IS 2762 (2009): Wire Rope Slings and Sling Legs [MED 10: Wire Ropes and Wire Products]

BLANK PAGE

भारतीय मानक

वायर रोप स्लिंग्स एवं स्लिंग लैग्स — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

WIRE ROPE SLINGS AND SLING LEGS — SPECIFICATION

(Second Revision)

ICS 53.020.30; 77.140.65

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

July 2009

Price Group 7

Wire Ropes and Wire Products Sectional Committee, MED 10

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wire Ropes and Wire Products Sectional Committee had been approved by the Mechanical Engineering Division Council.

This standard was first published in 1964 and revised in 1982. The experience gained in the implementation of the first revision and the prevailing practices in the industry necessitated the present revision.

Safe working load at different methods of loading is given in Annex A. Guidelines for use of slings is given in Annex B. Discard criteria is given in Annex C.

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

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.

Indian Standard

WIRE ROPE SLINGS AND SLING LEGS — SPECIFICATION

(Second Revision)

1 SCOPE

This standard specifies dimensions, construction, method of loading, testing, marking and certification of one-, two-, three and four-leg slings of wire rope of nominal diameters from 6 mm to 60 mm of the following types with hand or mechanically spliced eye termination:

a) Single part sling,
b) Double part endless sling, and
c) Double part grommet sling.

NOTE — The guidelines for use of slings and the discard criteria for slings have been included in Annex B and Annex C respectively.

2 REFERENCES

The following standards 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 parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1875 : 1992	Carbon steel billets, blooms, slabs and bars for forgings (*fifth revision*)
2266 : 2002	Steel wire ropes for general engineering purposes — Specification (*fourth revision*)
2315 : 1978	Specification for thimbles for wire ropes (*first revision*)
2758 : 1969	Mild steel point hooks for use with wire rope thimbles
2759 : 1969	Higher tensile steel point hooks for use with wire rope thimbles
2760 : 1980	Specification for steel chain slings (*first revision*)
5245 (Part 1) : 1969	Methods for splicing of wire ropes: Hand splicing of wire ropes
(Part 2) : 1971	Wire rope sling legs with ferrule-secured eye terminals
10942 : 2000	Ferrules — Specification (*first revision*)
IS/ISO 9001 : 2000	Quality management system — Requirements

3 GENERAL REQUIREMENTS

3.1 Type of Rope

The type of rope to be used shall be a six stranded fibre or steel core or eight stranded steel core, ordinary lay, rope grade 1770 as specified in IS 2266. Use of higher rope grade is permitted but the safe working load shall be calculated on the basis of rope grade of 1770 only.

NOTE — The safe working load of the sling used in special application, however can be calculated on the basis of actual rope grade and construction with the agreement between the manufacturer and the user.

3.2 Formation of Eyes

Eyes of sling legs shall be formed by using hand splicing or mechanical splicing using ferrules conforming to IS 10942. Such eyes shall be soft eyes or reinforced with thimbles as per the requirement.

NOTE — Use of other types of ferrule is permitted as agreed to between the purchaser and the manufacturer.

3.2.1 *Soft Eyes*

The length of the soft eye shall be minimum twelve times the rope diameter unless otherwise specified. The width of the eye shall be approximately half of its length. In order to protect the bearing surface of the soft eye, a stirrup may be fitted. The bearing point over which the soft eye used shall be more than twice the rope diameter for single part sling and four times the rope diameter in case of endless type sling.

3.2.2 *Eyes Reinforced with Thimble*

These thimbles shall be of galvanized ordinary, reeving or solid type appropriate for the size of rope used, conforming to IS 2315.

3.2.3 *Hooks*

Eye hooks shall be of mild steel conforming to IS 2758 or of high tensile steel conforming to IS 2759.

3.2.3.1 The safe working load of the hook shall not be less than that of the leg to which it is attached.

3.3 Master Links (Rings)

Steel rings shall conform to IS 2760.

3.3.1 *Mild Steel Rings*

Mild steel rings shall be made from steel of Class 1A, Designation 20C8 of IS 1875. The rings may be either weldless or welded. When welded, the mild steel ring shall be made by one of the following methods:

a)	Electrical resistance butt welding	Suitable for sizes above 50 mm diameter
b)	Flash-butt welding	
c)	Atomic hydrogen welding	
d)	Inert-gas shielded-arc welding	
e)	Submerged arc welding	
f)	Covered electrode welding	

The rings shall be smoothly finished all round, and if they are welded, care shall be taken to avoid porosity and to ensure penetration and fusion throughout. When inspection by radiography is required by the purchaser, this shall be specified at the time of enquiry and order. The mild steel rings shall be normalized by heating uniformly in a furnace until the whole of the metal has attained a temperature between 880°C and 910°C. The rings shall then be withdrawn from the furnace and allowed to cool in still air. In all other respects, the mild steel rings shall comply with the requirements specified in IS 2760.

3.3.2 *High Tensile Steel Rings*

High tensile steel rings shall comply with IS 2760. The dimensions of master links (rings) can be calculated using formulae as given in Annex A.

3.3.3 The main and intermediate rings shall withstand the respective rated safe working load for the sling legs.

4 SINGLE PART SLING

A sling that has been made with only one part of rope is called a single part sling.

4.1 Minimum Length

To provide adequate flexibility and to allow splicing, the effective length of a single part sling shall not be less than 70 times the rope diameter. The actual length of a sling shall not differ from the nominal length by more than two rope diameters or 1 percent of the nominal length whichever is greater. The measurement shall be taken without applying any load.

4.1.1 *Length of Matched Sets*

The difference in length of matched sets of mechanically spliced slings shall not exceed the rope diameter or 0.5 percent of the nominal length, whichever is greater. The difference in length of matched sets of hand spliced slings shall not exceed twice the rope diameter or 1 percent of the nominal length whichever is greater.

4.2 Fabrication

4.2.1 *Hand Splicing*

Hand splicing shall be done as per IS 5245 (Part 1). Each hand splice shall have at least five tucks — three tucks with full strand of the rope and two tucks with the strand after removing half the number of wires from the inner layer. The tucks shall be over and under against the lay of the rope. The splice shall be tightly drawn and made neatly. The approximate length of five tuck splice exclusive of the thimble is 20 times the diameter of the rope. The portion of the hand splicing which contains the wire ends shall be served neatly and effectively with spun yarn or seizing wire or strand to extend protection to injury during use. Alternatively, when required by the purchaser, the full length of the splice may be served.

