 (t/m^2)/h may be attained using coke having ash content around 21-27 percent under average working conditions. Specific melting rate of 4·8 (t/m^2)/h may be obtained with inferior coke having ash content higher than 27 percent.



B — Height of centre line of tuyeres from base plate.

C — Height of shell from sill end to the top of cupola without the spark arrester.

D — Effective height.

E — Height of centre line of tap hole from base plate.

F — Inner diameter of shell.

G_1 — Inner diameter after lining below the charging door.

G_2 — Inner diameter after lining above the charging door.

H — Height of centre line of slag hole from base plate.

J — Size of charging door.

T_1 — Thickness of shell plate below the charging door.

T_2 — Thickness of shell plate above the charging door.

All dimensions in millimetres.

FIG. 1 CONSTRUCTIONAL DETAILS FOR CUPOLA FURNACE

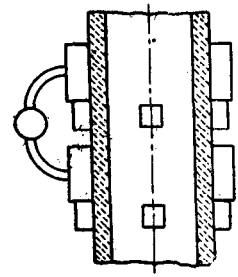


FIG. 2 SECTION OF CUPOLA WITH TWO WIND BELTS

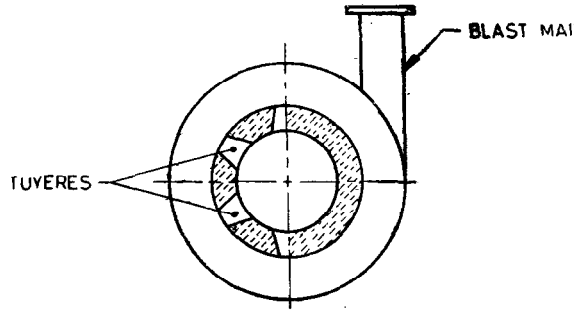


FIG. 3 FLAIRED CUPOLA TUYERES

2.5.1 Specific melting rate lower than 4·8 (t/m^2)/h shall be wholly uneconomical to operate on.

2.5.2 Besides the dimensions, Table 1 also shows average melting rates for three specific melting rate values. Blast pressure and blast volume values are also shown for two specific melting rates, 6·50 and 4·80 (t/m^2)/h.

2.5.3 Cupolas having internal diameter up to 900 mm, centrifugal type of blower may be used and for larger size positive displacement type blower is recommended.

2.6 While constructing the shell of the cupola, the brick retaining rings shall be rivetted around the inside of the shell below and above the charging door to help in keeping the brick lining in place.

TABLE 1 RECOMMENDED DIMENSIONS FOR CUPOLA FURNACES (FOR COLD BLAST OPERATION)

(*Clauses* 2.1, 2.2 *and* 2.5.2)

