भारतीय मानक

Indian Standard

IS 4600 : 2024

लचीले शाफ्ट — विशिष्टि

(पहला पुनरीक्षण)

Flexible Shafts — Specification

(First Revision)

ICS 21.120.10

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
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April 2024

Price Group 7

Transmission Devices Sectional Committee, PGD 33

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Transmission Devices Sectional Committee had been approved by the Production and General Engineering Division Council.

This standard was first published in 1968. This revision has been taken up to keep pace with the latest technological developments and international practices.

This standard has been prepared with a view to achieve uniformity in the manufacture and easy inter changeability of parts of flexible shafts.

Flexible shafts make it possible to transmit power or to provide remote control between any two points with a single self-contained element, regardless of the relative position of the two points or obstacles on the path between them.

Flexible shafts are mechanical power-transmission devices used to transmit rotary motion through bends and curves. They can be routed over, under, and around obstacles which would be otherwise impossible for a solid shaft and costly for universal joints.

A flexible shaft system uses a motor to rotate a flexible shaft. The end of the shaft contains a hand piece, which contains the desired-shape. It is operated by an adjustable power source. Flexible shaft hand piece accessories include burs, drill bits, polishing wheels, or brushes.

The composition of the Committee responsible for formulation of this standard is given in Annex A.

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 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FLEXIBLE SHAFTS — SPECIFICATION

(First Revision)

1 SCOPE

This standard covers the requirements and principal dimensions of flexible shafts for industrial purposes.

2 REFERENCES

The following standard given below contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and encouraged to investigate the possibility of applying the most recent edition of these standard:

IS No.	*Title*
IS 4454 (Part 1) : 2001	Steel wire for mechanical springs — Specification Part 1: Cold drawn unalloyed steel wire (*third revision*)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply:

3.1 Direction of Rotation — The direction which tightens up the outer layer of the inner shaft.

3.2 End Stiffener — A member helically wound and slipped over either end of the outer casing to prevent excessive bend of the shaft near the ends.

3.3 Flexible Shaft Assembly — A combination of inner shaft assembly and co-ordinated outer casing assembly. Practically all applications of the flexible shaft require a flexible shaft assembly.

3.4 Inner Shaft — The bare working element without end fittings.

3.5 Inner Shaft Assembly — The inner shaft with end fittings attached or one with integrally formed squares.

3.6 Outer Casing — A flexible covering in the form of tube which acts as a runway or guide for the inner shaft, protects it from dirt and injury, assists in retaining lubrication and prevents formation of loops in operation.

3.7 Outer Casing Assembly — The outer casing with end fittings attached.

3.8 Outer Casing end Fittings — Parts used for fastening to the ends of the outer casing, by means of which the outer casing is connected or coupled to the driving and driven elements (*see* Fig. 1).

3.9 Lay of the Shaft — The pitch direction of the outer layer of shaft. Depending upon the direction of lay, shaft shall be specified as right lay or left lay.

3.10 Shaft end Fittings — Parts for fastening to the ends of the inner shaft by means of which the flexible shaft assembly is connected to the driving and driven elements.

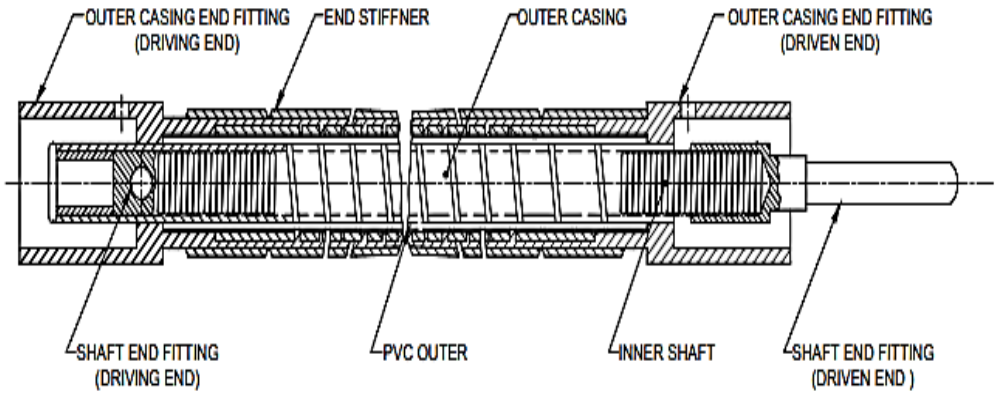


FIG. 1 FLEXIBLE SHAFT ASSEMBLY

4 MATERIALS AND MECHANICAL PROPERTIES

4.1 Inner Shaft — The inner shaft shall be made of spring steel according to IS 4454 (Part 1).

4.2 Outer Casing — The outer casing shall have an inner liner of suitable steel having a minimum tensile strength of 120 kgf/mm^2 with rolled rounded edge.

