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मानक



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Mazdoor Kisan Shakti Sangathan

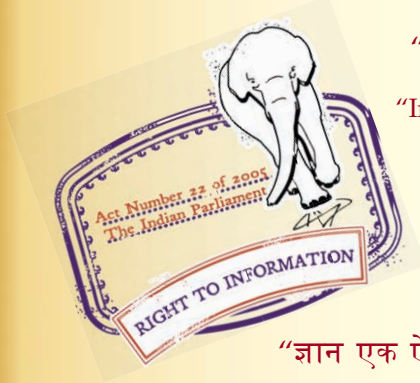
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“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 2004 (1991): Carbon steel forgings for general engineering purposes [MTD 16: Alloy Steels and Forgings]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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भारतीय मानक

सामान्य इंजीनियरी प्रयोजनों के लिए कार्बन इस्पात
की गढ़ाइयाँ — विशिष्ट

(तीसरा पुनरीक्षण)

Indian Standard

**CARBON STEEL FORGINGS FOR GENERAL
ENGINEERING PURPOSES — SPECIFICATION**

(*Third Revision*)

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Steel Forgings Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first issued in 1962 and subsequently revised in 1970 and 1978. Based on the experience gained during these years in the use of this standard, it has been decided to further revise this standard.

For the benefit of the purchaser an informative Annex (*see* Annex A), giving particulars to be specified while ordering for these steel forgings, has been included.

This standard contains clauses **6.2, 7.3, 8.1, 10.1, 10.1.1, 11.1, 12.1, 12.1.2.4, 12.1.2.5** and **13.1** which call for agreement between the purchaser and the manufacturer.

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

CARBON STEEL FORGINGS FOR GENERAL ENGINEERING PURPOSES — SPECIFICATION

(Third Revision)

1 SCOPE

1.1 This standard covers the requirements for nine classes of carbon steel forgings for general engineering purposes, designated as Class 1, 1A, 2, 2A, 3, 3A, 4, 5 and 6 (see Table 1).

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard.

IS No.	Title
228 :	Methods for chemical analysis of steel (<i>second revision</i>)
1387 : 1967	General requirements for the supply of metallurgical materials (<i>first revision</i>)
1599 : 1985	Method for bend test (<i>second revision</i>)
1608 : 1972	Method for tensile testing of steel products (<i>first revision</i>)
1762 (Part 1) : 1974	Code for designation of steels: Part 1 Based on letter symbols (<i>first revision</i>)
1875 : 1991	Carbon steel billets, blooms, slabs and bars for forgings (<i>fifth revision</i>)
1956 (Part 6) : 1976	Glossary of terms relating to iron and steel: Part 6 Forging (including drop forging)
3469 (Parts 1 to 3) : 1974	Tolerances for closed die steel forgings (<i>first revision</i>)

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 1956 (Part 6) : 1976 shall apply.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of carbon steel forgings shall be as laid down in IS 1387 : 1967.

4.2 The steel forgings covered by this standard should be ordered and delivered in any one or combination of the following:

- a) Chemical composition, and
- b) Tensile properties and/or hardness.

5 MANUFACTURE

5.1 All forgings shall be manufactured from killed steel produced by the open hearth, electric, basic-oxygen or any other suitable method which will meet the requirements of this standard.

5.2 The raw material for the production of carbon steel forgings shall be in accordance with IS 1875 : 1991. Wherever necessary further reduction ratio from the raw material to the forgings shall be as agreed to between the supplier and the purchaser.

6 DIMENSIONAL TOLERANCES

6.1 All forgings shall be free from harmful defects and produced to the prescribed dimensions.

Table 1 Chemical Composition
(Clauses 1.1, 7.1, 7.3 and 12.1.1)

Class	Designation [See IS 1762 (Part 1) : 1974]	Constituent, Percent				
		Carbon	Silicon	Manganese	Sulphur, Max	Phosphorus, Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	14C6	0.10-0.18	0.15-0.35	0.40-0.70	0.04	0.04
1A	15C8	0.10-0.20	0.15-0.35	0.60-0.90	0.04	0.04
2	20C8	0.15-0.25	0.15-0.35	0.60-0.90	0.04	0.04
2A	25C8	0.20-0.30	0.15-0.35	0.60-0.90	0.04	0.04
3	30C8	0.25-0.35	0.15-0.35	0.60-0.90	0.04	0.04
3A	35C8	0.30-0.40	0.15-0.35	0.60-0.90	0.04	0.04
4	45C8	0.40-0.50	0.15-0.35	0.60-0.90	0.04	0.04
5	55C8	0.50-0.60	0.15-0.35	0.60-0.90	0.04	0.04
6	65C6	0.60-0.70	0.15-0.35	0.50-0.80	0.04	0.04

NOTE — When the steel is aluminium killed or killed with both aluminium and silicon, the requirements of minimum silicon content shall not apply. For aluminium killed steel the total aluminium content shall be within 0.02 to 0.05 percent.