4.2.2 *Mechanical Splicing*

The splicing may also be done by mechanical means or swaging as required by the purchaser. Mechanical splicing shall be done as per IS 5245 (Part 2).

4.3 Safe Working Load

The safe working load (SWL) of a single part sling for straight pull can be calculated as follows:

$$SWL = \frac{F_o \times K_t}{9.806\,65 \times z_p}$$

where

F_o = minimum breaking force of the rope,

K_t = splicing efficiency factor (0.8 for hand splicing and 0.9 for mechanical splicing),

9.806 65 = constant for converting force unit (kN) to mass unit (tonne), and

z_p = (5) Coefficient of utilization.

5 DOUBLE PART ENDLESS SLING

A sling that is made endless by splicing the ends and subsequently folded to form double part sling.

5.1 Minimum Length

To provide adequate flexibility and to allow splicing, the effective length of a double part endless sling shall be not less than 70 times the diameter of the rope using ordinary thimble and 80 times the diameter of the rope using reeving thimble. The length of an endless sling shall be taken to be half the circumference of the circle formed on the centre line. The actual length of a sling shall not differ from the nominal length by more than two rope diameters or 1 percent of the nominal length, whichever is greater. The measurement shall be taken without applying any load.

5.1.1 *Length of Matched Sets*

The difference in length of matched sets of mechanically spliced slings shall not exceed the rope diameter or 0.5 percent of the nominal length, whichever is greater. The difference in length of matched sets of hand spliced slings shall not exceed twice the rope diameter or 1 percent of the nominal length, whichever is greater.

5.2 Fabrication

5.2.1 *Hand Splicing*

5.2.1.1 The initial length of the straight rope shall be placed overlapping two ends. The ends shall then be spliced at each side with a five tuck splice, making the complete splice ten tucks altogether. Hand splicing at each side shall have five tucks — three tucks with full strand of the rope and two tucks with the strand after removing half the number of wires from the inner layer. The tucks shall be over and under against the lay of the rope. The splice shall be tightly drawn and made neatly. The approximate length of a ten tuck splice is 40 times the diameter of the rope.

5.2.1.2 At those portions of the hand spliced endless rope which will seat in the thimble grooves, the single part of the rope shall be served with spun yarn to suit the grooves in the oversize thimble and to provide a foundation for the throat seizing. The length of each serving shall be such that in addition to the portion in contact with the thimble groove, it underlies and projects three rope diameters beyond the throat seizing.

5.2.1.3 Those portions of the splice which contain the wire ends shall be neatly and effectively served with spun yarn or seizing wire/strand to extend protection to injury during use. Alternatively, when required by the purchaser the full length of the taper splicing zone may be served.

5.2.1.4 The hand spliced endless rope shall have its two parts brought into parallel contact with the two served portions forming the bight at each end. A thimble shall be throat size close up to its point into each bight of the rope by means of a suitable annealed quality galvanized wire/strand. The overall length of each throat seizing shall not be less than six times the diameter of rope.

5.2.1.5 The seizing shall be tightly drawn and neatly made, free from projections liable to cause injury during use. When the sling leg exceeds 100 times the diameter of the rope, a central seizing equal to three times the diameter of rope shall be provided. In case of longer sling leg intermediate seizing of above length shall be provided at intervals not greater than 72 times the rope diameter.

NOTE — Unless specified otherwise, one end of the ten tuck served spliced point shall remain adjacent but clear of the thimble in the finished sling leg.

5.2.2 *Mechanically Spliced*

The splicing may also be done by mechanical means or swaging as required by the purchaser.

5.3 Safe Working Load

The safe working load (SWL) of a double part endless sling for straight pull can be calculated as follows:

$$SWL = \frac{2 \times F_o \times K_t}{9.806\ 65 \times z_p}$$

F_o = minimum breaking force of the rope,

K_t = splicing efficiency factor (0.8 for hand splicing and 0.9 for mechanical splicing),

9.806 65 = constant for converting force unit (kN) into mass unit (tonne) used in lifting application, and

z_p = (5) Co-efficient of utilization.

6 DOUBLE PART GROMMET SLING

6.1 Wire Rope Grommet

Wire rope grommet is an endless wire rope made from one continuous length of strand formed to make a body composed of six strands around a strand core. The strand ends are tucked into the body forming the core with the tuck position diametrically opposite to the core butt position.

6.2 Minimum Length

To provide adequate flexibility the effective length of a double part grommet sling shall not be less than 40 times the diameter of the rope when using ordinary thimbles and not less than 50 times the diameter of the rope when using reeving thimbles. The tolerance in length of the grommet shall be ± 0.5 percent of the nominal circumferential length or $\pm 0.5 \times d$ whichever is greater (d = diameter of the single part of the grommet). The measurement shall be taken without applying any load.

6.3 Fabrication

6.3.1 Fabrication shall be done as per IS 5245 (Part 1).

6.3.2 The strand used to produce a wire rope grommet shall be one of those required to form a six stranded rope of a construction as described in IS 2266 in right hand ordinary lay, fibre main core with wires of tensile designation of 1770. During production of grommet a temporary rigid circular core shall be used over which

the strand shall be laid side by side using a method which ensures that the strand tensions are equalized and the finished product is free from visible waviness. The grommet lay factor shall not be more than 8 times the nominal diameter of the rope. The crossing of the tucks shall be placed adjacent to, but clear of, one thimble and under the throat seizing in the finished sling leg. Those portions of the grommet which will seat in the thimble grooves, the single part of the rope shall be served with spun yarn to suit the grooves in the oversize thimbles and to provide foundation to the throat seizing. The length of each serving shall be such that, in addition to the portion in contact with the thimble groove it underlines and projects three rope diameters beyond the throat seizing.

6.3.3 The finished grommet shall have its two parts brought into parallel contact with the two served portions forming the bight at each end. A thimble shall be throat seized close up to its point into each bight of the rope by means of annealed quality galvanized wire/ strand. The overall length of each throat seizing shall not be less than six times the diameter of the rope. The seizing shall be tightly drawn and neatly made free from projections liable to cause injury during use. When the sling leg exceeds 100 times the diameter of the rope a central seizing equal to three times the diameter of the rope shall be provided. In case of longer sling legs, intermediate seizing of above length shall be provided at intervals not greater than 72 times the diameter of the rope.

