UDC 621·85·051·2 : [669·13 + 669·141·24]

(Reaffirmed 1995)

Indian Standard

SPECIFICATION FOR CAST IRON AND MILD STEEL FLAT PULLEYS

(Second Revision)

Pulleys and Belts Sectional Committee, EDC 42; Pulleys and Fasteners Subcommittee, EDC 42 : 4 [Ref : Doc : EDC 42 (2917)]

1. Scope — Covers the requirements for cast iron and mild steel pulleys for mechanical power transmission.

1.1 Pulleys of special types and dynamo pulleys are not covered in this standard.

1.2 The information to be supplied by the purchaser with the enquiry or order is given in Appendix A.

2. Types — The pulleys shall be of the following types:

Type of Pulley	*Maximum Rim Speed* m/min
i) Cast iron pulleys:	
a) Solid, with flat or crown face	1 500
b) Split, with flat or crown face	1 000
ii) Mild steel pulleys, solid or split, with flat or crown face and mild steel spokes	1 500

3. Dimensions

3.1 *Diameters and Tolerances* — Shall be as given in Table 1.

TABLE 1 DIAMETERS AND TOLERANCES ON DIAMETERS

All dimensions in millimetres.

Nominal Diameter	Tolerance on Nominal Diameter	Nominal Diameter	Tolerance on Nominal Diameter
(1)	(2)	(1)	(2)
40	±0·5	280	±3·2
45	±0·6	315	
50		355	
56	±0·8	400	±4·0
63		450	
71	±1·0	500	
80		560	±5·0
90	±1·2	630	
100		710	
112		800	±6·3
125	±1·6	900	
140		1 000	
160	±2·0	1 120	±8·0
180		1 250	
200		1 400	
224	±2·5	1 600	±10·0
250		1 800	
		2 000	

Adopted 28 January 1980

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3.2 *Width of Flat Pulleys* — Shall be as given in Table 2.

TABLE 2 WIDTH OF FLAT CAST IRON AND MILD STEEL PULLEYS

All dimensions in millimetres.

Width	Tolerance	Width	Tolerance
(1)	(2)	(1)	(2)
20		160	
25		180	
32		200	
40	± 1	224	± 2
50		250	
63		280	
71		315	
80		355	
90		400	
100		450	
112	± 1·5	500	± 3
125		560	
140		630	

3.3 *Shape of Pulleys*

3.3.1 *Shape of crown — See* Fig. 1.

3.3.1.1 The shape of the profile shall be flat (*see* Fig. 1A).

3.3.1.2 The shape of the profile shall be a regular, symmetrical curve as shown in Fig. 1B.

3.3.1.3 A symmetrical profile with a flat central part may, however, be accepted provided that:

a) the flat part is tangential to the curve, and

b) its width is not more than 40 percent of the width of the pulley (*see* Fig. 1C).

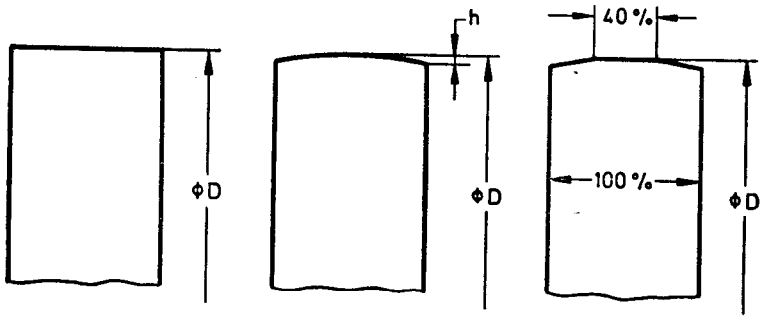


FIG. 1 SHAPES OF PULLEY CROWNS

3.3.2 *Dimensions of crown* — The height of the crown, h, of flat pulleys shall be as given in Tables 3 and 4. It varies with the diameter of pulleys (and for larger diameters, with the width of the rim).

Note — The crown values given in Tables 3 and 4 are calculated by the formula $h = 0{\cdot}003 \times D$, where D is the diameter of the pulley. An upper limit has, however, been applied above a certain value of D for each range of widths.

