

BUREAU OF INDIAN STANDARDS

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भारतीय मानक
तप्त वेल्डित मिश्र धातु इस्पात के छड़ें — विशिष्ट

Draft Indian Standard
HOT ROLLED ALLOY STEEL BARS – SPECIFICATION

ICS: 77.140.35

Alloy Steel and Forging Sectional Committee,
MTD 16

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FOREWORD

(Formal clauses to be added later)

This standard covers the technical requirements for hot rolled alloy steel bars to ensure uniform quality and performance. It aligns with international practices and meets the requirements of sectors including automotive, construction, and general engineering. The specification promotes consistency in production and enhances reliability in end-use.

Hot-rolled steel bars are produced from ingots, blooms, or billets and comprise a variety of sizes and cross sections. Most carbon steel and alloy steel hot-rolled bars contain surface imperfections with varying degrees of severity. Seams, laps, and slivers are probably the most common defects in hot-rolled bars. Thus, a need has been arrived to formulate an Indian standard with the following specifications.

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.

Draft Indian Standard
HOT ROLLED ALLOY STEEL BARS – SPECIFICATION

1 SCOPE

- 1.1** This standard covers the requirements for hot rolled alloy steel bars for the production of bright bars and machine parts for general engineering applications.
- 1.2** This standard applies to all types of hot-rolled products in **straight lengths in sections** that are uniform throughout their length.
- 1.3** This document does not apply to the following steel qualities of alloy steel bars:
- a) Alloy steel bars for forging as per IS 1875
 - b) Alloy steel bars for hardening and tempering as per IS 5517
 - c) Alloy steel bars for case hardening as per IS 4432
 - d) Alloy steel bars for flame and induction hardening as per IS 3930
 - e) Tool steel bars as per IS 3748
 - f) Bright steel bars as per IS 9550
 - g) Steel bars for the manufacture of volute and helical springs (for railway rolling stock) as per IS 3195
 - h) Steel bars for the manufacture of volute, helical and laminated springs for automotive suspension as per IS 3431
 - i) Wrought carbon and low alloy steel bars for cold heading/cold extrusion applications as per IS 11169 (Part 1)
 - j) Stainless steel bars and bright bars as per IS 6603
 - k) Stainless steel bars for cold heading/cold extrusion applications as per IS 11169 (Part 2)

2 REFERENCES

The standards listed in Annex A contain provisions, which through references 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 these standards.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1956 (various parts) shall apply.

4 SUPPLY OF MATERIAL

General requirements relating to the supply of steel shall conform to IS 8910.

5 Designation

- 5.1** The steel grades covered by this standard shall be designated as given in **Table 1**.

- 5.2 When steels other than those shown in **Table 1** are required, the composition limits shall be mutually agreed between the purchaser and the manufacturer. In that case, the grade designation shall be as per IS 1762-1 for alloy steels.

6 MANUFACTURE

- 6.1 Unless otherwise agreed to between the purchaser and the manufacturer, the processes used for making steel and in hot rolling shall be left to the discretion of the manufacturer. When so desired, the purchaser and manufacturer may agree to a particular secondary steel making / refining technology including degassing etc.
- 6.2 All grades shall be supplied only in fully killed condition.
- 6.3 The minimum reduction ratio (measured by cross section of the initial cast product to the final rolled bar) may be mutually agreed between the purchaser and the manufacturer.
- 6.4 Steels used for manufacturing the product covered in the standard shall conform to the requirements of IS 14650.

7 CHEMICAL COMPOSITION

- 7.1 The ladle analysis of the steel, when carried out by the method specified in the relevant parts of IS 228 or IS 8811 or any other established instrumental/chemical method, shall be as given in **Table 1**. In case of dispute, the procedure given in relevant parts of IS 228 shall be referee method. However, where method is not given in IS 228 and its relevant parts, the referee method shall be as agreed to between the purchaser and the manufacturer.
- 7.2 **Product Analysis**
The check analysis shall be carried out on the finished product if specified by the purchaser. Permissible variations in the case of check analysis from the limits of ladle analysis specified in **Table 1** shall be as given in **Table 2**. Variation shall not be applicable both over and under the specified limits in several determinations in one heat.

8 FREEDOM FROM DEFECTS

- 8.1 The bars shall be rolled to dimensions specified. The finished material shall be reasonably free from cracks, surface flaws, laminations and other harmful defects, which may impair the end use of the steel. Unless otherwise agreed between the purchaser and the manufacturer, the permissible limits shall be as specified in **Table 3**.
- 8.2 The hot rolled bars may be suitably tested for cracks and other surface defects. Sulphide inclusions and segregation bands which are characteristics of free cutting steel shall not be considered as defects in the material.

- 8.3** Test specimens, representative of the cross section of the material, shall be pickled in 1:1 hydrochloric acid at a temperature 70°C to 80°C. The specimens after macroetch shall be free from pipe, excessive porosity, harmful segregation, internal cracks and macro inclusions.
- 8.4** If necessary, the **billet or bloom** (including continuously cast) before rolling shall be suitably conditioned to ensure the quality of the finished material.

9 DIMENSIONS AND TOLERANCES

- 9.1** Hot rolled steel bars shall be manufactured to any size as agreed to between the manufacturer and the purchaser.
- 9.2** The dimensional tolerances shall be in accordance with IS 3739. Unless otherwise agreed to between the purchaser and the manufacturer, the level of tolerances and out of roundness shall be Grade 2. Stricter levels of tolerance and/or out of round may be mutually agreed upon between the manufacturer and the purchaser at the time of ordering.
- 9.3** All bars shall be supplied with their ends sheared or saw cut. The bars shall be supplied in lengths as ordered at the time of purchase.
- 9.4** The cutting and shearing tolerances shall not exceed the limits given below for orders in exact length:

<i>Nominal Size, mm</i>	<i>Permissible deviation, mm</i>
Up to 50	+75, -0
Over 50	+150, -0

- 9.5** The tolerance on straightness shall be in accordance with IS 3739.