Sl No.	Characteristic	Cupola Designation									
		C600	C750	C900	C1050	C1200	C1350	C1500	C1650	C1800	C1950	C2100
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	Cupola diameter, inside, after lining at the hearth (G_1), mm	600	750	900	1 050	1 200	1 350	1 500	1 650	1 800	1 950	2 100
ii)	Cupola plan area, cm²	2 825	4 415	6 360	8 655	11 300	14 300	17 660	21 370	25 430	29 850	34 620
iii)	Shell thickness below charging door (T_1), mm	5·0	8·0	10·0	10·0	10·0	12·0	12·0	12·0	16·0	16·0	16·0
iv)	Lining thickness in *melting zone*, mm											
	a) Short run	125	125	125	175	175	175	175	225	225	225	225
	b) *Long run*	150	150	150	200	200	200	200	250	250	250	250
v)	Inside diameter of cupola shell (F), mm											
	a) Short run	880	1 030	1 280	1 530	1 710	1 860	2 010	2 260	2 430	2 580	2 730
	b) Long run	930	1 080	1 330	1 580	1 760	1 910	2 060	2 310	2 480	2 630	2 780
vi)	Sand filling, mm	15	15	15	15	15	15	15	15	15	15	15
vii)	Split brick, mm	—	—	50	50	65	65	65	65	75	75	75
viii)	Inner diameter after lining above charging door (G_2), *mm*	600	840	1 000	1 200	1 350	1 550	1 700	1 900	2 050	2 200	2 350
ix)	Total tuyere area, cm² for tuyere ratios:											
	a) 1 : 4	705	1 105	1 590	2 165	2 825	3 575	4 100	5 340	6 360	7 460	8 665
	b) 1 : 5	565	885	1 270	1 730	2 260	2 860	3 530	4 275	5 085	5 970	6 240
	c) 1 : 6	470	735	1 060	1 440	1 885	2 385	2 945	3 360	4 240	4 975	5 770
	d) 1 : 7	405	630	910	1 235	1 615	2 045	2 525	3 055	3 635	4 265	4 945
x)	Number of tuyeres	4	4/5	6	6/8	8	8/10	10	10	10	10/12	12
xi)	Height of the centre line of tuyeres from base plate (B), mm	700	750	800	850	900	950	1 000	1 050	1 100	1 150	1 200
xii)	*Effective height from tuyeres*, to charging door sill (D), mm	3 000	3 250	3 500	3 750	4 000	4 250	4 500	4 800	5 100	5 400	5 700
xiii)	Minimum height from charging door *sill to* cupola top without the spark arrester (C), mm	3 000	3 000	3 500	3 500	4 000	4 000	4 500	4 500	5 000	5 000	5 000
xiv)	Charging door dimensions* (J), mm											
	a) Length	450	500	550	600	650	700	750	800	900	900	900
	b) Height	350	400	450	500	550	600	650	700	750	750	750
xv)	Height of the centre line of top hole from base plate (E), mm	150	150	175	175	200	200	225	225	250	250	275
xvi)	Height of the centre line of slag hole from *base plate* (H), *mm*	450	475	500	525	550	575	600	625	650	675	700
xvii)	Blast pipe diameter, mm	200	250	300	350	400	450	500	550	600	660	700
xviii)	Wind box size											
	a) Radial width, mm	200	250	300	325	350	375	400	425	450	475	500
	b) Height, mm	500	625	750	875	1 050	1 125	1 200	1 275	1 350	1 425	1 500
xix)	Motor power											
	a) hp	7·5	10·0	18·0	25·0	35·0	45·0	60·0	70·0	85·0	100·0	120·0
	b) kW	5·6	7·5	13·5	19·0	26·0	33·8	45·0	52·0	63·4	74·6	90·0
xx)	Melting rate (t/h) with specific melting rates of:											
	a) 8·00 (t/m²)/h	2·5	3·5	5·0	7·0	9·0	11·5	14·0	17·0	20·5	24·0	28·0
	b) 6·50 (t/m²)/h	2·0	3·0	4·0	5·5	7·5	9·5	11·5	14·0	16·5	19·5	22·5
	c) 4·80 (t/m²)/h	1·5	2·0	3·0	4·0	5·5	7·0	8·5	10·5	12·5	14·5	17·0
xxi)	Blast pressure WG (cm) *at specific melting* rates of 6·50 (t/m²)/h and above, at core metal ratios:											
	a) 1 : 5	72	81	87	97	103	110	119	125	131	140	146
	b) 1 : 6	59	64	69	72	75	81	84	89	94	100	104
	c) 1 : 7	50	54	56	60	62	65	68	72	75	78	80
	d) 1 : 8	43	46	48	50	52	54	56	58	60	62	64
xxii)	Blast pressure WG (cm) at specific melting rates of less than 6·50 (t/m²)/h at coke metal ratios:											
	a) 1 : 5	67	75	81	88	94	100	108	114	120	126	133
	b) 1 : 6	58	61	65	68	72	76	80	84	80	92	95
	c) 1 : 7	48	51	55	57	60	62	65	68	70	72	—
	d) 1 : 8	43	45	47	50	51	53	55	56	58	60	—
xxiii)	Blast volume, m³/min, at specific *melting* rates 6·50 (t/m²)/h and above, at coke metal ratios:											
	a) 1 : 5	53	65	97	132	166	219	268	308	357	414	467
	b) 1 : 6	49	57	81	114	154	191	235	276	317	378	426
	c) 1 : 7	32	42	68	93	130	168	212	255	303	350	400
	d) 1 : 8	25	33	54	80	118	158	196	240	280	325	377
xxiv)	Blast volume, m³/min, at specific melting rates less than 6·50 (t/m²)/h, at coke *metal* ratios:											
	a) 1 : 5	45	55	70	90	112	148	188	230	275	317	365
	b) 1 : 6	40	45	60	75	100	132	170	210	250	295	340
	c) 1 : 7	32	35	46	65	89	115	146	185	125	266	310
	d) 1 : 8	25	27	40	55	75	102	131	170	207	245	285

*For mechanical charging system, the charging door dimensions may be adjusted suitably.