5 DIMENSIONS

The dimensions of flexible shall assembly covered in this standard are of two types, namely, Type A and Type B as given below:

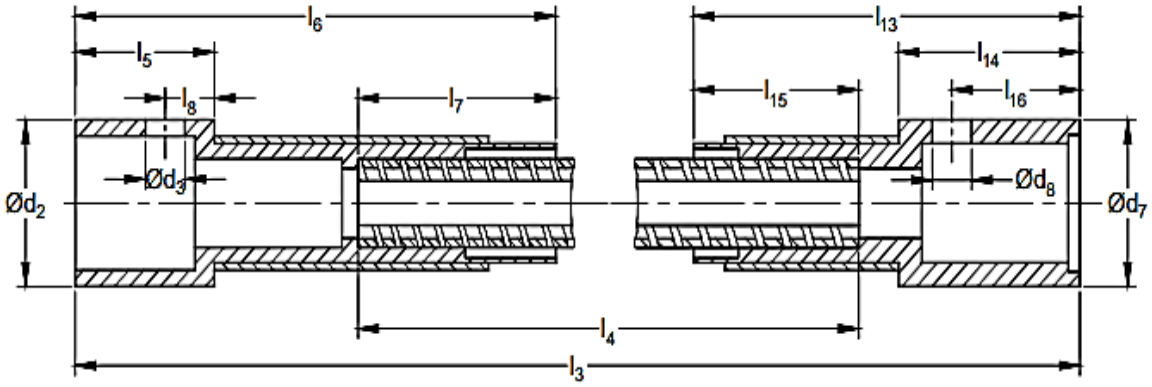
a) Type A — Threaded shaft end fittings on both ends with the outer casing sliding at the driving end. The dimensions of Type A flexible shaft assembly and their parts shall be as given in Table 1 and Table 2.

b) Type B — Fixed outer casing end fittings on both ends and sliding shaft end fittings at the driven end. The dimensions of Type B flexible shaft assembly and their parts shall be as given in Table 3.

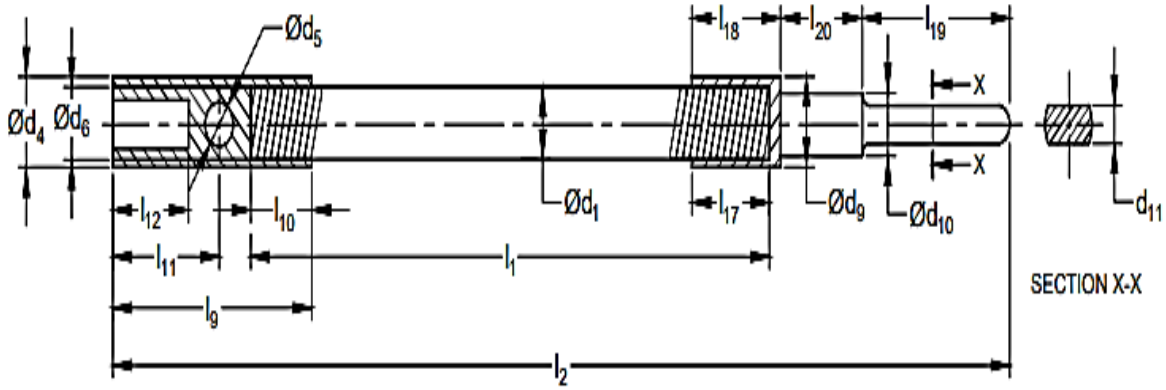
Table 1 Dimensions for Flexible Shafts

[*Clause* 5 (a)]

All dimensions are in millimeters.