TABLE 3 CROWN OF CAST IRON AND STEEL FLAT PULLEYS OF DIAMETERS FROM 40 TO 355 mm INCLUSIVE

(*Clause* 3.3.2)

Nominal Diameter *D* mm	Crown* *h* mm
40 to 112	0·3
125 and 140	0·4
160 ,, 180	0·5
200 ,, 224	0·6
250 ,, 280	0·8
315 ,, 355	1

Note — In the case of 140 mm diameter pulley, used for the railway train-lighting dynamo drive, in order to ensure that the belt rides centrally and to compensate for slight misalignment, while negotiating curves, the crown at present used is 3·2 mm.

*Crown is unrelated to the width in this diameter range.

TABLE 4 CROWN OF CAST IRON AND MILD STEEL PULLEYS OF DIAMETERS FROM 400 TO 2 000 mm

(*Clause* 3.3.2)

Nominal Diameter *D*	Crown (in mm) of Pulleys of Width (*a*) (in mm)						
	125 and Smaller	140 and 160	180 and 200	224 and 250	280 and 315	355	400 and Larger
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
400	1	1·2	1·2	1·2	1·2	1·2	1·2
450	1	1·2	1·2	1·2	1·2	1·2	1·2
500	1	1·5	1·5	1·5	1·5	1·5	1·5
560	1	1·5	1·5	1·5	1·5	1·5	1·5
630	1	1·5	2	2	2	2	2
710	1	1·5	2	2	2	2	2
800	1	1·5	2	2·5	2·5	2·5	2·5
900	1	1·5	2	2·5	2·5	2·5	2·5
1 000	1	1·5	2	2·5	3	3	3
1 120	1·2	1·5	2	2·5	3	3	3·5
1 250	1·2	1·5	2	2·5	3	3·5	4
1 400	1·5	2	2·5	3	3·5	4	4
1 600	1·5	2	2·5	3	3·5	4	5
1 800	2	2.5	3	3·5	4	5	5
2 000	2	2·5	3	3·5	4	5	6

3.4 Preferred sizes of pulleys (diameter × width of face) or other proportions have not been prescribed in this specification, and these shall be agreed upon between the purchaser and the supplier. However, size details of spokes and other proportions of pulleys commonly used have been given in Appendix B for information.

3.5 *Bore* — When ordering pulleys, the purchaser shall specify the diameter of the bore and shall furnish details of keyways. Unless otherwise stipulated by the purchaser, the bore shall have the following tolerance limits, as specified in IS : 919-1963 'Recommendations for limits and fits for engineering (*revised*) ':

a) Solid pulleys — H7

b) Split pulleys — U7

4. Material

Type of Pulley	*Material*
i) Cast iron	Grade FG 200 of IS : 210-1978 'Specification for grey iron castings (*third revision*) '
ii) Mild steel	Steel conforming to IS : 226-1975 'Specification for structural steel standard quality (*fifth revision*) '

5. Manufacture

5.1 The pulleys shall be of solid or split construction, and with flat or crown face, as may be specified by the purchaser. Pulleys with central disc construction are also permissible in the smaller sizes, but additional details of such pulleys shall be subject to agreement between the manufacturer and the purchaser.

5.2 In case of mild steel pulleys, the boss may be of cast iron or of mild steel.

5.3 If cast iron is used for pulleys, the casting shall be of close grain and free from porosity or blow holes after machining and free from contraction cracks and hollows in the spokes, centre plate and boss. Iron cement or other recognized filling medium may, however, be used to fill small defects in the rim, centre plate and boss.

5.4 When the length of the boss is more than twice the diameter of the bore, chamfered bores are acceptable provided the width of the chamfer is not greater than one-third of the boss length.

5.5 Any superficial defects in the rim, boss and web (excluding those in spokes) may be rectified by welding or brazing in such a way as not to give rise to internal stresses. The use of plastic having the appearance of metal, or lead or of compressed soft metals, is not permitted.

5.6 The spokes made of steel may be shrunk fit or securely screwed where the hub is made of cast iron, and may also be welded if the hub is made of steel. Where the spokes are of cast iron, they shall be cast solid with the hub.

5.7 The joints between the rim and the spokes may be either welded or riveted where both rim and spokes are made of mild steel.

5.8 The rim and bore shall be machined to have a good finish. Unless otherwise specified by the purchaser, the bore shall be machined for sliding fit on the appropriate shaft (*see* **3.5**).

5.9 The face of cast iron pulleys shall be machined, either flat or crown, as may be specified by the purchaser. The face of mild steel pulleys shall be either rolled or machined to form flat or crown, as may be specified by the purchaser.