6.2 Unless otherwise agreed, the forging tolerances shall conform to the following standards:

For drop and press forgings	IS 3469 (Part 2) : 1974
For upset forgings	IS 3469 (Part 3) : 1974

6.2.1 Weight and quantity tolerances shall conform to IS 3469 (Part 1) : 1974.

7 CHEMICAL COMPOSITION

7.1 Ladle Analysis

The ladle analysis of steel, when carried out either by the methods specified in the relevant parts of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of any dispute, the procedure given in relevant parts of IS 228 shall be the referee method.

7.2 Check Analysis

The purchaser may specify check analysis on finished forgings. The number of samples on which the analysis has to be carried out shall be at the rate of one sample per cast per section.

7.2.1 The permissible deviation in check analysis from the specified composition limits given in Table 1 shall be as given below:

<i>Constituent, Percent</i>	<i>Variation from the Specified Limits, Percent</i>
Carbon:	
Up to 0.25	± 0.02
Over 0.25 up to and including 0.50	± 0.03
Over 0.50	± 0.04
Silicon	± 0.03
Manganese	± 0.04
Phosphorus	+ 0.005
Sulphur	+ 0.005

NOTE — Variations shall not be applicable both over and under the specified limits in several determinations in a heat.

7.3 Elements not specified in Table 1 shall not be added to the steel, except when agreed to, other than for the purpose of finishing the heat and shall not exceed the following limits:

<i>Constituent</i>	<i>Percent</i>
Nickel	0.30
Coromium	0.30
Copper	0.25
Molybdenum	0.05
Vanadium	0.05
Tin	0.05
Boron	0.000 3

NOTES

- 1 Trace elements (Cr + Ni + Mo) when added together shall not exceed 0.50 percent.
- 2 Percent copper + 10 × (Percent tin) shall not exceed 0.50 percent.

8 HEAT TREATMENT

8.1 Forgings shall be supplied in the as-forged or as-forged and normalised condition unless any specific heat treatment is required by the purchaser, in which case the heat treatment details shall be as agreed to between the purchaser and the manufacturer.

9 MECHANICAL TEST

9.1 Tensile Tests

The tensile test shall be carried out in accordance with IS 1608 : 1972. The test pieces shall be machined lengthwise from each test sample selected according to 10. The tensile properties shall conform to the requirements given in Table 2.

10 SAMPLING FOR MECHANICAL TESTS

10.1 Unless otherwise agreed, for the purpose of mechanical tests, the sample shall be tested for each cast and heat treatment batch.

10.1.1 If the product is continuously heat-treated, the sampling for mechanical test shall be as agreed to between the purchaser and the manufacturer.

Table 2 Tensile Properties and Hardness (Clause 9.1)

Class	Tensile Strength <i>Min</i> (MPa)	Yield Strength <i>Min</i> (MPa)	Elongation (GL= 5.65√S ₀) <i>Min</i> , Percent	Hardness <i>Min</i> (HB)	Normalizing Temperature °C
(1)	(2)	(3)	(4)	(5)	(6)
1	370	200	26	100	880-910
1A	410	220	25	110	880-910
2	430	230	24	120	880-910
2A	460	250	22	130	880-910
3	490	270	21	140	860-890
3A	540	280	20	155	850-880
4	620	320	15	175	830-860
5	710	350	13	200	810-840
6	740	370	10	210	800-830

NOTE — The properties given in the table refer to ruling section up to 100 mm in the as-rolled or as-forged and normalized condition and are applicable to test samples taken along the direction of grain flow. For higher sections as well as for the supply in hardened and tempered condition, the properties shall be as agreed to between the purchaser and the manufacturer.

11 CONDITIONS OF SUPPLY

11.1 The forgings may be supplied in any one of the following conditions subject to agreement

between the purchaser and the manufacturer:

- a) As-forged;
- b) As-forged and normalized or annealed;
- c) As-forged, normalized, hardened and tempered; and
- d) Any other condition.