OUTER CASING ASSEMBLY



INNER SHAFT ASSEMBLY

Table (*Concluded*)

Sl No.	Designation	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	d_9	l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}	l_{11}	l_{12}	l_{13}	l_{14}	l_{15}	l_{16}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
i)	7 × 1 500	7	22	12.0	5	M10	8.5	5.0	3.9	7.5	1 500	1 590	1 547	1 463	30	75	33	40	11	24	18	20	15	20	18	38
ii)	7 × 2 000	7	22	12.0	5	M10	8.5	5.0	3.9	7.5	2 000	2 090	2 047	1 963	30	75	33	40	11	24	18	20	15	20	18	38
iii)	10× 1 500	10	28	12.0	5	M10	12.0	7.5	5.9	7.5	1 500	1 605	1 548	1 448	40	90	40	47	15	25	18	28	20	23	18	52
iv)	10 × 2 000	10	28	12.0	5	M10	12.0	7.5	5.9	7.5	2 000	2 105	2 048	1 948	40	90	40	47	15	25	18	28	20	23	18	52
v)	12 × 1 500	12	28	14.0	5	M10	14.0	7.5	5.9	11.0	1 500	1 607	1 550	1 450	40	95	40	50	18	25	18	28	25	30	18	52
vi)	12 × 2 000	12	28	14.0	5	M10	14.0	7.5	5.9	11.0	2 000	2 107	2 050	1 950	40	95	40	50	18	25	18	28	25	301	8	52
vii)	15 × 2 000	15	35	17.5	7	M14	17.5	10.0	8.9	11.0	2 000	2 109	2 059	1 959	50	95	45	64	26	33	23	34	25	28	13	55
viii)	15 × 3 000	15	35	17.5	7	M14	17.5	11.0	8.9	11.0	3 000	3 109	3 059	2 959	50	95	45	64	26	33	23	34	25	28	13	55
ix)	20 × 2 000	20	40	23.0	7	M14	—	—	—	—	2 000	2 086	2 110	1 960	43	110	35	73	30	33	23	27	—	—	—	—
x)	20 × 3 000	20	40	23.0	7	M14	—	—	—	—	3 000	3 086	2 110	2 960	43	110	35	73	30	33	23	27	—	—	—	—

NOTE — The dimensions given for 20 mm shaft are for the type where the shaft has a threaded (fixed) connection at both aides and not sliding at the tool holder.

Table 2 Dimensions of Type A Flexible Shaft Assembly and Parts

[*Clause* 5(a)]

All dimension are in millimeters.