10 CONDITIONS OF DELIVERY

- 10.1** Unless otherwise agreed to between the purchaser and the manufacturer, steels covered by this standard shall be ordered and delivered on any one or a combination of the following basis:
- Chemical composition
 - Mechanical Properties in as rolled or normalized or annealed
 - Hardness
 - Surface quality
 - Grain size
 - Inclusion content and
 - Others (as agreed upon at the time of enquiry and order)

11 TEST

11.1 Tensile Test

For steels ordered as rolled or normalized or annealed on the basis of mechanical properties, the tensile tests shall be carried out in accordance with IS 1608 (Part 1). The test pieces shall be taken in the longitudinal direction as shown in Fig. 1. The required tensile properties shall be as mutually agreed.

11.2 Hardness Test

For steels ordered on the basis of hardness, the hardness test shall be carried out in accordance with IS 1500 (Part 1). The hardness requirements of the test pieces shall be mutually agreed.

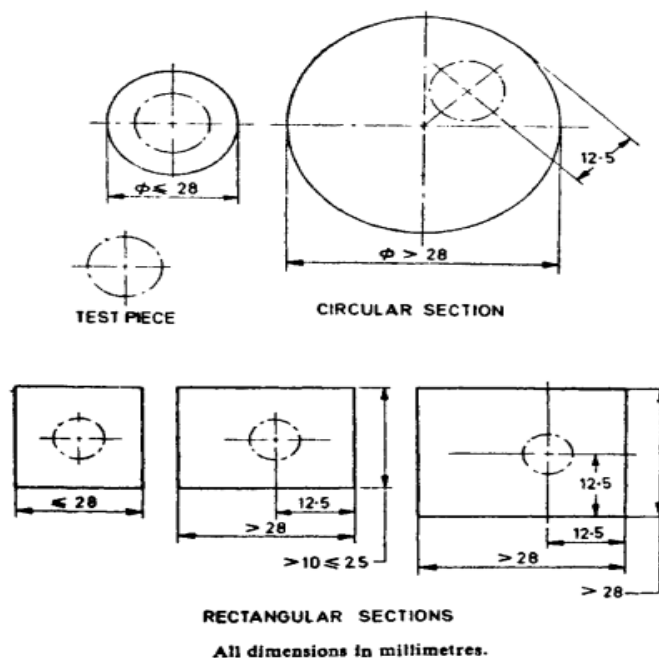


FIG. 1 LOCATION OF THE TENSILE TEST PIECES IN THE PRODUCTS

11.3 Grain Size

If specifically agreed to between the purchaser and the manufacturer, the austenitic grain size shall be tested in accordance with IS 4748.

11.3.1 When a fine austenitic grain size is specified, the steel shall have a grain size number of 5 or finer. Conformance to this grain size of 70 % of the area examined shall constitute the basis of acceptance. One test per heat shall be made unless the provisions of 11.3.2 or 11.3.3 are exercised.

11.3.2 When aluminum is used as the grain refining element, the fine austenitic grain size requirement shall be deemed to be fulfilled if, on heat analysis, the aluminum content is not less than 0.020% total aluminum or, alternately, 0.015% acid soluble aluminum. The aluminum content shall be reported. The grain size test specified in 11.3.1 shall be the referee test.

11.3.3 By agreement between purchaser and supplier, Niobium or Vanadium or both may be used for grain refining instead of or with aluminum. When Niobium or Vanadium is used as a grain refining element, the fine austenitic grain size requirement shall be deemed to be fulfilled if, on heat analysis, the Niobium or Vanadium content is as follows (the content of the elements shall be reported with the heat analysis):

Steels having 0.25 % carbon or less

Nb	0.025 min
V	0.050 min

Steels having over 0.25 % carbon

Nb	0.015 min
V	0.020 min

The maximum contents shall be

Nb	0.05 max
V	0.08 max
Nb + V	0.06 max

11.4 Decarburized depth — Total depth of decarburization when tested as per IS 6396 shall be 1.5% of the diameter per side and 2.0% in the annealed condition.

11.5 Inclusion Rating — If specifically agreed to between the purchaser and the manufacturer, non-metallic inclusion rating in rolled steel products having a reduction ratio of at least 3 may be carried out according to IS 4163 (*Method A*). The worst field shall be recorded as a rating for the specimen. The limits for inclusion rating shall be agreed to between the purchaser and the manufacturer.

12 SAMPLING

12.1 If check analysis is required, at least one sample shall be taken from each cast. Samples for check analysis shall be taken midway between the centre and outside of the material.

12.2 For bars supplied on the basis of mechanical properties, in the case of bars up to 100 mm size, the test samples shall be selected from finished parts at the rate of one sample from each lot, provided the quantity from one cast does not exceed 25 metric tonnes. Where the quantity from each cast exceeds 25 metric tonnes, one more test sample shall be selected. When more than one diameter or thickness of bar is rolled from the same cast, one additional test sample shall be selected from each diameter or thickness of bar. For other sections the sampling rate shall be as per mutual agreement.

12.3 For material supplied on the basis of maximum hardness, at least one sample shall be taken from each cast from each size of each heat treatment batch. If the material is continuously heat-treated, one sample shall be taken from each 10 tonnes or part thereof, but at least one sample from each cast shall be taken.

12.4 For material supplied to other conditions of delivery, at least one sample shall be taken from each cast for testing.

12.5 Higher sampling rate may be agreed to at the time of enquiry and order.

13 RETESTS

13.1 Retests shall be as specified in IS 8910.

13.2 For thermally treated bars only, the manufacturer may retreat a lot one or more times, and retests shall be made in the same manner as the original tests. Each such retest shall conform to the requirements specified.

14 ADDITIONAL REQUIREMENTS

14.1 If agreed to between the purchaser and the manufacturer at the time of enquiry and order, any or a combination of the following tests may also be carried out as additional requirements to ensure that the steels meet the quality requirements of the purchaser. The sampling frequency and acceptable level for each or any of these additional tests shall be mutually agreed to at the time of enquiry and order.

14.2 Cleanliness of the steel can be assessed by any or a combination of the following tests:

- a) Blue Fracture test as per IS 10138
- b) Step Machined test as per IS 10138
- c) Magnetic Particle inspection as per IS 10138
- d) Macroscopic Flaw test as per IS 4075

However, this is not applicable for re-sulphurized steel grades according to **Table 1**.

