

Indian Standard

SPECIFICATION FOR
EYE BOLTS WITH COLLARS

(*First Revision*)

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

Indian Standard

SPECIFICATION FOR EYE BOLTS WITH COLLARS

(*First Revision*)

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SPECIFICATION FOR EYE BOLTS WITH COLLARS

(*First Revision*)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 March 1984, after the draft finalized by the Lifting Chains and Associated Fittings and Components Sectional Committee had been approved by the Marine, Cargo Movement and Packaging Division Council.

0.2 This standard was first published in 1967. This revision has been necessitated to bring this standard in line with international practice and to incorporate the experience gained by manufacturers and users during these years. In this revision, only critical dimensions have been specified. Further maximum lifting capacity has separately been given for axial loading and inclined loading.

0.3 This specification covers eyebolts designed to use with shackles. The provision of a collar adds substantially to the strength of an eyebolt and eyebolts without collars are unsuitable for inclined loading. Although there are eyebolts which are designed to accept a load hook, it is felt that these types of eyebolts would be considerably larger in size so as to render them uneconomic; these are excluded from this specification.

0.4 Due to the tension in the horizontal portion of the sling, the recommended safe working loads are excessive for eyebolts used in pairs with a continuous sling, the ends of which are assembled on the load hook. Eyebolts in pairs should be loaded by individual sling ends. Correct and incorrect methods of slinging in this respect are shown in Appendix A.

0.5 Periodical annealing is not required once the eyebolts have been manufactured according to this specification. However, the eyebolts shall be subjected to periodical critical examination and when the threads show signs of damage or the eye shows appreciable bruising the eyebolts shall be scrapped.

0.6 Undue tightening of the eyebolts, whether during service or permanently, should be strictly guarded against.

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0.7 Collar eyebolts are intended for permanent attachment to massive items which may need periodically to be lifted; they will normally be fitted in pairs for use with shackles and a two-leg sling as depicted in Appendix A.

0.8 It is vitally important that pairs of collar eyebolts to be so used should be carefully fitted, each eyebolt being tightened down with the underside of its collar in firm contact with its machined seating over the whole perimeter and when so tightened the plane of the eye of each eyebolt shall not be inclined to the plane containing the axes of the two eyebolts by more than 5°. If at first fitting this condition be not fulfilled, it is to be achieved by machining the underside of the collar, care being taken to preserve the accurate planity of this surface perpendicular to the axis of the eyebolt.

0.9 The load applied to a collar eyebolt shall always lie in the plane of the eye. When two pairs of eyebolts are fitted to a single item it is recommended that they be used with two-legged slings and a spreader bar, and in any case precise instructions as to the proper method of lifting should always be furnished.

0.10 The reliability of eyebolts is an important factor and, therefore, it is recommended that supplies should be obtained from manufacturers possessing adequate facilities for heat treatment and testing, and employing competent staff for detailed inspection.

0.11 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.

1. SCOPE

1.1 This standard specifies the basic dimensions, material, lifting capacity and conditions of use of lifting eyebolts of Grade M. These eyebolts, which are described as 'universal' may be used in all cases involving vertical and inclined lifting.

1.1.1 This standard covers only eyebolts with eyes of internal diameters capable of permitting direct engagement with cyehooks of the same lifting capacity (working load limit) for use with Grade T(8) chain. In the case of cyehooks for use with Grade M(4) chain, it may be necessary to use an intermediate component such as a shackle to make the connection.

*Rules for rounding off numerical values (revised).

1.1.2 It excludes eyebolts which are not forged in one piece.

NOTE — The grading of lifting components is given in IS : 5616-1982*.

2. TYPES

2.1 Two types of eyebolts are included in this standard:

Type 1 — Eyebolt with recessed collar (See Fig. 1a) suitable for use with chamfered or unchamfered holes.

Type 2 — Eyebolt without recessed collar (See Fig. 1b) suitable for use with chamfered holes only.

3. EYEBOLT NUMBER (THREAD DIMENSIONS)

3.1 Eyebolts are identified according to their basic thread dimensions. The maximum axial lifting capacity (*WLL*) for each eyebolt is given in Table 1.