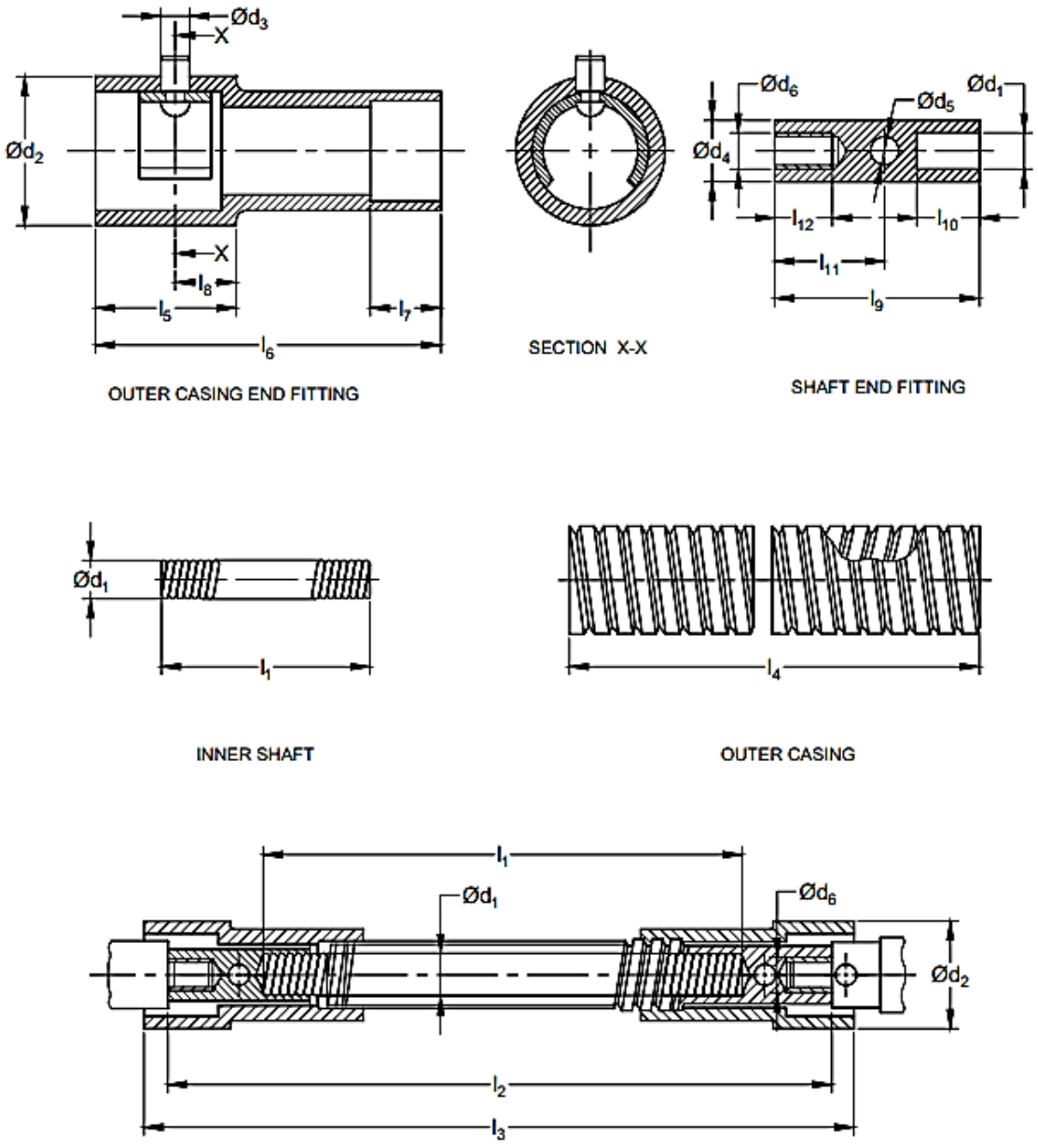


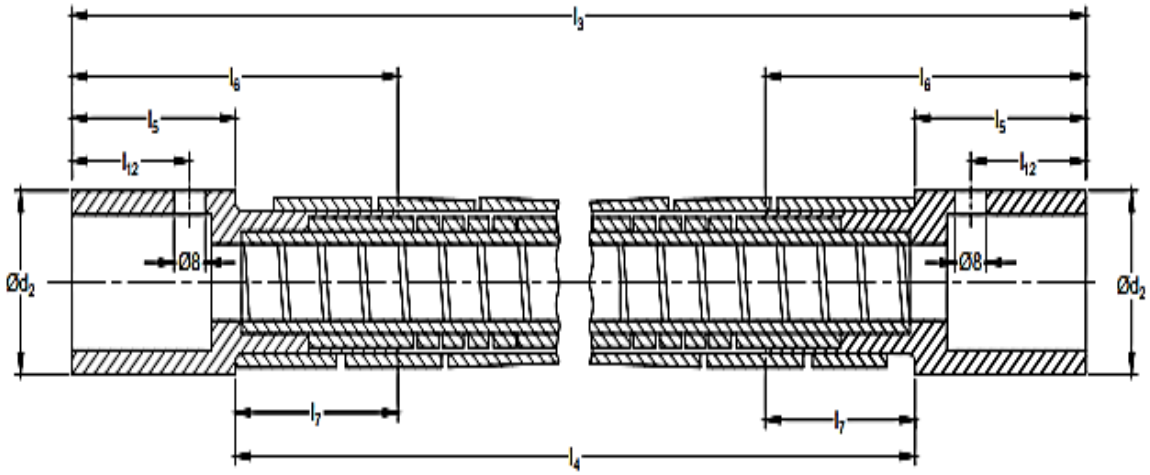
Table *(Concluded)*

Sl No.	Designation	d_1	d_2	d_3	d_4	d_5	d_6	l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}	l_{11}	l_{12}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
i)	7 × 1 500	7	20	6	9	3	M6	1 500	—	—	1 470	40	133	36	13	35	10	19	12
ii)	7 × 2 000	7	20	6	9	3	M6	2 000	—	—	1 220	40	133	36	13	35	10	19	12
iii)	10 × 1 500	10	28	8	12	4.5	M10	1 500	1 570	1 610	1 460	40	133	36	13	50	15	27	17
iv)	10 × 2 000	10	26	8	12	4.5	M10	2 000	2 070	2 110	1 960	40	133	36	13	50	15	27	17
v)	12 × 1 500	12	28	8	14	4.5	M10	1 500	1 570	1 590	1 450	40	133	36	13	55	20	27	17
vi)	12 × 2 000	12	28	8	14	45	M10	2 000	2 070	2 090	1 950	40	133	36	13	55	20	27	17
vii)	13 × 2 000	13	34	8	18	6.5	M10	2 000	2 090	2 114	1 930	40	133	36	13	70	25	35	22
viii)	15 × 3 000	15	34	8	18	6.5	M10	3 000	3 090	3 114	2 930	40	133	36	13	70	25	35	22
ix)	20 × 2 000	20	40	8	23	65	M14	2 000	2 090	2 114	1 920	40	133	36	13	75	30	35	22
x)	20 × 3 000	20	40	8	23	65	M10	3 000	3 090	3 114	2 920	40	133	36	13	75	30	35	22

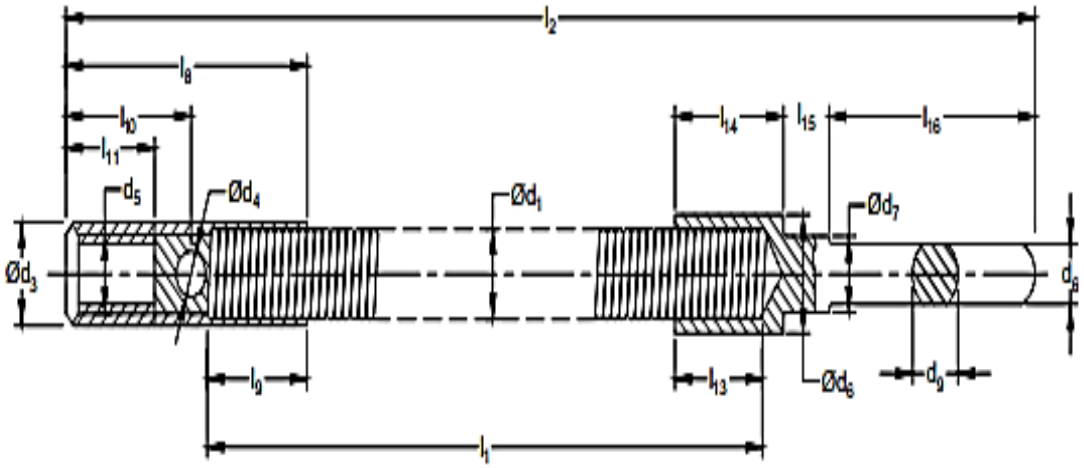
Table 3 Dimensions for Type B Flexile Shaft

[*Clause* 5(b)]

All dimensions are in millimeters.



OUTER CASING ASSEMBLY



INNER SHAFT ASSEMBLY

Table (*Concluded*)