6.4 Safe Working Load

The safe working load (SWL) of a double part grommet sling for straight pull can be calculated as follows:

$$SWL = \frac{2 \times F_o \times K_t}{9.806\,65 \times z_p}$$

F_o = minimum breaking force of the unit rope with fibre main core and wire tensile Designation of 1770 whose strand is utilized in making the grommet,

K_t = (0.80) Splicing efficiency factor,

9.806 65 = constant for converting force unit (kN) into mass unit (tonne) used in lifting application, and

z_p = (5) Coefficient of utilization.

7 SLING ASSEMBLIES

7.1 The assembled slings shall be one of the forms shown in the Fig. 1 to 10.

7.2 Components Attachment

The components for all slings shall be spliced or seized (as may be appropriate) directly to the sling leg, with the exception of four-leg slings, which shall comprise two-leg assemblies complete with intermediate rings and a main ring. The welding and heat treatment of the rings shall be completed before the wire rope legs are attached.

7.3 Effective Length

The effective length of all slings and sling legs shall be the length between the bearing points of their terminal components like thimble, ring or hook unless otherwise specified. The measurement shall be taken without applying any load. For multi-leg slings the actual individual leg lengths shall not differ from the nominal length of the sling by more than two rope diameters or 1 percent of the nominal length whichever is greater. The difference in length between the individual legs of any multi-leg sling shall not exceed 1.5 times the rope diameter or 0.5 percent of the nominal length whichever is greater.

8 TESTING

Before assembly all rings and hooks shall be tested to a proof load which is equivalent to twice the safe working load. A sample of rope shall be tested according to IS 2266. After fabrication of sling, each sling leg shall be tested to a proof force which is equivalent to twice its safe working load.

8.1 Extent of Manufacturing Proof Force Testing

The manufacturing tests shall depend on whether the manufacturer has an applicable quality management system or not. The system shall comply with an internationally acceptable standard like IS/ISO 9001 and be certified by internationally accredited third party certification body. If such system is in place and operating, the test described in 7 shall be designated as type test and shall be carried out by the sling manufacturer as per their quality plan and shall be presented to the customer or his representative for verification whenever required. Every non-standard or one-off sling assembly shall be tested in accordance with 7.

9 METHOD OF LOADING

9.1 The safe working load for slings as given in **4.3**, **5.3** and **6.4** is for one sling under straight pull. Slings however can be utilized using different methods of loading as described in Annex A. The safe working load under each method of loading can be worked out using the appropriate factor given in Annex A. The safe working load and the proof load for the master ring may also be calculated under different conditions as given in **9.2** and **9.3**.

9.2 After final heat treatment of the master ring and intermediate ring the slings with accessories shall be tested as an assembly. Multi-leg wire rope slings shall, however, be tested in sections as given in Table 1.

9.3 Proof Load

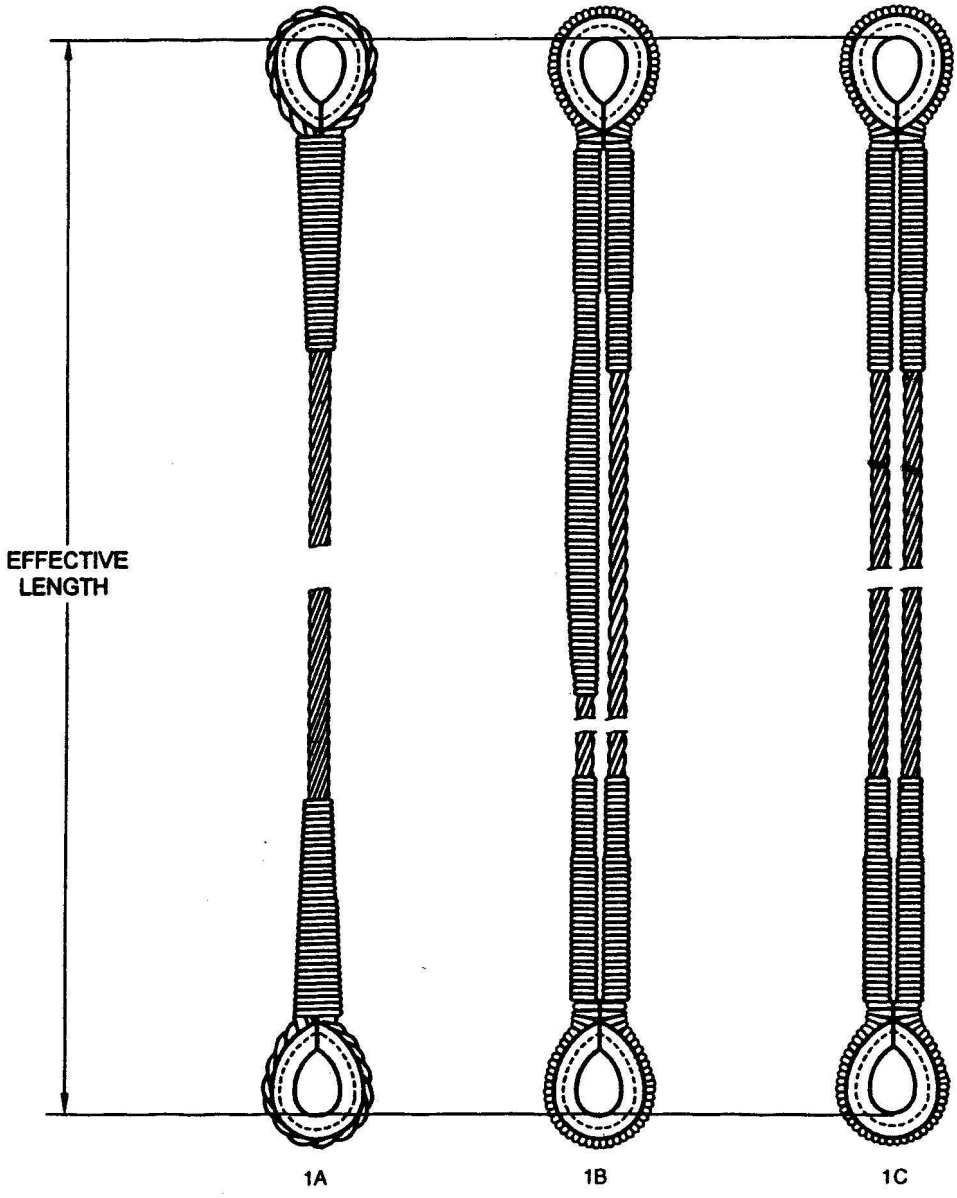
Proof load for the rope, master ring, intermediate ring and the complete assembly shall be equal to double their respective safe working load for the angle of application, as given in **9.2**.