5.10 The rivet heads or protruding welded portions on the rim face shall be properly dressed smooth to prevent damage to the belt.

5.11 Sharp corners on the rim edges of both cast iron and mild steel pulleys shall be removed to prevent damage to the belt.

5.12 The faces of the boss and rim sides of both cast iron and mild steel pulleys shall be well finished.

6. Balancing of Pulleys — Since out-of-balance pulleys set up vibrations which increases as the speed increases or which may develop to serious amplitudes at certain speeds, all pulleys shall be balanced statically, and they shall be dynamically balanced subject to agreement between the manufacturer and the purchaser if the width of the face in relation to the peripheral speed makes it necessary.

7. True Running — The permissible errors for true running of the outside diameter and rim sides of the pulleys shall be as given in Table 5.

8. Tests

8.1 *True Running* — For testing the true running of the outside diameter and rim sides, the pulley shall be fitted to the respective size of test mandrel and shall be placed on lathe centres. The pulley shall be revolved slowly to find out the degree of inaccuracy as illustrated in Fig. 2.

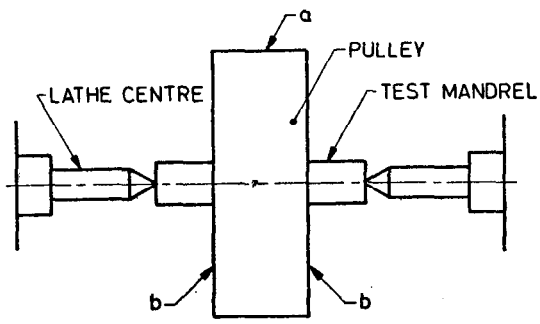
8.2 *Static Balancing* — Test for balancing shall be made in a balancing machine. A typical testing machine is illustrated in Fig. 3. The machine essentially consists of two supporting frames each carrying a bevelled straightedge which has been carefully levelled.

TABLE 5 PERMISSIBLE ERRORS FOR TRUE RUNNING FOR OUTSIDE DIAMETER AND RIM SIDE

(Clause 7)

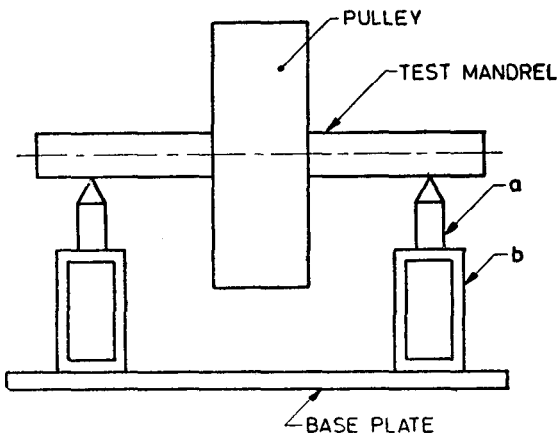
All dimensions in millimetres.

Diameter	Permissible Errors	
	Cast Iron Pulleys	Mild Steel Pulleys
(1)	(2)	(3)
100 to 250	0·25	—
300 ,, 500	0·38	1·52
560 ,, 960	0·50	2·03
1 000 ,, 1 500	0·63	2·54
1 500 ,, 2 000	0·76	3·05



Note — Testing at *a* for true running of pulley diameter.
Testing at *b* for true running of rim sides of pulley.

FIG. 2 TESTING DEVICE FOR TRUE RUNNING OF PULLEYS



a = machined bevel straight parallel edges carefully levelled, and
b = supporting frame for straightedges.

FIG. 3 TESTING DEVICE FOR STATIC BALANCING OF PULLEYS

9. Inspection and Testing Facilities — The manufacturer or supplier of pulleys shall afford at his own expenses all reasonable facilities to the inspector to assure himself that the pulleys have been manufactured fully in accordance with the requirements of this standard.

10. Marking — Each pulley shall be marked with nominal diameter and nominal width. It may also be marked with the manufacturer's name, initials or trade-mark.

10.1 *ISI Certification Marking* — Details available with the Indian Standards Institution.

11. Preservative Treatment — The pulleys shall be painted all over with anti-corrosive paint except for the bore which shall be greased.

12. Packing — The pulley shall be supplied loose or in packages as may be agreed to between the purchaser and the supplier. When cast iron pulleys are required to be transported by rail or steamer, they shall be packed in wooden cases or crates or in other suitable manner to prevent damage in transit.