Sl No.	Designation	d_1	d_2	d_3	d_4	d_5	d_6	d_7	d_8	d_9	d_{10}	d_{11}	l_1	l_2	l_3	l_4	l_5	l_6	l_7	l_8	l_9	l_{10}	l_{11}	l_{12}	l_{13}	l_{14}	l_{15}	l_{16}	l_{17}	l_{18}	l_{19}	l_{20}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
i)	7 × 1 500	7	30	8	120	5	M 10	22	8	8.5	5.0	3.9	1 500	1 590	1 547	1 452	30	86	33	10	40	11	24	18	75	31	33	20	15	20	38	18
ii)	7 × 2 000	7	30	8	120	5	M 10	22	8	8.5	5.0	3.9	2 000	2 090	2 047	1 952	30	96	33	10	40	11	24	18	75	31	33	20	15	20	38	18
iii)	10 × 1 500	10	30	8	120	5	M 10	28	8	12.5	7.5	5.9	1 500	1 605	1 548	1 436	30	102	40	10	47	15	25	18	90	40	40	28	20	23	52	18
iv)	10 × 2 000	10	30	8	120	5	M 10	28	8	14.0	7.5	5.9	2 000	2 105	2 048	1 936	30	102	40	10	47	15	25	18	90	40	40	28	20	23	52	18
v)	12 × 1 500	12	30	8	140	5	M 10	28	8	14.0	7.5	5.9	1 500	1 607	1 550	1 430	33	105	40	13	50	18	25	18	95	40	40	28	25	30	52	18
vi)	12 × 2 000	12	30	8	140	5	M 10	28	8	140	7.5	5.9	2 000	2 107	2 050	1 930	33	105	40	13	50	18	25	18	95	40	40	28	25	30	52	18
vii)	15 × 2 000	15	40	8	175	7	M 14	35	8	17.5	11.0	8.9	2 000	2 109	2 059	1 959	40	95	45	13	64	26	33	23	95	50	45	34	25	28	55	13
viii)	15 × 3 000	15	40	8	175	7	M 14	35	8	17.5	11.0	8.9	3 000	3 109	3 059	2 059	40	95	45	13	64	26	33	23	95	50	45	34	25	28	55	13
ix)	20 × 2 000	20	40	8	23.0	7	M 14	40	8	—	—	—	2 000	2 086	2 110	1 960	43	110	35	16	73	30	33	23	110	43	35	27	—	—	—	—
x)	20 × 3 000	20	40	8	23.0	7	M 14	40	8	—	—	—	3 000	3 086	3 110	2 960	43	110	35	16	73	30	33	23	110	43	35	27	—	—	—	—