14.3 Other Tests:

- a) Ultrasonic Test
- b) Blank hardening test for core strength guarantee
- c) Microstructure for machinability including banding.

The method of testing and requirements shall be as mutually agreed.

15 MARKING

15.1 All bars of above 40 mm diameter or equivalent section and shall be stamped or suitably marked at the end with grade / material designation, cast number, size and manufacturer's name or trademark. Bars of smaller sections shall be tied in suitable bundles which shall carry tags giving the information. If mutually agreed, the weight of steel may be included in the tag. The ends of bars may be suitably colour coded to mark the grade of the material as per agreement between the purchaser and the manufacturer. Further requirements to special marking of the products shall be agreed at the time of enquiry and order.

15.2 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.

16 ORDERING INFORMATION

While placing an order for the product(s) covered by this standard, the purchaser should specify clearly the following:

- a) Grade designation;
- b) Description regarding product form, size, length, etc.;
- c) Condition of delivery;
- d) Tests required;
- e) Method for manufacture;
- f) Additional requirements as per Clause 13; and
- g) Any special requirements;

Table 1 Ladle Analysis
(Clauses 5.1, 5.2, 7.1, 7.2 and 14.1)

Sl	Designation	CONSTITUENT, PERCENT											
		C	Si	Mn	Ni	Cr	Mo	V	Al	Cu	B	S	P
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
NICKEL STEEL													
1	40Ni14	0.35-0.45	0.15-0.35	0.50-0.80	3.20-3.60	-	-	-	-	-	-	0.030 max	0.030 max
CHROMIUM STEEL													
2	15Cr2	0.12-0.17	0.15-0.35	0.30-0.50	-	0.30-0.50	-	-	-	-	-	0.030 max	0.030 max
3	15Cr3	0.12-0.18	0.15-0.35	0.40-0.60	-	0.50-0.80	-	-	-	-	-	0.030 max	0.030 max
4	16Cr3	0.13-0.18	0.15-0.35	0.60-0.90	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
5	16Cr4	0.13-0.18	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
6	17Cr3	0.14-0.20	0.15-0.35	0.60-0.90	-	0.70-1.00	-	-	-	-	-	0.030 max	0.030 max
7	20Cr3	0.17-0.23	0.15-0.35	0.60-0.90	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
8	20Cr4	0.17-0.23	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
9	28Cr4	0.24-0.31	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
10	30Cr4	0.28-0.33	0.15-0.35	0.60-0.90	-	0.80-1.20	-	-	-	-	-	0.030 max	0.030 max
11	34Cr3	0.30-0.35	0.15-0.35	0.60-0.90	-	0.75-1.00	-	-	-	-	-	0.030 max	0.030 max
12	34Cr4	0.30-0.37	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
13	35Cr4	0.33-0.38	0.15-0.35	0.60-0.90	-	0.80-1.20	-	-	-	-	-	0.030 max	0.030 max
14	37Cr4	0.34-0.41	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
15	40Cr4	0.35-0.45	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
16	41Cr3	0.38-0.43	0.15-0.35	0.70-0.90	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
17	41Cr4	0.38-0.45	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
18	45Cr1	0.43-0.48	0.15-0.35	0.75-1.00	-	0.20-0.25	-	-	-	-	-	0.030 max	0.030 max
19	45Cr3	0.43-0.48	0.15-0.35	0.70-0.90	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
20	45Cr4	0.43-0.48	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
21	47Cr4	0.46-0.51	0.15-0.35	0.70-0.95	-	0.85-1.15	-	-	-	-	-	0.030 max	0.030 max
22	50Cr3	0.48-0.53	0.15-0.35	0.70-0.90	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
23	50Cr4	0.45-0.55	0.15-0.35	0.60-0.90	-	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max

24	55Cr3	0.50-0.60	0.15-0.35	0.60-0.90	-	0.60-0.90	-	-	-	-	-	0.030 max	0.030 max
25	60Cr3	0.56-0.61	0.15-0.35	0.75-1.00	-	0.70-0.90	-	-	-	-	-	0.030 max	0.030 max
26	104Cr2	0.98-1.10	0.15-0.35	0.25-0.45	-	0.40-0.60	-	-	-	-	-	0.025 max	0.025 max
27	104Cr4	0.98-1.10	0.15-0.35	0.25-0.45	-	0.90-1.15	-	-	-	-	-	0.025 max	0.025 max
28	104Cr6	0.98-1.10	0.15-0.35	0.25-0.45	-	1.30-1.60	-	-	-	-	-	0.025 max	0.025 max
29	100Cr6	0.93-1.05	0.15-0.35	0.25-0.45	-	1.35-1.60	0.10 max	-	0.050 max	0.30 max	-	0.015 max	0.025 max
MOLYBDENUM STEEL													
30	12Mo2	0.09-0.14	0.15-0.35	0.75-1.00	-	-	0.15-0.25	-	-	-	-	0.030 max	0.030 max
31	19Mo5	0.18-0.23	0.15-0.35	0.45-0.65	-	-	0.45-0.60	-	-	-	-	0.030 max	0.030 max
32	23Mo2	0.20-0.25	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
33	23Mo4	0.20-0.25	0.15-0.35	0.70-0.90	-	-	0.35-0.45	-	-	-	-	0.030 max	0.030 max
34	27Mo2	0.25-0.30	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
35	27Mo4	0.24-0.29	0.15-0.35	0.70-0.90	-	-	0.35-0.45	-	-	-	-	0.030 max	0.030 max
36	32Mo2	0.30-0.35	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
37	37Mo2	0.35-0.40	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
38	42Mo2	0.40-0.45	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
39	47Mo2	0.45-0.50	0.15-0.35	0.70-0.90	-	-	0.20-0.30	-	-	-	-	0.030 max	0.030 max
NICKEL CHROMIUM STEEL													
40	13Ni13Cr3	0.10-0.15	0.15-0.35	0.40-0.70	3.00-3.50	0.60-1.00	-	-	-	-	-	0.030 max	0.030 max
41	14Cr6Ni6	0.12-0.17	0.15-0.35	0.40-0.60	1.40-1.70	1.40-1.70	-	-	-	-	-	0.030 max	0.030 max
42	15Ni9Cr1	0.12-0.18	0.15-0.35	0.35-0.65	2.00-2.50	0.20-0.50	-	-	-	-	-	0.030 max	0.030 max
43	15Ni13Cr3	0.12-0.18	0.15-0.35	0.35-0.65	3.00-3.50	0.60-1.00	-	-	-	-	-	0.030 max	0.030 max
44	15Ni16Cr5	0.12-0.18	0.15-0.35	0.40-0.70	3.80-4.30	1.00-1.40	-	-	-	-	-	0.030 max	0.030 max
45	16Ni3Cr2	0.12-0.20	0.15-0.35	0.60-1.00	0.60-1.00	0.40-0.80	-	-	-	-	-	0.030 max	0.030 max
46	16Ni4Cr3	0.13-0.19	0.15-0.35	0.70-1.00	0.80-1.10	0.60-1.00	-	-	-	-	-	0.030 max	0.030 max
47	17Ni6Cr6	0.14-0.20	0.15-0.35	0.50-0.90	1.40-1.70	1.40-1.70	-	-	-	-	-	0.030 max	0.030 max
48	18Ni5Cr4	0.16-0.21	0.15-0.35	0.60-0.90	1.20-1.50	0.90-1.20	-	-	-	-	-	0.030 max	0.030 max
49	30Ni16Cr5	0.26-0.34	0.15-0.35	0.40-0.70	3.90-4.30	1.10-1.40	-	-	-	-	-	0.030 max	0.030 max
50	31Ni11Cr3	0.27-0.35	0.15-0.35	0.35-0.65	2.50-3.00	0.60-1.00	-	-	-	-	-	0.030 max	0.030 max
51	35Ni5Cr2	0.30-0.40	0.15-0.35	0.60-0.90	1.00-1.50	0.45-0.75	-	-	-	-	-	0.030 max	0.030 max