10 MARKING

10.1 All slings shall be marked legibly on,

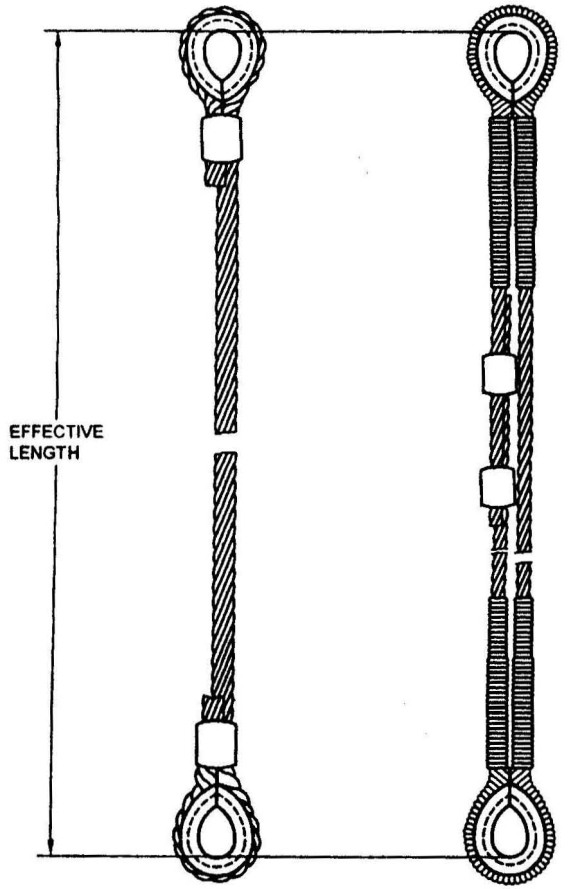
a) a durable metal label or a sleeve firmly attached to the sling;
b) body of the ferrule (without causing any damage); and
c) master link (ring).

with at least following information:



1A Single Part Sling
1B Double Part Endless Sling
1C Double Part Grommet Sling

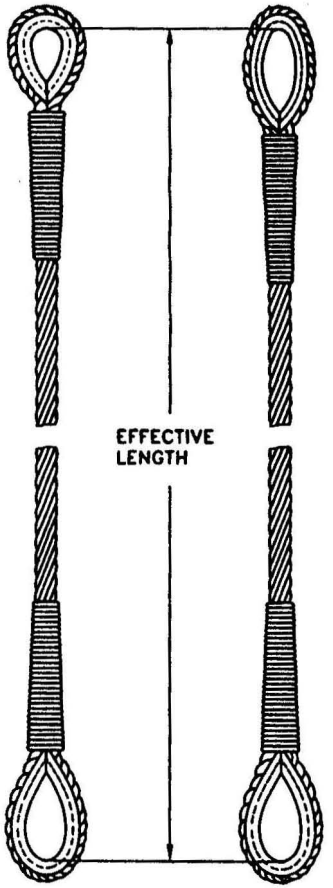
FIG. 1 ONE-LEG WIRE ROPE SLINGS WITH ORDINARY THIMBLES AT BOTH ENDS (HAND SPLICED)



2A 2B

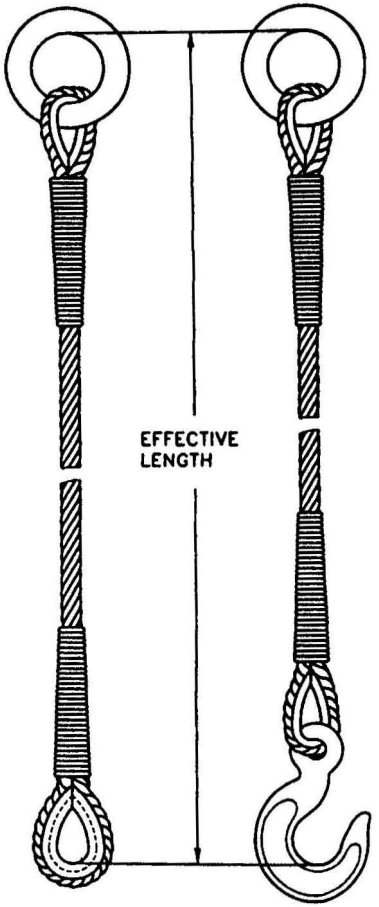
2A Single Part Sling
2B Double Part Endless Sling

FIG. 2 ONE-LEG WIRE ROPE SLING WITH ORDINARY THIMBLES AT BOTH ENDS (MECHANICALLY SPLICED)



3A 3B

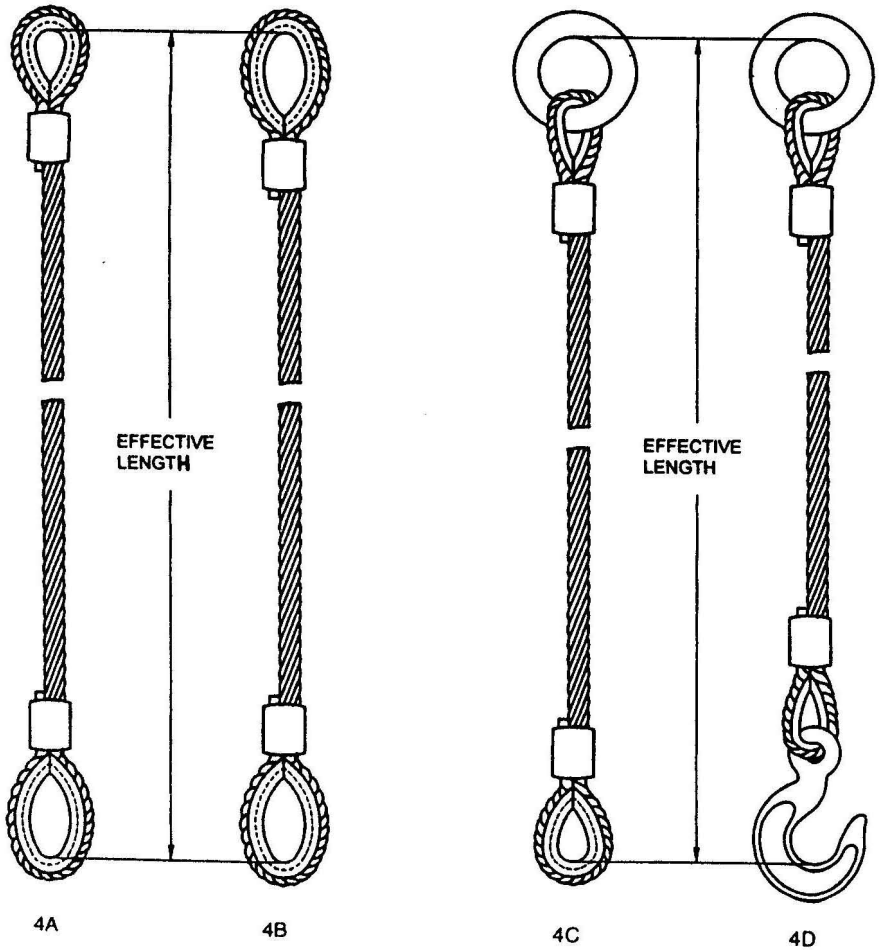
3A Ordinary Thimble at One End
Reeving Thimble at Other End
3B Reeving Thimbles at Both Ends