4. MATERIAL

4.1 The steel shall be produced by the open hearth process, the electrical process, or by an oxygen blown process.

4.2 In its finished state, as supplied to the eyebolt maker, the steel shall meet the following requirements as determined by a cast or product analysis on the bar or on the finished eyebolt:

- a) It shall be fully killed, shall be suitable for forging and shall be capable of being heat treated to obtain the mechanical properties required by this standard.
- b) The proportions of sulphur and phosphorus shall be limited as follows:

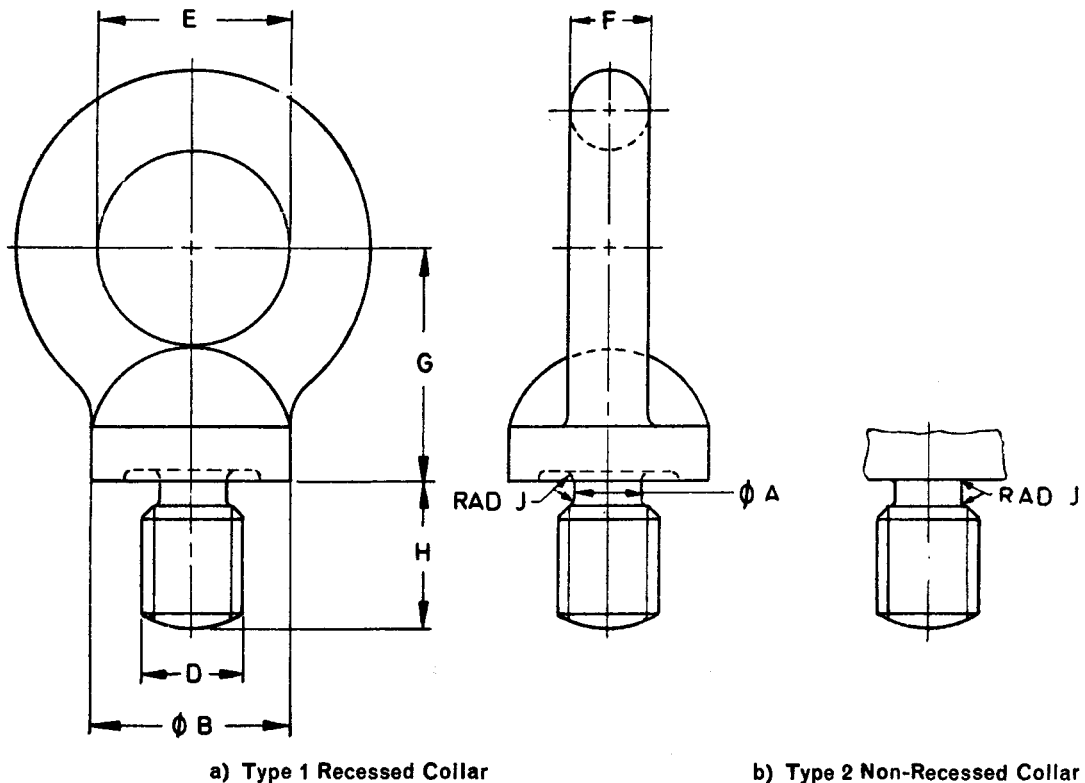
	<i>Cast Analysis</i>	<i>Product Analysis</i>
Sulphur, percent, <i>Max</i>	0.045	0.050
Phosphorus, percent, <i>Max</i>	0.040	0.045

4.3 The steel shall be made in conformity with a suitable deoxidization practice in order to obtain an austenitic grain size of 5 or finer when tested in accordance with IS : 2853-1964†.

4.3.1 This could be accomplished, for example, by ensuring that it contains sufficient aluminium or equivalent element to permit the manufacture of eyebolts stabilized against strain-age embrittlement. A minimum of 0.02 percent of metallic aluminium is recommended for guidance.

*Specification for short link chain for lifting purposes : General conditions of acceptance (*first revision*).