52	36Ni5Cr3	0.32-0.40	0.15-0.35	0.50-0.80	1.00-1.50	0.50-0.90	-	-	-	-		0.030 max	0.030 max
53	36Ni13Cr3	0.32-0.40	0.15-0.35	0.35-0.65	3.00-3.50	0.60-1.00	-	-	-	-		0.030 max	0.030 max
CHROMIUM MOLYBDENUM STEEL													
54	7Cr4Mo6	0.12 max	0.15-0.35	0.40-0.70	-	0.70-1.10	0.45-0.65	-	-	-		0.030 max	0.030 max
55	10Cr9Mo10	0.15 max	0.15-0.35	0.40-0.70	-	2.00-2.50	0.90-1.10	-	-	-		0.030 max	0.030 max
56	15Cr4Mo2	0.13-0.18	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.25	-	-	-		0.030 max	0.030 max
57	15Cr13Mo6	0.10-0.20	0.15-0.35	0.40-0.70	-	2.90-3.40	0.45-0.65	-	-	-		0.030 max	0.030 max
58	18Cr4Mo2	0.15-0.21	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.25	-	-	-		0.030 max	0.030 max
59	20Cr4Mo2	0.17-0.23	0.15-0.35	0.60-1.00	-	0.90-1.20	0.15-0.25	-	-	-		0.030 max	0.030 max
60	20Cr2Mo1	0.18-0.23	0.15-0.35	0.70-0.90	-	0.40-0.60	0.08-0.15	-	-	-		0.030 max	0.030 max
61	20Cr2Mo2	0.18-0.23	0.15-0.35	0.90-1.20	-	0.40-0.60	0.13-0.20	-	-	-		0.030 max	0.030 max
62	20Cr2Mo3	0.18-0.23	0.15-0.35	0.75-1.00	-	0.45-0.65	0.20-0.30	-	-	-		0.030 max	0.030 max
63	20Cr2Mo5	0.17-0.23	0.15-0.35	0.70-1.00	-	0.30-0.60	0.40-0.50	-	-	-		0.030 max	0.030 max
64	21Cr4Mo2	0.26 max	0.15-0.35	0.50-0.80	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
65	22Cr3Mo5	0.19-0.24	0.15-0.35	0.70-1.00	-	0.70-1.00	0.40-0.50	-	-	-		0.030 max	0.030 max
66	22Cr4Mo4	0.20-0.25	0.15-0.35	0.60-0.90	-	0.90-1.20	0.35-0.45	-	-	-		0.030 max	0.030 max
67	24Cr4Mo2	0.20-0.27	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
68	25Cr4Mo2	0.22-0.29	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
69	25Cr13Mo6	0.20-0.30	0.15-0.35	0.40-0.70	-	2.90-3.40	0.45-0.65	-	-	-		0.030 max	0.030 max
70	30Cr4Mo2	0.28-0.33	0.15-0.35	0.40-0.60	-	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max
71	31Cr4Mo2	0.28-0.33	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
72	32Cr6Mo2	0.27-0.37	0.15-0.35	0.30-0.60	-	1.00-1.50	0.15-0.30	-	-	-		0.030 max	0.030 max
73	34Cr4Mo4	0.30-0.37	0.15-0.35	0.60-0.90	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
74	35Cr4Mo2	0.33-0.38	0.15-0.35	0.60-0.90	-	0.80-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
75	37Cr4Mo2	0.35-0.40	0.15-0.35	0.70-0.90	-	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max
76	40Cr4Mo2	0.38-0.45	0.15-0.35	0.60-1.00	-	0.80-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
77	40Cr4Mo3	0.35-0.45	0.15-0.35	0.50-0.80	-	0.90-1.20	0.20-0.35	-	-	-		0.030 max	0.030 max
78	42Cr4Mo2	0.40-0.45	0.15-0.35	0.75-1.00	-	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max
79	45Cr4Mo2	0.43-0.48	0.15-0.35	0.60-1.00	-	0.80-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
80	47Cr4Mo2	0.45-0.50	0.15-0.35	0.75-1.00	-	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max