3C 3D

3C Ring at One End
Ordinary Thimble at Other End
3D Ring at One End, Hook at Other End

FIG. 3 ONE-LEG WIRE ROPE SLINGS (HAND SPLICED)



4A Ordinary Thimble at One End
Reeving Thimble at Other End
4B Reeving Thimbles at Both Ends
4C Ring at One End, Ordinary Thimble at Other End
4D Ring at One End, Hook at Other End

FIG. 4 ONE-LEG WIRE ROPE SLING (MECHANICALLY SPLICED)

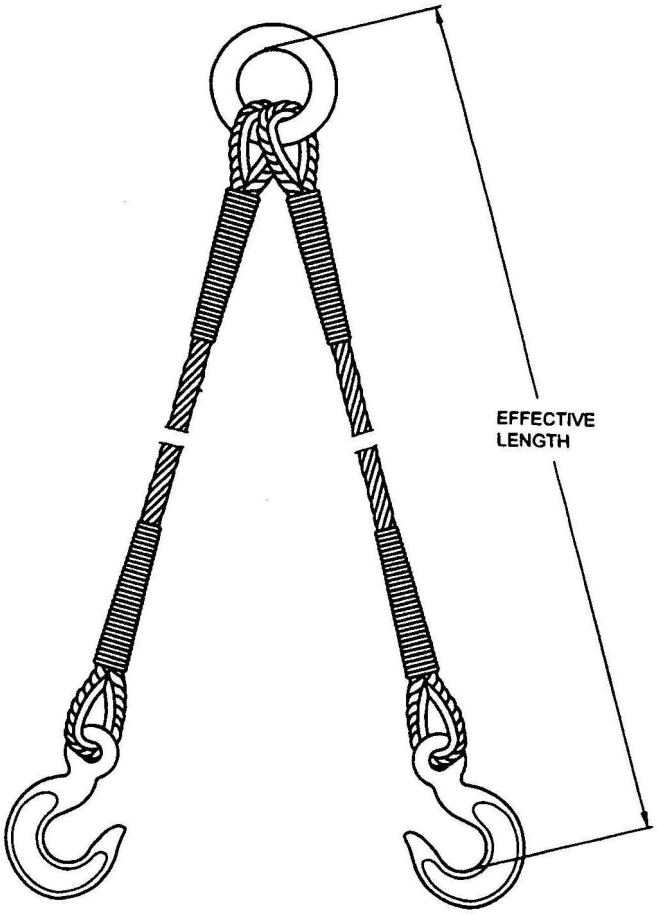


FIG. 5 TWO-LEG WIRE ROPE SLINGS WITH MAIN RING AT ONE END, HOOKS AT OTHER ENDS (HAND SPLICED)

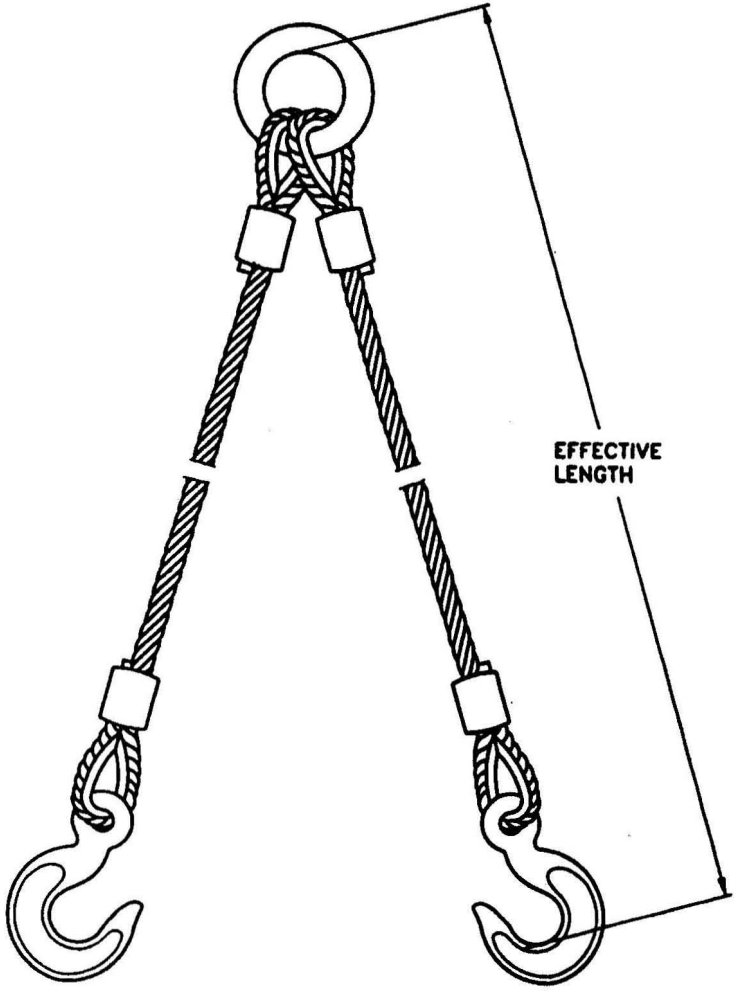


FIG. 6 TWO-LEG WIRE ROPE SLING WITH MAIN RING AT ONE END, HOOKS AT OTHER ENDS (MECHANICALLY SPLICED)