†Method of determining austenitic grain size of steel.



NOTE —These drawings illustrate the specified dimensions only and not the actual form of the eyebolt which is left to manufacturer.

FIG. 1 DIMENSIONS OF EYEBOLT (TABLE 1) SHOWING RECESSED AND NON-RECESSED COLLARS

TABLE 1 DIMENSIONS OF EYEBOLTS

(Clauses 3.1, 5.1 and Fig. 1)

All dimensions in millimetres.

THREAD SIZE <i>D</i>	MAXIMUM AXIAL LIFTING (WLL) CAPACITY	<i>E</i> <i>Min</i>	<i>A</i> <i>Min</i>	<i>G</i> <i>Max</i>	<i>H</i> <i>Min</i>	<i>F</i> <i>Max</i>	<i>J</i> <i>Min</i>	<i>B</i> <i>Min</i> FOR UNMAC- HINED COLLARS	<i>B</i> MACHINED COLLARS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	<i>t</i>								
M8	0.16	20	6	20	15	6.3	1	20	20 ^{-0.040} -0.092
M10	0.25	24	7.7	25	17	8	1	24	24 ^{-0.040} -0.092
M12	0.40	28	9.4	30	20	9.5	1	28	28 ^{-0.040} -0.092
M16	0.63	34	13	36	24	12.5	1	34	34 ^{-0.050} -0.112
M20	1	40	16.4	45	27	16	1	40	40 ^{-0.050} -0.112
M24	1.6	48	19.6	53	31	19	2	48	48 ^{-0.050} -0.112
M30	2.5	56	25	64	39	24	2	56	56 ^{-0.060} -0.134
M36	4	67	30.3	75	48	28	3	67	67 ^{-0.060} -0.134
M42	6.3	80	35.6	90	56	34	3	80	80 ^{-0.060} -0.134
M48	8	95	41	100	65	38	3	95	95 ^{-0.072} -0.159
M56	10	112	48.3	119	73	45	4	112	112 ^{-0.072} -0.159
M64	16	125	55.7	135	85	50	4	125	125 ^{-0.085} -0.185
M72 × 6	20	140	63.7	153	95	58	4	140	140 ^{-0.085} -0.185
M80 × 6	25	160	71.7	165	110	63	4	160	160 ^{-0.085} -0.185
M90 × 6	32	180	81.7	180	125	71	5	180	180 ^{-0.085} -0.185
M100 × 6	40	200	91.7	195	140	80	5	200	200 ^{-0.100} -0.215

4.4 Within the above limitations or as otherwise agreed with the purchaser it is the responsibility of the eyebolt maker to select the steel so that the finished eyebolt, suitably heat-treated, meets the mechanical properties required by this standard.

4.5 The following steels in the hardened and tempered condition are recommended for the manufacture of eyebolts:

Class 3 or 3A of IS : 1875-1978*.

Grades 20 Mn 2 and C 35 Mn 75 of IS : 1570-1961†.

5. DIMENSIONS AND TOLERANCES

5.1 The form and basic dimensions of eyebolts shall be in accordance with Fig. 1 and Table 1. They are formulated on the basis of the available threads listed in IS : 4218 (Part 1)-1976‡.

5.2 A symmetrical tolerance on ovality of ± 5 percent is permitted in respect of the internal diameter E of the eyebolt.

5.3 A symmetrical tolerance of 5 percent on the diameter F of the steel of the eye is permitted.

6. MANUFACTURE

6.1 Each eyebolt, including the shank, shall be forged in one piece without any joint.

7. MACHINING

7.1 The eyebolts shall be machined to ensure that:

- The threads of the shanks comply with IS : 4218 (Part 2)-1976§. Unless otherwise specified the coarse series thread form of IS : 4218 (Part 2)-1976§ shall be used and the tolerance of the thread shall conform to IS : 4218 (Part 5)-1967||. If required by the purchaser the shanks of eyebolts of lifting capacities 10 t and above may be provided with square threads conforming to IS : 4694-1968¶.
- The machined face of the collar and the axis of the threaded shank are at right angles, subject to a tolerance of 30'.
- The axis of the cylindrical part of the collar and the threaded shank are the same.