81	50Cr4Mo2	0.46-0.54	0.15-0.35	0.50-0.80	-	0.90-1.20	0.15-0.30	-	-	-		0.030 max	0.030 max
82	51Cr4Mo2	0.48-0.53	0.15-0.35	0.75-1.00	-	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max
83	60Cr3Mo3	0.56-0.64	0.15-0.35	0.75-1.00	-	0.70-0.90	0.25-0.35	-	-	-		0.030 max	0.030 max
NICKEL MOLYBDENUM STEEL													
84	15Ni7Mo2	0.13-0.18	0.15-0.35	0.45-0.65	1.65-2.00		0.20-0.30			-		0.030 max	0.030 max
85	20Ni7Mo2	0.17-0.22	0.15-0.35	0.45-0.65	1.65-2.00	-	0.20-0.30	-	-	-		0.030 max	0.030 max
86	21Ni7Mo2	0.18-0.23	0.15-0.35	0.70-0.90	1.65-2.00		0.20-0.30			-		0.030 max	0.030 max
87	26Ni3Mo2	0.24-0.29	0.15-0.35	0.45-0.65	0.70-1.00		0.15-0.25			-		0.030 max	0.030 max
88	17Ni14Mo2	0.15-0.20	0.15-0.35	0.40-0.60	3.25-3.75		0.20-0.30			-		0.030 max	0.030 max
89	20Ni14Mo2	0.18-0.23	0.15-0.35	0.40-0.70	3.25-3.75		0.20-0.30			-		0.030 max	0.030 max
NICKEL CHROMIUM MOLYBDENUM STEEL													
90	10Ni13Cr5Mo1	0.08-0.13	0.15-0.30	0.45-0.65	3.00-3.50	1.00-1.40	0.08-0.15			-		0.025 max	0.025 max
91	15Ni1Cr2Mo1	0.13-0.18	0.15-0.35	0.70-0.90	0.20-0.40	0.30-0.50	0.08-0.15			-		0.030 max	0.030 max
92	15Ni2Cr2Mo2	0.13-0.18	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
93	15Ni3Cr2Mo5	0.13-0.18	0.15-0.35	0.70-0.90	0.70-1.00	0.45-0.65	0.45-0.60			-		0.030 max	0.030 max
94	15Ni5Cr4Mo1	0.12-0.18	0.15-0.35	0.60-1.00	1.00-1.50	0.75-1.25	0.08-0.15	-	-	-		0.030 max	0.030 max
95	15Ni7Cr2Mo2	0.12-0.18	0.15-0.35	0.40-0.70	1.60-2.00	0.40-0.60	0.15-0.30	-	-	-		0.030 max	0.030 max
96	15Ni7Cr4Mo2	0.12-0.18	0.15-0.35	0.60-1.00	1.50-2.00	0.75-1.25	0.10-0.20	-	-	-		0.030 max	0.030 max
97	15Ni17Cr3Mo2	0.12-0.18	0.15-0.35	0.30-0.60	4.00-4.50	0.70-1.00	0.15-0.30	-	-	-		0.030 max	0.030 max
98	16Ni8Cr6Mo2	0.12-0.20	0.15-0.35	0.40-0.70	1.80-2.20	1.40-1.70	0.15-0.25	-	-	-		0.030 max	0.030 max
99	16Ni12Cr6Mo5	0.13-0.20	0.15-0.35	0.80-1.20	2.80-3.20	1.40-1.80	0.40-0.60	-	-	-		0.030 max	0.030 max
100	17Ni2Cr2Mo2	0.15-0.20	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
101	17Ni6Cr4Mo2	0.14-0.20	0.15-0.35	0.60-0.90	1.20-1.60	0.80-1.10	0.15-0.25	-	-	-		0.030 max	0.030 max
102	18Ni4Cr2Mo4	0.15-0.20	0.15-0.35	0.70-0.90	0.90-1.20	0.35-0.55	0.30-0.40			-		0.030 max	0.030 max
103	18Ni6Cr7Mo3	0.15-0.21	0.15-0.35	0.50-0.90	1.40-1.70	1.50-1.80	0.25-0.35	-	-	-		0.030 max	0.030 max
104	20Ni2Cr2Mo2	0.17-0.23	0.15-0.35	0.60-0.95	0.40-0.70	0.35-0.70	0.15-0.30	-	-	-		0.030 max	0.030 max
105	20Ni4Cr2Mo2	0.18-0.23	0.15-0.35	0.50-0.70	0.90-1.20	0.35-0.55	0.15-0.25			-		0.030 max	0.030 max
106	20Ni7Cr2Mo2	0.17-0.23	0.15-0.35	0.40-0.70	1.60-2.00	0.40-0.60	0.15-0.30	-	-	-		0.030 max	0.030 max
107	22Ni2Cr2Mo2	0.20-0.25	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
108	22Ni2Cr2Mo4	0.20-0.25	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.30-0.40			-		0.030 max	0.030 max