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2.6.1 The size of brick retaining rings below the charging door shall be at a distance of 1 200 mm above the upper tuyeres and subsequently after every 1 200 mm height. The size of brick retaining rings above the charging door shall be 100 mm wide and 16 to 25 mm thick according to the size of cupola, and these rings shall be placed 1 200 mm apart.

2.7 In building the lining for cupola diameters up to 750 mm, the fire bricks shall be about 12 mm clear of the cupola shell and this space shall be filled with sand or genister as the work proceeds. For larger cupola furnaces, split bricks of thickness ranging from 50 to 75 mm shall be used in between the lining and sand filling (*see* Fig. 4A and 4B).

2.8 To protect the lining, cast iron blocks shall be provided to a height of 1 000 mm below the charging door (*see* Fig. 5).

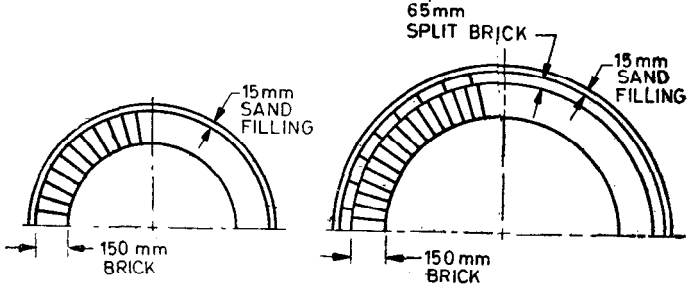
2.9 The thickness of shell above the charging door (T_2) may range between 5 and 10 mm according to the size of cupola.

2.9.1 The material used for shell, shall be of mild steel conforming to IS : 226-1975*.

2.10 A suitable stack level indicator mechanism may be provided as agreed to between the manufacturer and the user.

2.11 The minimum height of the supporting column from ground level to base plate shall be decided so that the drop bottom opens freely and unused material is discharged freely.

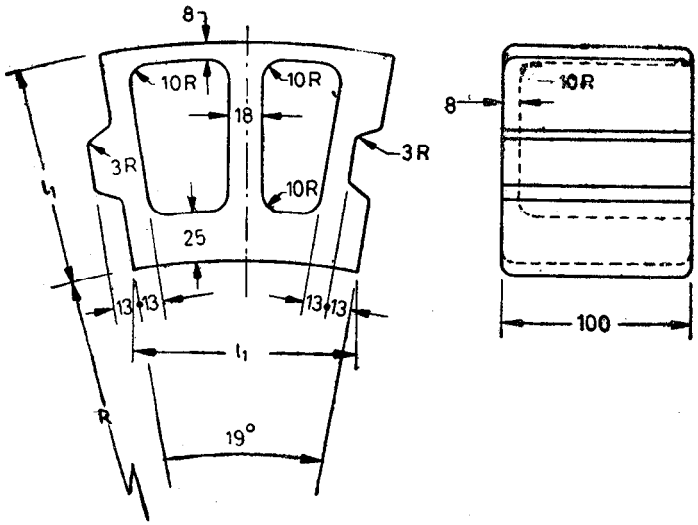
2.12 For the provision of a suitable dust collector, the height of the cupola shell above the charging door may be modified.



4A Small Cupola 4B Big Cupola

FIG. 4 LINING PLANS FOR SMALL AND BIG CUPOLAS

*Structural steel (standard quality) (*fifth revision*).



l_1 = 2/3 of lining thickness below the charging door
R = ½ lined diameter
Material = chilled cast iron (45 HRC)

All dimensions in millimetres.

FIG. 5 TYPICAL CAST IRON BLOCK