APPENDIX A

(*Clause* 1.2)

INFORMATION TO BE SUPPLIED BY THE PURCHASER WITH THE ENQUIRY OR ORDER

A-1. Duty Conditions

A-2. Type of Pulleys

a) *Material* — Cast iron or mild steel (*see* **4**),
b) *Construction* — Solid or split (*see* **5.1**), and
c) *Face*
   1) Flat or crown,
   2) Rolled or machined (for mild steel pulleys only) (*see* **5.9**).

A-3. Dimensions

a) Nominal diameter (*see* Table 1),
b) Width (*see* Table 2), and
c) Diameter of bore and details of keyway (*see* **3.5**).

A-4. Other Details

a) Disc construction (*see* **5.1**),
b) Other proportions (*see* **3.4**), and
c) Packing (*see* **12**).

APPENDIX B

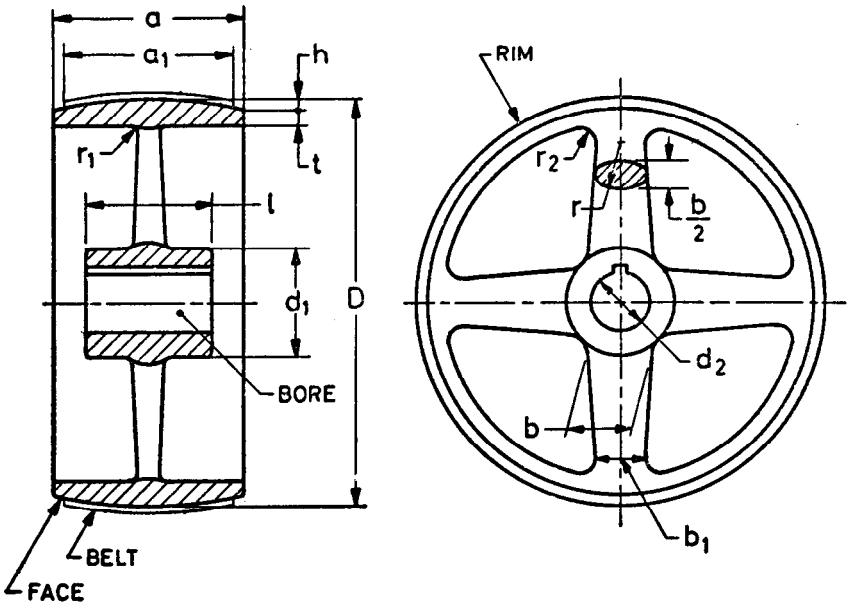
(*Clause* 3.4)

INFORMATION ON CURRENT PRACTICES IN DESIGN OF PULLEYS

B-1. General — Information on current practices in design on pulleys followed by reputable manufacturers is given in this appendix. Purchasers are recommended to get in touch and obtain recommendations of reputable manufacturers for procuring the right type of pulleys for their use. Full details of the duty conditions should be furnished while making enquiries. This appendix should not be used as a basis for purchaser.

B-2. Cast Iron Pulleys — The diameters of cast iron pulleys most commonly in demand are given in Table 1. It is quite common for users to give their own drawings for cast iron pulleys up to 200 mm diameter, but even up to this diameter, efforts should be made to popularize the sizes that have been tabulated. Above 200 mm the sizes given in the table are quite popular.

B-2.1 *Proportions for Cast Iron Pulleys* — *See* Fig. 4.



a_1 = width of belt

FIG. 4 CAST IRON PULLEY

a) Number of arms:
   1) For pulleys up to 200 mm diameter, use webs.
   2) For pulleys above 200 mm diameter and up to 450 mm diameter, use 4 arms.
   3) For pulleys above 450 mm diameter use 6 arms.

b) Cross-sections of arms — elliptical.

c) (1) Thickness of arm b near boss $= 2{\cdot}94 \sqrt[3]{\frac{aD}{4n}}$ for single belt

$= 2{\cdot}94 \sqrt[3]{\frac{aD}{2n}}$ for double belt

where

a = width of pulley,
D = diameter of pulley, and
n = number of arms in the pulley.