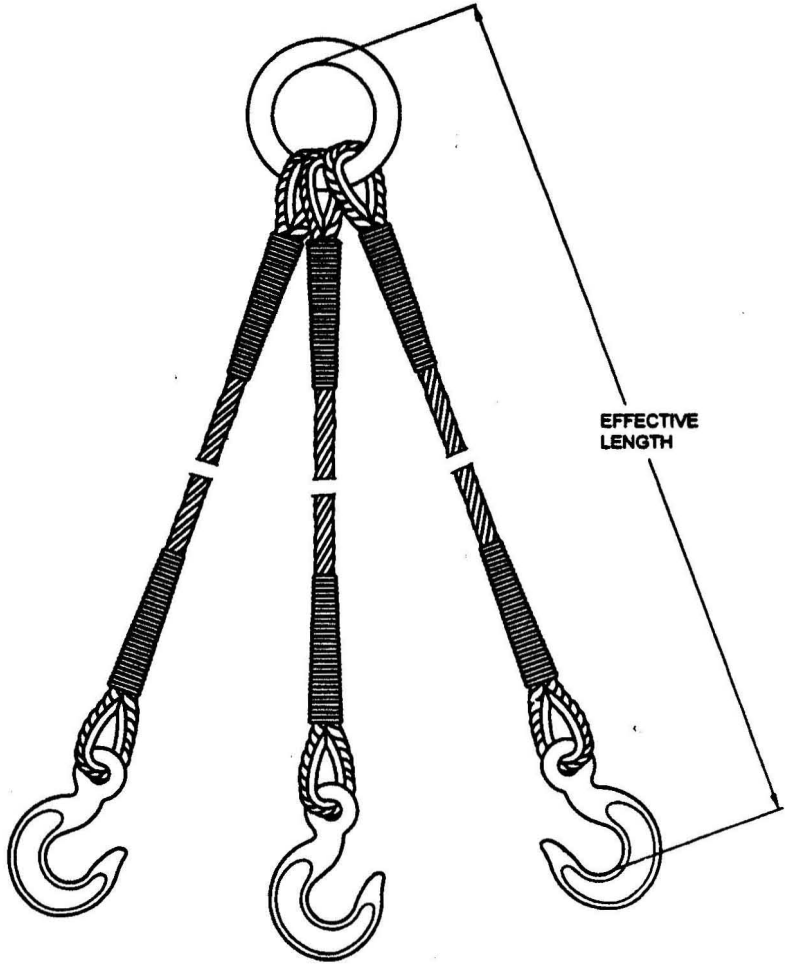


FIG. 7 THREE-LEG WIRE ROPE SLING WITH MAIN RING AT ONE END, HOOKS AT OTHER ENDS (HAND SPLICED)

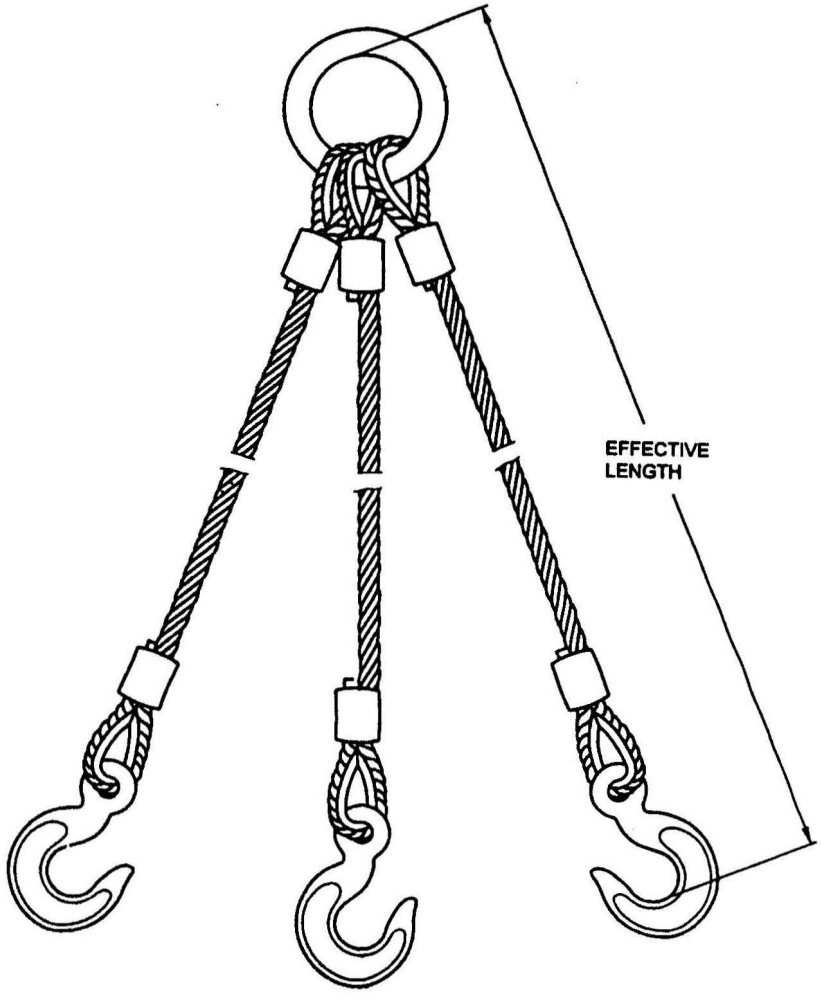


FIG. 8 THREE-LEG WIRE ROPE SLING WITH MAIN RING AT ONE END, HOOKS AT OTHER ENDS (MECHANICALLY SPLICED)