109	25Ni2Cr2Mo2	0.23-0.28	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
110	25Ni13Cr5Mo2	0.20-0.30	0.15-0.35	0.35-0.60	3.00-3.50	1.00-1.50	0.15-0.30	-	-	-		0.030 max	0.030 max
111	27Ni2Cr2Mo2	0.25-0.30	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
112	30Ni2Cr2Mo2	0.28-0.33	0.15-0.35	0.70-0.90	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
113	30Ni8Cr8Mo4	0.26-0.34	0.15-0.35	0.50-0.80	1.80-2.20	1.80-2.20	0.30-0.50	-	-	-		0.030 max	0.030 max
114	30Ni12Cr12Mo6	0.25-0.35	0.15-0.35	0.35-0.60	2.50-3.50	2.50-3.50	0.50-0.70	-	-	-		0.030 max	0.030 max
115	31Ni7Cr3Mo2	0.27-0.35	0.15-0.35	0.60-0.90	1.60-2.00	0.60-1.00	0.15-0.30	-	-	-		0.030 max	0.030 max
116	31Ni10Cr3Mo6	0.27-0.35	0.15-0.35	0.40-0.70	2.25-2.75	0.50-0.80	0.40-0.70	-	-	-		0.030 max	0.030 max
117	34Ni6Cr6Mo2	0.30-0.38	0.15-0.35	0.50-0.80	1.30-1.70	1.30-1.70	0.15-0.30			-		0.030 max	0.030 max
118	36Ni4Cr4Mo2	0.32-0.40	0.15-0.35	0.50-0.80	0.90-1.20	0.90-1.20	0.15-0.30			-		0.030 max	0.030 max
119	37Ni2Cr2Mo2	0.35-0.40	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
120	39Ni7Cr3Mo2	0.36-0.43	0.15-0.35	0.60-0.90	1.60-2.00	0.60-1.00	0.15-0.30	-	-	-		0.030 max	0.030 max
121	40Ni2Cr2Mo2	0.37-0.44	0.15-0.35	0.70-1.00	0.40-0.70	0.40-0.60	0.15-0.30	-	-	-		0.030 max	0.030 max
122	40Ni6Cr4Mo2	0.35-0.45	0.15-0.35	0.40-0.70	1.20-1.60	0.90-1.30	0.10-0.20	-	-	-		0.030 max	0.030 max
123	40Ni6Cr4Mo3	0.35-0.45	0.15-0.35	0.40-0.70	1.25-1.75	0.90-1.30	0.20-0.35	-	-	-		0.030 max	0.030 max
124	40Ni7Cr3Mo3	0.38-0.43	0.15-0.35	0.60-0.85	1.65-2.00	0.70-0.90	0.20-0.30			-		0.030 max	0.030 max
125	40Ni10Cr3Mo6	0.36-0.44	0.15-0.35	0.40-0.70	2.25-2.75	0.50-0.80	0.40-0.70	-	-	-		0.030 max	0.030 max
126	42Ni2Cr2Mo2	0.40-0.45	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
127	45Ni2Cr2Mo2	0.43-0.48	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
128	47Ni7Cr3Mo2	0.44-0.50	0.15-0.35	0.60-0.90	1.60-2.00	0.60-1.00	0.15-0.30	-	-	-		0.030 max	0.030 max
129	50Ni2Cr2Mo2	0.48-0.53	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
130	55Ni2Cr2Mo2	0.51-0.59	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
131	60Ni2Cr2Mo2	0.56-0.64	0.15-0.35	0.75-1.00	0.40-0.70	0.40-0.60	0.15-0.25			-		0.030 max	0.030 max
MANGANESE STEEL													
132	30Mn7	0.28-0.33	0.15-0.35	1.60-1.90	-	-	-	-	-	-	-	0.030 max	0.030 max
133	35Mn7	0.33-0.38	0.15-0.35	1.60-1.90	-	-	-	-	-	-	-	0.030 max	0.030 max
134	40Mn7	0.38-0.43	0.15-0.35	1.60-1.90	-	-	-	-	-	-	-	0.030 max	0.030 max
135	45Mn7	0.43-0.48	0.15-0.35	1.60-1.90	-	-	-	-	-	-	-	0.030 max	0.030 max
SILICON ALLOYED STEEL													
136	36Si7	0.33-0.40	1.50-2.00	0.80-1.00	-	-	-	-	-	-	-	0.030 max	0.030 max

137	37Mn5Si5	0.33-0.41	1.10-1.40	1.10-1.40	-	-	-	-	-	-	-	0.030 max	0.030 max
138	50Si8	0.51-0.59	1.80-2.20	0.70-0.95	-	-	-	-	-	-	-	0.030 max	0.030 max
139	55Si7	0.50-0.60	1.50-2.00	0.80-1.00	-	-	-	-	-	-	-	0.030 max	0.030 max
140	60Si8	0.56-0.64	1.80-2.20	0.75-1.00	-	-	-	-	-	-	-	0.030 max	0.030 max
SILICON CHROMIUM STEEL													
141	45Cr36Si12	0.40-0.50	2.75-3.25	0.30-0.60	-	8.50-9.50	-	-	-	-	-	0.030 max	0.030 max
142	50Si6Cr3	0.51-0.59	1.20-1.60	0.60-0.80	-	0.60-0.80	-	-	-	-	-	0.030 max	0.030 max
143	55Si6Cr3	0.50-0.60	1.20-1.60	0.50-0.80	-	0.50-0.80	-	-	-	-	-	0.030 max	0.030 max
144	60Si4Cr2	0.56-0.64	0.70-1.10	0.75-1.00	-	0.45-0.65	-	-	-	-	-	0.030 max	0.030 max
MANGANESE CHROMIUM STEEL													
145	16Mn5Cr4	0.14-0.19	0.15-0.35	1.00-1.30	-	0.80-1.10	-	-	-	-	-	0.030 max	0.030 max
146	20Mn5Cr2	0.17-0.23	0.15-0.35	1.20-1.50	-	0.35-0.70	-	-	-	-	-	0.030 max	0.030 max
147	20Mn5Cr5	0.17-0.22	0.15-0.35	1.00-1.40	-	1.00-1.30	-	-	-	-	-	0.030 max	0.030 max
148	43Mn6Cr2	0.40-0.46	0.15-0.35	1.35-1.65	-	0.35-0.70	-	-	-	-	-	0.030 max	0.030 max
MANGANESE MOLYBDENUM STEEL													
149	35Mn6Mo3	0.30-0.40	0.15-0.35	1.30-1.80	-	-	0.20-0.35	-	-	-	-	0.030 max	0.030 max
150	35Mn6Mo4	0.30-0.40	0.15-0.35	1.30-1.80	-	-	0.35-0.55	-	-	-	-	0.030 max	0.030 max
CHROMIUM MOLYBDENUM STEEL													
151	8Cr16Mo5	0.04-0.12	0.15-0.35	0.80-1.20	-	3.70-4.30	0.40-0.60	-	-	-	-	0.030 max	0.025 max
152	24Cr13Mo6	0.20-0.27	0.15-0.35	0.40-0.70	-	3.00-3.50	0.50-0.70	-	-	-	-	0.030 max	0.025 max
153	31Cr12Mo4	0.28-0.35	0.15-0.35	0.40-0.70	0.30 max	2.80-3.30	0.30-0.50	-	-	-	-	0.030 max	0.025 max
CHROMIUM VANADIUM STEEL													
154	18Cr2V1	0.16-0.21	0.15-0.35	0.50-0.70		0.50-0.70		0.10-0.15		-	-	0.030 max	0.030 max
155	42Cr6V1	0.37-0.47	0.15-0.35	0.50-0.80	-	1.40-1.70	-	0.07-0.12	-	-	-	0.030 max	0.030 max
156	50Cr4V1	0.45-0.55	0.15-0.35	0.70-1.10	-	0.90-1.20	-	0.10-0.20	-	-	-	0.030 max	0.030 max
157	50Cr4V2	0.45-0.55	0.15-0.35	0.50-0.80	-	0.90-1.20	-	0.15-0.30	-	-	-	0.030 max	0.030 max
158	51Cr4V4	0.47-0.55	0.15-0.35	0.60-1.00	-	0.80-1.10	-	0.10-0.25	-	-	-	0.030 max	0.030 max
159	58Cr4V1	0.53-0.63	0.15-0.35	0.80-1.10	-	0.90-1.20	-	0.07-0.12	-	-	-	0.030 max	0.030 max
CHROMIUM MOLYBDENUM VANADIUM STEEL													
160	20Cr5Mo7V3	0.16-0.24	0.15-0.35	0.40-0.80	-	1.20-1.50	0.65-0.80	0.25-0.35	0.30 max	-	-	0.030 max	0.025 max