(2) Thickness of arm b_1, near rim = taper 4 mm per 100 mm.

d) Radius of the cross-section of arms, $r = \frac{3}{4}b$.

e) Minimum length, l, of the bore = 2/3 a; it may be more for loose pulleys, but in no case it exceeds a.

f) $\frac{d_1 - d_2}{2} = 0{\cdot}412 \times \sqrt[3]{aD} + 6$ mm for single belt.

$= 0{\cdot}529 \times \sqrt[3]{aD} + 6$ mm for double belt.

g) Radius $r_1 = \frac{b}{2}$ (near rim)

Radius $r_2 = \frac{b}{2}$ (near rim).

B-3. Mild Steel Pulleys

B-3.1 The diameters of mild steel pulleys most commonly in demand are given in Table 1.

B-3.1.1 *Proportions and other details of mild steel pulleys (see Fig. 5)* — Pulleys are normally supplied split flat unless otherwise specified.

B-3.1.2 *Arrangement of arms* — Pulleys up to 300 mm width are normally supplied with single row of spokes. Wider pulleys requiring double row of spokes are at times in demand, but details of the same not included in this appendix.

B-3.1.3 *Number of arms in pulleys*

Diameter mm	*Details of Spokes*	
	Number	Diameter mm
280 to 500	6	19
560 to 710	8	19
800 to 1 000	10	22
1 120	12	22
1 250	14	22
1 400	16	22
1 600	18	22
1 800	18	22
2 000	22	22

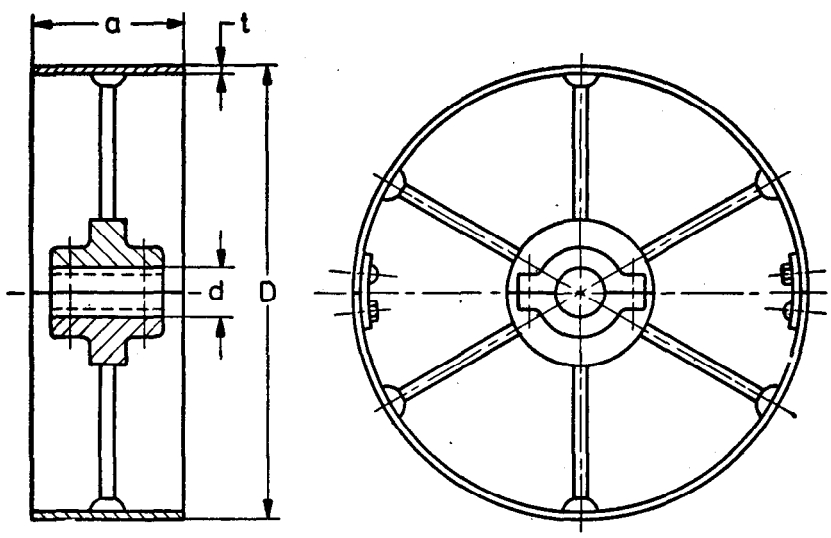


FIG. 5 MILD STEEL PULLEY

B-3.1.4 *Minimum length of boss* — The length of boss is equal to half the width of face, subject to a minimum of 100 mm in the case of pulleys with 19 mm diameter spokes and minimum of 138 mm for pulleys with 22 mm diameter spokes. The length of the boss is practically greater than the width of the pulleys.

B-3.1.5 *Thickness of rims* — The thickness of 5 mm for the rim of all the pulleys tabulated in Table 1 may be applicable for mild steel pulleys only. For cast iron flat pulleys the thickness may be specified as below:

$$\text{Rim thickness} = \frac{D}{200} + 3 \text{ mm for single belt}$$

$$= \frac{D}{200} + 6 \text{ mm for double belt}$$

EXPLANATORY NOTE

This standard, originally published in 1960, was revised in 1968 to bring this standard in line with the then current technological practices. The present revision has been taken up to bring this standard in line with the modern manufacturing techniques.

Pulleys of various types are in use for different power transmission systems. This standard covers the requirements only for mild steel and cast-iron flat and crowned pulleys of the very commonly used types. It does not include dynamo pulleys and other special types of pulleys.

While preparing this standard assistance has been derived from the following standard issued by the International Organization for Standardization:

ISO 22-1975 Widths of flat transmission belts and corresponding pulleys

ISO 99-1975 Diameters of pulleys for flat transmission belts

ISO 100-1975 Crowns of pulleys and balancing of transmission pulleys

ISO/R 254-1962 Quality, machining and balancing of transmission pulleys

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