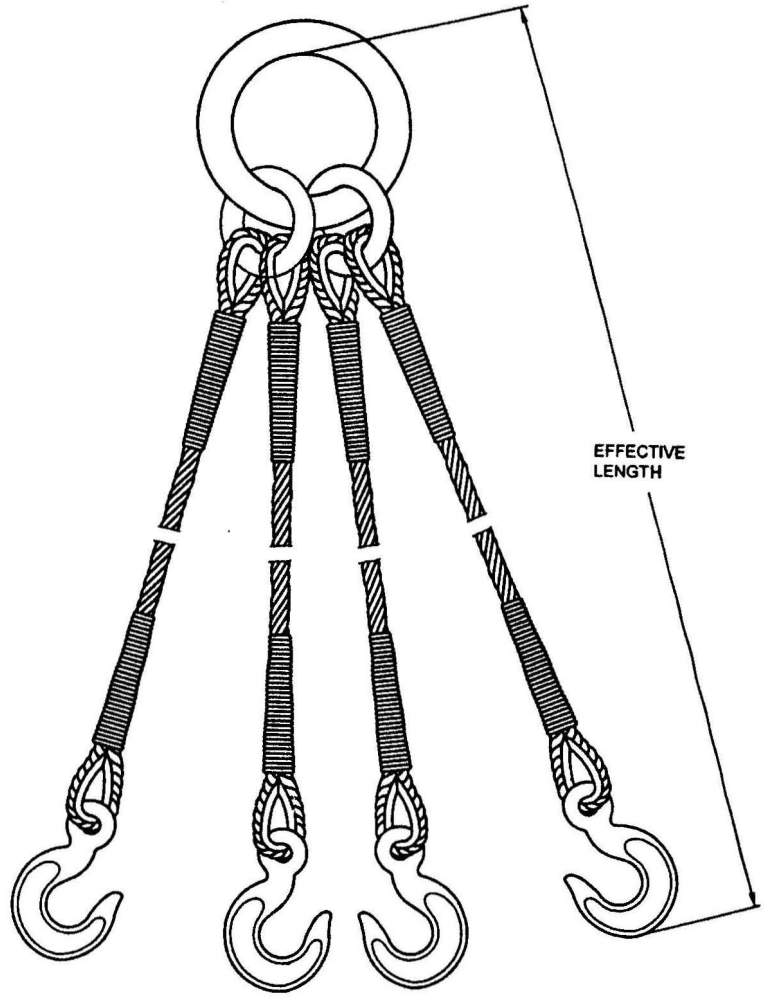


FIG. 9 FOUR-LEG WIRE ROPE SLING WITH MAIN AND INTERMEDIATE RINGS AT ONE END, HOOKS AT OTHER ENDS (HAND SPLICED)

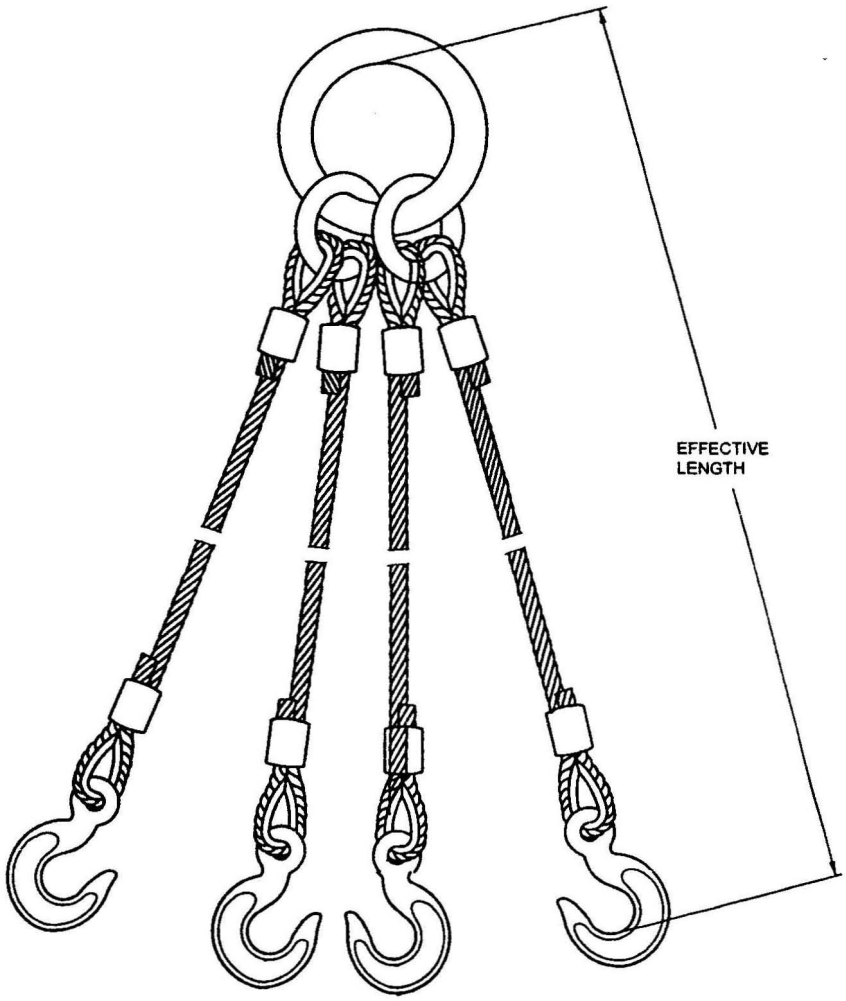


FIG. 10 FOUR-LEG WIRE ROPE SLING WITH MAIN AND INTERMEDIATE RINGS AT ONE END, HOOKS AT OTHER ENDS (MECHANICALLY SPLICED)

i) unique reference number identifying the sling with its test certificate,

ii) the safe working load of the sling for single leg sling or the safe working load(s) related to the leg angle(s) in case of multi-leg sling, and

iii) month and year of manufacture.

10.2 BIS Certification Marking

Each sling may also be marked with the Standard Mark.

10.2.1 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 details of conditions under which a license for the use of Standard Mark may be granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards

11 CERTIFICATE OF TEST AND EXAMINATION

Every sling or batch of slings shall be provided with a test certificate issued by a competent person giving the following information:

a) Name of the manufacturer/ supplier,

b) Full description of the sling,

c) Safe working load,

d) Tested to proof load,

e) Date of test, and

f) Specification No.

Table 1 Safe Working Load
(*Clause* 9.2)

Sl No.	Number of Legs	Angle of Usage Degree	Safe Working Load				Remarks
			Rope	Master Ring	Intermediate Ring	Complete Assembly	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	1	0	W	1.0 W	—	1.0 W	—
ii)	2	0 90 120 2A	W W W W	2.0 W 1.4 W 1.0 W 2 W cos A	— — — —	2.0 W 1.4 W 1.0 W 2 W cos A	Critical
iii)	3	0 90 120 2A	W W W W	3.0 W 2.1 W 1.5 W 3 W cos A	1.0 W 1.0 W 1.0 W 1.0 W	3.0 W 2.1 W 1.5 W 3 W cos A	Critical
iv)	4	0 90 120 2A	W W W W	4 W 2.8 W 2.0 W 4 W cos A	1.0 W 1.0 W 1.0 W 1.0 W	4 W 2.8 W 2.0 W 4 Wcos A	Critical

NOTES

1 A — Angle between any leg and the vertical line through the support point.

2 W — Safe working load.

ANNEX A

(*Foreword*, and *Clauses* 3.3.2 *and* 9.1)