12 SUPPLEMENTARY REQUIREMENTS

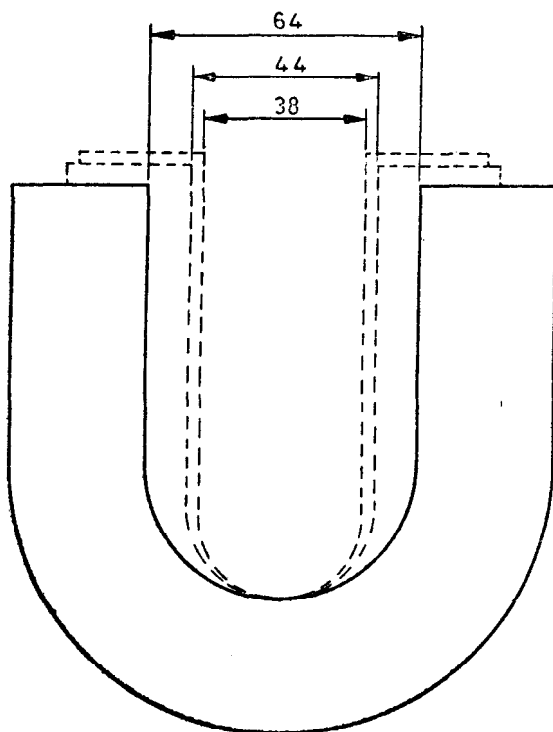
12.1 The following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract and order. Details of these supplementary requirements shall be as agreed to between the manufacturer and the purchaser.

12.1.1 Chemical Composition

The purchaser may specify in special cases more restricted range for one or more elements in respect of carbon, sulphur and phosphorus than the compositional limits indicated in Table 1.

12.1.2 Bend Test

If required by the purchaser, bend test shall be carried out in accordance with IS 1599 : 1985. Where the dimensions permit, test piece, 230 mm long and 32 mm square with edges rounded off, shall be machined lengthwise from each test sample and bent cold by direct pressure round a former of diameter, appropriate to the class of steel as shown in Fig. 1, until the sides of the test piece are parallel.



- 64 For Class 4
44 For Classes 3 and 3A
38 For Classes 1, 1A, 2 and 2A

FIG. 1 BEND TEST

12.1.2.1 Smaller sizes shall be bent in full section by a former having a diameter proportional to that specified for a 32 mm square test piece. Each bend test shall comply with the requirements without fracture.

12.1.2.2 Subsequently, the ends of the test pieces for classes 1, 1A, 2, 2A, 3, 3A and 4 forgings shall be brought together by direct pressure and the test piece shall not fracture.

12.1.2.3 No bend test shall be required for classes 5 and 6.

12.1.2.4 Grain flow

If required by the purchaser, one forging from each delivery run batch shall be examined for grain flow by sectioning and macroetching. The macro structure should not show any coarse randomly oriented dendritic structure.

12.1.2.5 Optional test

Subject to mutual agreement between the purchaser and the manufacturer, the following tests, as applicable, may also be carried out:

- a) Microscopic test;
- b) Macroscopic test;
- c) Magnaflux test; and
- d) Ultrasonic test.

13 RETESTS

13.1 Should any of the original test pieces fail to pass the mechanical test specified under 10, two further test samples shall be selected for retest for each sample that failed. One of the test samples shall be taken from the forging from which the original test sample was taken, unless that forging has been withdrawn by the manufacturer.

13.2 The mechanical properties obtained from the test pieces prepared from two further test samples shall comply with the specified requirements. Should either of the test pieces fail to meet the specified requirements the material represented shall be liable to rejection except that the supplier may reheat-treat (not more than twice) the forging or forgings represented and resubmit for testing. In case of materials re-offered for inspection after reheat treatment, all the forgings have to be resubmitted for inspection and testing.

14 MARKING

14.1 Unless agreed otherwise, each forging shall be legibly stamped with the class, the cast number or identification mark (as indicated in the drawing) by which the forgings can be traced to the cast from which they were made.

14.1.1 When forgings are ordered, in fully machined condition, the identification marks shall be transferred in the presence of the purchaser after full machining.

14.1.2 The forgings may also be marked with the Standard Mark.

ANNEX A
(Foreword)

INFORMATION TO BE GIVEN BY THE PURCHASER

A-1 While placing an order for the steels covered by this standard, the purchaser should specify clearly the following:

- a) Grade designation;
- b) Description regarding size, length, etc;
- c) Condition of delivery;
- d) Tests required;
- e) Method of manufacture;
- f) Any special requirements, such as bundling and packing; and
- g) Test report, if required.

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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 Handbook' and 'Standards Monthly Additions'.

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