*Specification for carbon steel billets, blooms, slabs and bars for forgings (fourth revision).

†Schedules for wrought steels for general engineering purposes.

‡Specification for ISO metric screw threads : Part 1 Basic and design profiles.

§Specification for ISO metric screw threads : Part 2 Diameter pitch combination (first revision).

||Specification for ISO metric screw threads : Part 5 Tolerances.

¶Basic dimensions for square threads.

8. HEAT TREATMENT

8.1 Eyebolts shall be suitably heat treated to get the proper hardness values as given in 9.1. The following heat treatment is recommended for eyebolts after forging:

Heating to a temperature between 860 and 890°C, followed by quenching in oil or water and tempering at a suitable temperature between 550 and 660°C.

9. HARDNESS TEST

9.1 Eyebolt shall have a brinell hardness of 190 ± 25 HB. When practicable, the tests shall be made in accordance with IS : 1500-1968*, using a 10 mm ball and a load of 300 kg. If another method is employed conversion shall be made in accordance with IS : 4258-1967†.

9.1.1 The surface on which the impression is to be made shall be obtained by filing, grinding or smooth machining.

9.1.2 Suitable precautions shall be taken to ensure that the surface tested is representative of the material and that its hardness is not affected by decarburization, carburization or by the method used for the preparation of the test sample.

10. MECHANICAL PROPERTIES

10.1 Maximum Lifting Capacity

10.1.1 *In Axial Loading* — The maximum lifting capacity (*WLL*) in axial loading shall be as specified in Table 2.

10.1.2 *In Inclined Loading* — The maximum lifting capacity (*W*) in axial loading, for a pair of eyebolts, when the angle between the sling legs is $\leq 45^\circ$, shall be as specified in Table 3.

10.2 Minimum Axial Breaking Force — The minimum axial breaking force for eyebolts of each specified working load limit shall be as given in Table 2.

10.3 Bend Test — Eyebolts of 36 mm or less in diameter, after being screwed into a steel block to the full thread length and bent 45° by pressure or blows, shall not show any visible surface ruptures in the un-threaded section of the eyebolts.

10.4 The sampling shall be in accordance with IS : 2614-1969‡.

*Method for brinell hardness test for steel (*first revision*).

†Hardness conversion tables for metals.

‡Methods for sampling of fasteners (*first revision*).

TABLE 2 MECHANICAL PROPERTIES

(Clauses 10.1.1, 10.2 and 11.3.1)

THREAD SIZE <i>D</i>	MAXIMUM AXIAL LIFTING CAPACITY <i>WLL</i>	AXIAL PROOF FORCE	MINIMUM AXIAL BREAKING FORCE
(1)	(2)	(3)	(4)
	t	kN	kN
M8	0.16	3.2	6.3
M10	0.25	5	10
M12	0.40	8	16
M16	0.63	12.5	25
M20	1	20	40
M24	1.6	32	63
M30	2.5	50	100
M36	4	80	160
M42	6.3	125	250
M48	8	160	320
M56	10	200	400
M64	16	320	630
M72 × 6	20	400	800
M80 × 6	25	500	1 000
M90 × 6	32	630	1 250
M100 × 6	40	800	1 600

NOTE — 1 kgf = 9.81 ≈ 10 N within 2 percent

$$1 \text{ t f} = 1\,000 \text{ kgf} = 9.81 \text{ kN}$$

$$\approx 10 \text{ kN}$$

11. PROOF LOADING

11.1 Each eyebolt after manufacture and subsequent heat-treatment shall be subjected to an axial proof force, as specified in Table 2. After removal of proof force, each eyebolt shall be examined by a competent person and shall be accepted only if found free from visible flaw or defect.