SAFE WORKING LOAD AT DIFFERENT METHODS OF LOADING

Nominal Rope Diameter	Single Part (Single Leg)		Double Part Endless and Grommet			Two-Leg				Three-Leg		Four-Leg	
	Straight Pull	Choke Hitch	Straight Pull (1 No.)	Choke Hitch	Straight Pull (2 No.)	$0° < \alpha \leq 90°$		$90° < \alpha \leq 120°$		$0° < \alpha \leq 90°$		$90° < \alpha \leq 120°$	
mm	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*	*t*
Factor	1.00	0.80	2.00	1.60	2 × 2	1.40	1.12	1.00	0.80	2.10	1.50	2.80	2.00

Coefficient of utilization: 5

Angle subtended by the slings at the point of lifting: α

Load (mass) for lifting: *t* (tonne)

ANNEX B

(*Foreword*, and *Clause* 1)

GUIDELINES FOR USE OF SLINGS

a) Assess load to be lifted and its position of centre of gravity.

b) Ensure that a proper sling is chosen for lifting the load.

c) Select the appropriate method of slinging.

d) The effective diameter of double part should not be less than twice the diameter of rope.

e) While fitting eye termination particularly with thimble reinforcement to the lifting hook, ensure that it is seated properly without overcrowding.

f) Slings shall not be used for bending or strapping unless they are so designed for lifting purposes.

g) Avoid use of lang's lay rope for making sling.

h) Do not use hand spliced sling if it is likely to rotate during lifting the load.

j) Lift the load slowly avoiding jerk, shock, etc.

k) Capacity of master link (ring) shall be at least equal to the capacity of the full sling. For intermediate link (ring) it shall be at least 1.4 times that of one sling leg.

m) For two or more leg slings, maximum permissible angle to the vertical for any sling leg shall not be more than 60°.

n) Do not use sling beyond its permissible service temperature as given below:

Type of Splicing	*Wire Rope With*	*Service Temperature* °C	*Bearing Capacity* Percent
Mechanically spliced with Aluminium-ferrule	Fibre core	–60 to +100	100
	Steel core		
	Fibre core	–60 to +100	100
Hand spliced		–60 to +250	100
	Steel core	+250 to +400	75

ANNEX C

(*Foreword*, and *Clause* 1)

DISCARD CRITERIA FOR SLINGS

C-1 Presence of broken wires, excessive wear, mechanical and other damages due to heat, chemical reaction etc. are the main criteria for discarding a sling during use. Appearance of any of the following kinds of damage shall be a reason to withdraw a sling from the service:

a) Broken strand.

b) Slackening under no load.

c) Crushing under no load.

d) Visible wire breakage at any point on a sling for a length of:

$3 \times d$ > four numbers

$6 \times d$ > six numbers

$30 \times d$ > sixteen numbers

where d is diameter of rope.

e) Crushing at the load bearing point of the eye along with four broken wires.

f) Kink formation.

g) Sign of corrosion.

h) Damage or undue wear at the eye termination.

ANNEX D
(*Foreword*)

COMMITTEE COMPOSITION

Wire Ropes and Wire Products Sectional Committee, MED 10

Organization	*Representative(s)*
Directorate General of Mines Safety, Dhanbad	Shri T. S. Mukherjee (*Chairman*) Deputy Director (Mech), HQ (*Alternate*)
Amar Promoters Pvt Ltd, Solan	Shri Virender Agarwal Shri Jatinder Agarwal (*Alternate*)
Bharat Coking Coal Ltd, Dhanbad	Shri Ramji Sahay
Bharat Wire Ropes Ltd, Mumbai	Shri D. M. Shah Shri Ashwini Lokhande (*Alternate*)
Central Institute of Mining and Fuel Research, Dhanbad	Shri Awadhesh Mahto Shri S. K. Ritolia (*Alternate*)
Directorate of Quality Assurance, New Delhi	Col P. K. Srivastava Col V. V. Kadam (*Alternate*)
Directorate General Factory Advice Service & Lab Institute, Mumbai	Shri G. M. E. K. Raj Shri S. N. Borker (*Alternate*)
Directorate General of Aeronautical Quality Assurance, New Delhi	Shri S. B. Prasad Shri Sanjay Chawla (*Alternate*)
Directorate General of Civil Aviation, New Delhi	Shri R. C. Gupta Shri M. M. Kaushal (*Alternate*)
Directorate General of Suppliles & Disposals (Quality Assurance Wing), New Delhi	Shri R. K. Agarwal Shri Akhilesh Kumar (*Alternate*)
Eastern Coalfields Ltd, Kolkata	Shri Chatterjee Shri Kapil K. Rai (*Alternate*)
Ministry of Shipping, New Delhi	Shri A. R. Rao Shri D. J. Basu (*Alternate*)
National Test House, Kolkata	Shri S. P. Roy Shri R. N. Ram (*Alternate*)
Oil and Natural Gas Commission, Dehra Dun	Shri R. K. Garg Shri P. K. Sood (*Alternate*)
Orient Wire Ropes, Indore	Shri Sameer Golwelkar Shri Shishir Akarte (*Alternate*)
Paradip Port Trust, Paradip	Shri B. B. Panigrahi Shri Mohan Patel Khetra (*Alternate*)
South Eastern Coalfields Ltd, Bilaspur	Shri S. K. Mishra Shri G. Ramaswami (*Alternate*)
Tata Steel Ltd, Dhanbad	Shri Soumendu K. Majhi Shri A. K. Sil (*Alternate*)
The Shipping Corporation of India Ltd, Mumbai	Shri G. S. Bhalla Capt R. Modi (*Alternate*)
The Singareni Collieries Co Ltd, Andhra Pradesh	Sri Ivn Prasada Rao Sri P. V. Raghava Raju (*Alternate*)
Usha Breco Ltd, Dist Ghaziabad (UP)	Shri Rajesh Prasad Shri Manoj Panwar (*Alternate*)
Usha Martin Industris Ltd, Ranchi	Shri Subrata Dutta Shri S. B. N. Sharma (*Alternate*)
Vidarbha Hardware Industries, Akola	Shri Om Prakash Dalmia Shri Sanjay O. Dalmia (*Alternate*)
BIS Directorate General	Shri C. K. Veda, Scientist 'F' & Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri D. K. Das
Scientist 'E' (MED), BIS

MGIPF—114 Deptt. of BIS/2009—24.7.2009—300 Books

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.

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 latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: MED 10 (0857).

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: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices:		*Telephones*
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	2323 7617, 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi, KOLKATA 700054	2337 8499, 2337 8561, 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 3843, 60 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442, 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East), MUMBAI 400093	2832 9295, 2832 7858, 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Printed by the Manager, Govt. of India Press, Faridabad