NOTE – The dimensions given for 20 mm shaft are for the type where the shaft has a threaded (fixed) connection at both sides and not sliding at the tool holder.

6 DESIGNATION

Flexible shaft assembly shall be designated by the commonly known name, a letter 'L' or 'R' representing left lay or right lay of the outer layer of the inner shaft, by the diameter of the inner shaft, length of the inner shaft and the number of this standard.

Example:

A flexible shaft having left lay as the outer layer of the inner shaft with inner shaft diameter of 12 mm and length 2 000 mm shall be designated as:

Flexible shaft L 12 × 2 000 (IS 4600)

7 TESTS

7.1 Visual Inspection

The shaft shall be free from obvious flaws, kinks, bends, looseness, etc.

7.2 Roll Test

A length of about 1 000 mm or more is taken, and is laid on the floor in a slight curve of about 10 m diameter and rolled back and forth at the center by foot the shaft shall roll smoothly throughout its length without offering resistance and without jerking or flapping about. The extreme ends may flap a little.

7.3 Locking Diameter Test

The flexible shaft assembly is looped and the junction is held in hand. One end of the flexible shaft is pulled, so as to reduce the diameter of the loop until the shaft assembly is felt to offer considerable resistance. The diameter of the loop is then measured. It shall be within 20 times the diameter of the inner shaft. The loop shall be as nearly circular as possible and there shall not be any obvious difference in the radius of curvature at two adjacent points.

8 MARKING

All the shafts shall be marked with the designation and manufacturer’s name or trademark. Cartons or the packages for the shaft shall be marked with the following:

a) Type and designation of the shaft;
b) Length of shaft;
c) Direction of shaft;
d) Manufacturer's name or trade-mark; and
e) Date of manufacturing.

9 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

10 PACKING

The flexible shaft shall be suitably packed to avoid damage during handling and transportation.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Transmission Devices Sectional Committee, PGD 33

Organization	*Representative(s)*
Maruti Suzuki India Limited, Gurugram	SHRI VIKAS CHOPRA **(*Chairperson*)**
Elecon Engineering Company Limited, Gujarat	SHRI VRAJLAL SENJALIYA SHRI VILAS B. KALYAN (*Alternate*) SHRI PRAYASVIN B. PATEL (*Alternate* II)
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Suzlon Energy Limited, New Delhi	SHRI MOHAMED NASEERUDDIN
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VE Commercial Vehicles Limited, Dewas	SHRI ARVIND MANOHAR SHRI MAHENDRAN MOHAN (*Alternate* I) SHRI SAPTHARISHI IYER (*Alternate* II)
In Personal Capacity (*20/2, At Rabindra Nagar Near Sikshan Bhaban, West Midnapore)*	SHRI ASHISH KUMAR KHANRA
In Personal Capacity (*D*-1, *Kailashpuri Complex, Kusum Vihar. Phase-2, Koylanagar, Dhanbad)*	SHRI K. K. S. SINHA

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Member Secretary
SHRI VICHITRA VIR SINGH
SCIENTIST 'D'/JOINT DIRECTOR
(PRODUCTION AND GENERAL ENGINEERING), BIS

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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