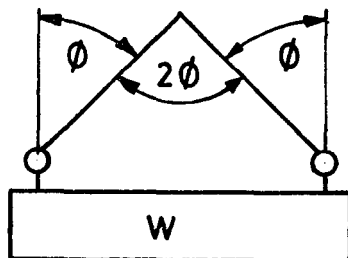
11.2 Method — The force is applied using a freely rotating round section pin of diameter not exceeding 50 percent of the eye diameter. The force should be applied continuously and gradually for a minimum duration of 3 seconds, held for 5 seconds at the specified proof force, and gradually reduced to zero.

In the case of eyebolts in axial loading, the force is applied to the eyebolt by an in-line pull between the threaded shank and the eye.

In the case of eyebolts in inclined loading, the force is applied at an angle of 45° to their axes, such that the resultant axial force on a pair of eyebolts equals that specified in Table 3.

TABLE 3 USE OF EYEBOLTS IN INCLINED LOADING CONDITIONS

(Clauses 10.1.2 and 11.2)



THREAD SIZE D	MAXIMUM AXIAL LIFTING CAPACITY OF SINGLE EYEBOLT (WLL)	MAXIMUM LIFTING CAPACITY (W) FOR A PAIR OF EYEBOLTS WHEN THE ANGLE BETWEEN EACH SLING LEG AND VERTICAL (ϕ) IS	DEFORMATION FORCE* FOR A PAIR OF EYEBOLTS, WHEN THE ANGLE BETWEEN EACH SLING LEG AND THE VERTICAL (ϕ) IS
(1)	(2)	0 to 45°	45°
	t	(3)	(4)
		t	kN
M8	0.16	0.08	1.6
M10	0.25	0.125	2.5
M12	0.40	0.2	4.0
M16	0.63	0.32	6.3
M20	1	0.5	10.0
M24	1.6	0.8	16.0
M30	2.5	1.25	25
M36	4	22	40
M42	6.3	3.2	63
M48	8	4	80
M56	10	5	100
M64	16	8	160
M72 × 6	20	10	200
M80 × 6	25	12.5	250
M90 × 6	32	16	320
M100 × 6	40	20	400

*The equivalent deformation force if required to be applied to the eye of a single eyebolt at 45° to its axis is $\frac{1}{\sqrt{2}} \times$ tabulate value.

(Continued)

TABLE 3 USE OF EYEBOLTS IN INCLINED LOADING CONDITIONS — Contd

NOTE 1 — Working loads are given for eyebolts when used in pairs for inclined loading conditions, with the collars screwed down on the faces and the eyes in the plane of the lifting sling.

In order to achieve the necessary alignment of the eye, it may be necessary to use shims (spacing washers) or to machine the collar.

Care should be taken not to overtighten the eyebolt in an attempt to achieve the correct alignment, beyond that tightness achieved by hand without mechanical aid, as this can cause overstressing in the shank which can reduce the lifting capacity of the eyebolt.

NOTE 2 — The use of eyebolts for included angle of more than 90° is not permitted.

11.3 Deformation

11.3.1 In Axial Loading — Each eyebolt shall be capable of sustaining the axial force specified in Table 2 without permanent deformation exceeding 0.5 percent of the external diameter of the eye, and without permanent deformation of the shank.

11.3.2 In Inclined Loading — Eyebolts when used in pairs shall be capable of sustaining the force specified in Table 3 when loaded at 45° to their axis, without permanent deformation exceeding 0.5 percent of the external diameter of the eye, and without permanent deformation of the shank.

12. INSPECTION, CERTIFICATE OF TEST AND EXAMINATION

12.1 The representative of the purchaser shall have access to the works of the manufacturer at all reasonable times for the purpose of witnessing the specified tests and inspecting the machine and methods of examination.

12.2 The manufacturer shall supply a certificate of test and examination as given in Appendix B with every supply of eyebolts. The certificate shall give the results of all tests made.

13. IDENTIFICATION MARKING

13.1 Each eyebolt shall be legibly and permanently identified in the zone bounded by the shoulder and the horizontal axis of the eye with the following markings:

- a) Such marks or symbols as shall allow identification with the manufacturer's certificate.
- b) Eyebolt number, that is, thread dimension (as col 1 of Table 1).
- c) Maximum axial lifting capacity (*WLL*), in general service (see col 2 of Table 2).