161	31Cr10Mo2V1	0.27-0.34	0.15-0.35	0.40-0.70	-	2.30-2.70	0.15-0.25	0.10-0.20	-	-	-	0.030 max	0.025 max
162	33Cr12Mo9V2	0.29-0.36	0.15-0.35	0.40-0.70	-	2.80-3.30	0.70-1.00	0.15-0.25	-	-	-	0.030 max	0.025 max
163	40Cr13Mo10V2	0.35-0.45	0.15-0.35	0.40-0.70	-	3.00-3.50	0.80-1.10	0.15-0.25	-	-	-	0.030 max	0.025 max
CHROMIUM ALUMINIUM MOLYBDENUM STEEL													
164	32Cr7Al10Mo	0.28-0.35	0.15-0.35	0.40-0.70	-	1.50-1.80	0.20-0.40	-	0.80-1.20	-	-	0.030 max	0.025 max
165	34Cr5Al10Mo2	0.30-0.37	0.15-0.35	0.40-0.70	-	1.00-1.30	0.15-0.25	-	0.80-1.20	-	-	0.030 max	0.025 max
166	40Cr7Al10Mo2	0.35-0.45	0.15-0.35	0.40-0.70	-	1.50-1.80	0.10-0.25	-	0.90-1.30	-	-	0.030 max	0.030 max
167	40Cr7Al10Mo3	0.38-0.45	0.15-0.35	0.40-0.70	-	1.50-1.80	0.20-0.35	-	0.80-1.20	-	-	0.030 max	0.025 max
168	45Cr6Al10Mo2	0.40-0.50	0.15-0.50	0.60 Max	-	1.30-1.70	0.15-0.30	-	0.70-1.20	-	-	0.030 max	0.030 max
CHROMIUM ALUMINIUM NICKEL MOLYBDENUM STEEL													
169	34Cr7Al10Ni4Mo2	0.30-0.37	0.15-0.35	0.40-0.70	0.85-1.15	1.50-1.80	0.15-0.25	-	0.80-1.20	-	-	0.030 max	0.025 max
STEELS WITH BORON													
170	20Mn5BT	0.17-0.23	0.15-0.35	1.10-1.40	-	-	-	-	-	-	0.0008-0.0050	0.030 max	0.030 max
171	30Mn5BT	0.27-0.33	0.15-0.35	1.15-1.45	-	-	-	-	-	-	0.0008-0.0050	0.030 max	0.030 max
172	39Mn5BT	0.36-0.42	0.15-0.35	1.15-1.45	-	-	-	-	-	-	0.0008-0.0050	0.030 max	0.030 max
173	44Cr2BT	0.43-0.48	0.15-0.35	0.75-1.00	-	0.20-0.60	-	-	-	-	0.0008-0.0050	0.030 max	0.030 max
174	46Cr1BT	0.44-0.49	0.15-0.35	0.75-1.00	-	0.20-0.35	-	-	-	-	0.0008-0.0050	0.030 max	0.030 max
175	50Cr2BT	0.48-0.53	0.15-0.35	0.75-1.00	-	0.40-0.60	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
176	60Cr2BT	0.56-0.64	0.15-0.35	0.75-1.00	-	0.40-0.60	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
177	60Cr3BT	0.56-0.64	0.15-0.35	0.75-1.00	-	0.70-0.90	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
178	16Mn5Cr5BT	0.14-0.19	0.15-0.35	1.00-1.30	-	0.80-1.10	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
179	27Mn5Cr2BT	0.24-0.30	0.15-0.35	1.10-1.40	-	0.30-0.60	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
180	33Mn5Cr2BT	0.30-0.36	0.15-0.35	1.20-1.50	-	0.30-0.60	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
181	39Mn6Cr2BT	0.36-0.42	0.15-0.35	1.40-1.70	-	0.30-0.60	-	-	-	-	0.0005-0.0050	0.030 max	0.030 max
182	17Cr2Ni2Mo1BT	0.15-0.20	0.15-0.35	0.75-1.00	0.30-0.60	0.30-0.50	0.08-0.15	-	-	-	0.0005-0.0050	0.030 max	0.030 max
183	30Cr2Ni2Mo1BT	0.28-0.33	0.15-0.35	0.75-1.00	0.30-0.60	0.30-0.50	0.08-0.15	-	-	-	0.0005-0.0050	0.030 max	0.030 max
184	45Cr2Ni1Mo1BT	0.43-0.48	0.15-0.35	0.75-1.00	0.20-0.40	0.35-0.55	0.08-0.15	-	-	-	0.0005-0.0050	0.030 max	0.030 max
RESULPHURIZED STEEL													
185	46V1S3	0.42-0.50	0.60 max	0.60-1.00	-	-	-	0.08-0.13	-	-	-	0.045-0.065	0.030 max

NOTES

1 Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions shall be taken to prevent the addition of such elements from scrap or other material used in the manufacture which affect the mechanical properties and applicability. Small quantities of certain elements are present in alloy steels, which are not specified or required. These elements are considered as incidental and may be present to the following maximum amounts until and unless otherwise agreed upon between the purchaser and the manufacturer: copper 0.35%; nickel 0.25%; chromium 0.20% and molybdenum 0.06%.

2 The nitrogen content of the steel shall not be more than 0.007 percent. For aluminium killed or silicon-aluminium killed, the nitrogen content shall not exceed 0.012 percent. This shall be ensured by the manufacturer by occasional check analysis.

3 When required, the steels shall be supplied in fully aluminium killed condition and the total aluminium content shall be within 0.020-0.050 percent. When the steel is aluminium killed, the requirements of minimum silicon content shall not apply except for grades alloyed with Silicon (≥ 0.50 percent). Aluminium less than 0.02 percent can be mutually agreed to between the purchaser and the supplier for Aluminium killed steel. When the steel is silicon killed, the silicon content shall not be less than 0.10 percent. When the steel is Aluminium silicon killed, the silicon content shall not be less than 0.03 percent and total Aluminium content shall not be less than 0.01 percent.

4 Restricted chemistry may be mutually agreed to between the purchaser and the supplier.

5 When silicon ranges or limits are required, the following ranges are commonly used: 0.10% max; 0.10 to 0.20%; 0.10 to 0.35%; 0.15 to 0.35%; or 0.20 to 0.40%. Accordingly, Si range can be mutually agreed between the purchaser and the manufacturer.

6 For grades specifying maximum Sulphur, Sulphur in the range of 0.020-0.035 percent or any other range may be agreed to between the manufacturer and purchaser. For such grades specifying sulphur range, a letter 'S' shall be added at the end of grade designation along with nominal S x 1000 e.g., 17Cr3S30.

Table 2 Variation for Check Analysis
(Clause 7.2)

Element	Limiting values of the ladle (heat) analysis	Permissible deviation (±) for the product analysis for nominal size, mm			
		Up to 250	Over 250 up to 500	Over 500	
	percent mass fraction	percent mass fraction	percent mass fraction	To be mutually agreed	
Carbon	up to 0.45	0.02	0.04		
	Over 0.45 to 0.90	0.03	0.05		
Silicon	up to 0.40	0.03	0.04		
	Over 0.40 to 2.00	0.05	0.06		
	Over 2.00	To be mutually agreed			
Manganese	up to 1.20	0.04	0.06		
	Over 1.20 to 2.00	0.05	0.07		
Nickel	up to 1.00	0.03	0.03		
	Over 1.00 to 2.20	0.05	0.05		
	Over 2.20 to 5.00	0.07	0.07		
Chromium	up to 0.80	0.03	0.04		
	Over 0.80 to 2.20	0.05	0.06		
	Over 2.20 to 5.50	0.11	0.13		
	Over 5.50	To be mutually agreed			
Molybdenum	up to 0.40	0.03	0.04		
	Over 0.40 to 1.20	0.04	0.05		
Vanadium	up to 0.15	0.02	0.02		
	Over 0.15 to 0.30	0.03	0.03		
Aluminium	≤ 0.060	0.005	To be mutually agreed		
	Over 0.060	To be mutually agreed			
Sulphur		0.005	0.010		
Phosphorus		0.005	0.010		
NOTES					
1) The deviation of the product analysis in one heat for a given element may occur over the upper value or under the lower value of the specified range of the ladle analysis, but not both at the same time.					
2) For sulphur-controlled steels, the permitted variation in the product analysis of sulphur is ± 0.005 percent. However, for steels with a minimum sulphur range of 0.020 percent according to ladle analysis, sulphur in the product should not have less than 0.017 percent, unless otherwise agreed.					

Table 3 Permissible Depth of the Surface Defects for Black Bars
(Clause 8.1)

<i>Dimensions, mm</i>		<i>Depth of Defects, mm</i>		
Over	Up to and including	Type 1	Type 2	Crack tested
(1)	(2)	(3)	(4)	(5)
6	8	0.13	0.26	
8	12	0.15	0.30	
12	14	0.18	0.36	
14	20	0.25	0.50	
20	25	0.28	0.56	By agreement
25	32	0.30	0.60	between the
32	42	0.35	0.60	purchaser and the
42	53	0.40	0.80	manufacturer
53	63	0.60	1.20	
63	80	0.80	1.60	
80	100	1.00	2.00	
Above 100 mm		By agreement		

NOTES

Type 1 – recommended for bright bars

Type 2 – recommended for the production of machined parts for general engineering purposes

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

<i>IS No.</i>	<i>Title</i>
IS 228 (Various Parts)	Methods for chemical analysis of steel
IS 1500 (Part 1) : 2019 /ISO 6506-3 : 2014	Metallic materials - Brinell hardness test Part 1 Test method (<i>fifth revision</i>)
IS 1608 (Part 1) : 2022 /ISO 6892-1 : 2019	Metallic materials -Tensile testing Part 1 Method of test at room temperature (<i>fifth revision</i>)
IS 1762 (Part 1):1974	Code for designation of steels: Part 1 based on letter symbols (<i>first revision</i>)
IS 1956 (Various Parts)	Glossary of terms relating to iron and steel
IS 3739 : 1987	Dimensional tolerances for carbon and alloy constructional steel products
IS 4075 : 1985	Macroscopic flaw test for steel — Method of test (<i>second revision</i>)
IS 4163 : 2021 /ISO 4967 : 2013	Steel — Determination of content of nonmetallic inclusions - Micrographic method using standard diagrams (<i>fourth revision</i>)
IS 4748 : 2021 / ISO 643 : 2019	Steels - Micrographic determination of the apparent grain size (<i>third revision</i>)
IS 6396 : 2023 /ISO 3887 : 2017	Steels — Determination of the Depth of Decarburization (<i>third revision</i>)
IS 8811 : 1998	Method for emission spectrometric analysis of plain carbon and low alloy steels point to plane technique (<i>first revision</i>)
IS 8910 : 2022 /ISO 404 : 2013	General technical delivery requirements for steel and steel products (<i>second revision</i>)
IS 10138 : 2010	Macroscopic methods for determination of non-metallic inclusion content in wrought steels (<i>second revision</i>)