13.1.1 The stamps shall have a concave surface and the indentation should be neither too sharp nor excessive in depth.

The recommended sizes of stamps shall be as given below:

<i>Diameter of Material in Bow Piece</i>	<i>Size of Mark</i>
mm	mm
Up to and including 25	5
Over 25	6

13.2 BIS Certification Marking

The product may also be marked with Standard Mark.

13.2.1 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 the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

14. ADDITIONAL TESTS

14.1 If the purchaser requires tests or chemical analysis of the material, or additional tests on the finished eyebolts, these requirements shall be clearly stated in the enquiry and order and, if so desired, the samples shall be selected by a person representing or approved by the purchaser.

APPENDIX A

(Clauses 0.4 and 0.7)

CORRECT AND INCORRECT METHODS OF SLINGING

A-1. The correct and incorrect methods of slinging are shown in Fig. 2.

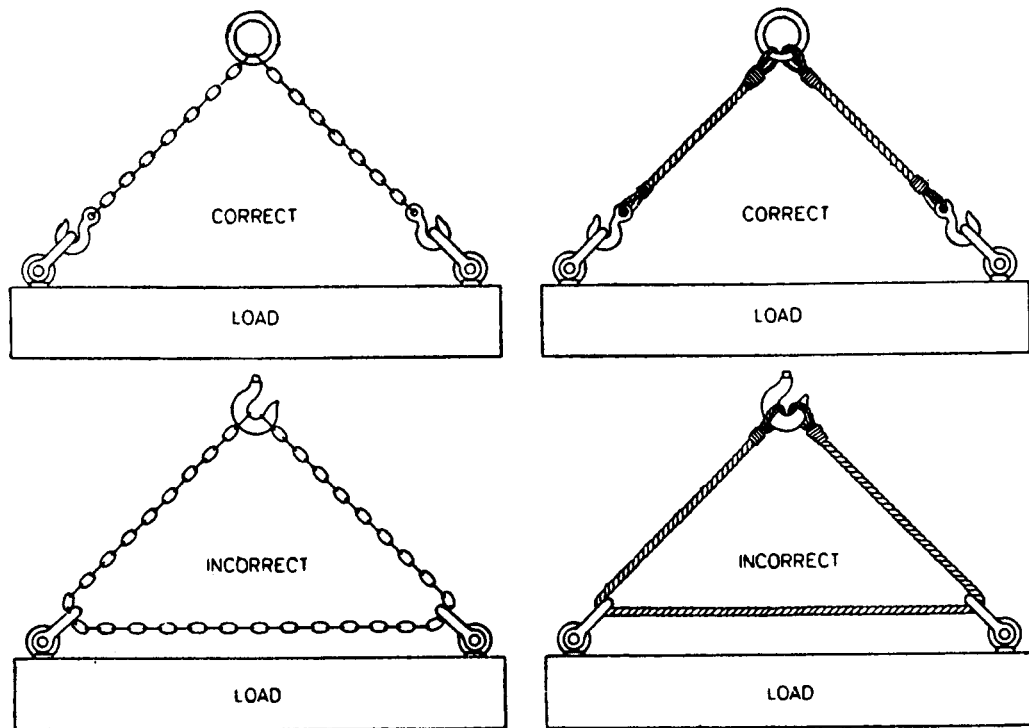


FIG. 2 CORRECT AND INCORRECT METHOD OF SLINGING

APPENDIX B

(Clause 12.2)

CERTIFICATE OF TEST AND EXAMINATION

<i>Distinguishing Mark</i>	<i>Eyebolt Number</i>	<i>Proof Force Applied</i>	<i>Maximum Axial Lifting Capacity Tonnes</i>
(1)	(2)	(3)	(4)
...

Particulars of heat treatment to which the eyebolts have been subjected are as follows:

We hereby certify that the eyebolts, described above, comply in all respects with IS : 4190-1967 'Specification for eyebolts with collars' and that they were subjected to the proof load and subsequently examined and passed by a competent person.

Signature.....

Date.....

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