

Table 1 Chemical Composition
(Clauses 8.1, 8.3, 8.4.1 and 8.4.2)

Sl No.	Grade	Constituent, Percent, Max				
		C	Si	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Grade 1	0.25	0.60	1.20	0.040	0.045
ii)	Grade 2	0.30	0.60	1.00	0.040	0.045
iii)	Grade 3	0.25	0.60	0.70	0.040	0.045

NOTES

1 For each reduction of 0.01 percent below the specified maximum carbon content, an increase of 0.04 percent manganese above the specified maximum is permitted up to a maximum of 1.40, 1.28 and 1.10 percent for Grades 1, 2 and 3 respectively.

2 If so specified at the time of enquiry and order, the carbon contents shall be limited to 0.25 percent in all grades regardless of the manganese percent.

8.4.2 The following limits shall apply for the elements not specified in Table 1:

Constituent	Percent, Max
Chromium	0.50
Nickel	0.50
Molybdenum + tungsten	0.25
Copper	0.30
Vanadium	0.03
Total content of all the unspecified elements	1.00

8.4.3 Analysis and reporting of analysis in the test certificate for the above residual elements need be made only when so specified by the purchaser in the enquiry and order. However, the manufacturer shall ensure that the residual elements are within the limits specified.

8.4.4 When specified in the enquiry and order the maximum carbon equivalent as determined by the formula given in 16.3 shall be restricted to:

Grade	Carbon Equivalent
1	0.55
2 and 3	0.50

9 WORKMANSHIP AND FINISH

9.1 The castings shall be accurately moulded in accordance with the pattern or the working drawings supplied by the purchaser or as mutually agreed to, with the addition of such letters, figures and marks as may be specified.

9.2 The purchaser shall specify the tolerances on all important dimensions. On other dimensions, tolerances specified in IS 4897 shall apply.

10 FREEDOM FROM DEFECTS

10.1 All castings shall be free from defects that will adversely affect machining and utility of castings.

10.2 When necessary to remove risers or gates by flame or arc or a combination thereof, or by any other process involving intense heat, care shall be taken to make the cut at a sufficient distance from the body of the casting so as to prevent any defect being introduced into the casting due to local heating. Any such operation is preferably done before heat treatment.

10.3 In the event of any casting proving defective from foundry causes in the course of preparation, machining or erection, such casting may be rejected notwithstanding any previous certification of satisfactory testing and/or inspection.

11 FETTLING AND DRESSING

All castings shall be properly fettled and dressed, and all surfaces shall be thoroughly cleaned.

12 HEAT TREATMENT

12.1 Castings shall be heat treated in a properly constructed furnace, having adequate means of temperature control, which shall permit the whole of the castings being uniformly heated to the necessary temperature. All castings shall be suitably heat treated so as to attain specified mechanical properties.

12.2 The test pieces shall be heat treated along with the castings they represent.

13 MECHANICAL TESTS

13.1 The mechanical properties specified are those which are to be obtained from test bars cast either separately or attached to the castings to which they refer and heat treated as given in 12.2. The test values so exhibited, therefore, represent the quality of steel from which the castings have been poured; they do not necessarily represent the properties of the castings themselves.

13.2 Tensile Test

The tensile test shall be carried out in accordance with IS 1608. The relevant mechanical properties shall be as given in Table 2.

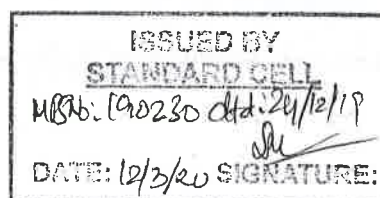


Table 2 Mechanical Properties
(Clauses 13.2, 13.3 and 13.4)

Sl. No.	Grade	Ultimate Tensile Stress MPa	Yield Stress MPa	Elongation Percent	Reduction of Area Percent	Impact Value Charpy V-Notch ¹⁾ J	Angle of Bend ¹⁾ Degree
(1)	(2)	(3)	Min	Min	Min	Min	Min
i)	1	485-655	275	20	35	20	90
ii)	2	485-655	250	20	35	20	90
iii)	3	415-585	205	22	35	22	90

¹⁾ These tests are optional.

13.3 Charpy V-Notch Impact Test

If specified in the enquiry and order, the impact test shall be carried in accordance with IS 1757 and the values shall conform to the requirements given in Table 2.

13.4 Bend Test

If so specified at the time of enquiry and order, the bend test shall be carried out in accordance with IS 1599. Test pieces shall be capable of being bent cold without fracture to an angle specified in Table 2 round a mandrel having a diameter of 50 mm.

13.4.1 Bend test pieces shall be of suitable length, convenient for the machine in which they will be bent and shall have either a diameter of 25 mm or a rectangular section of 25 mm × 20 mm. The edges of the rectangular test piece shall be rounded to a radius of not more than 1.5 mm and the test shall be made by bending the test piece over the thinner action.

14 ELEVATED TEMPERATURE PROPERTIES

14.1 The minimum values for ratio of 0.2 percent proof stress at elevated temperatures (*E_t*) to the specified minimum tensile strength at room temperature (*R*) shall be as given below:

Temperature, °C	250	275	300	325	350	375	400	425
<i>E_t/R</i>	0.40	0.38	0.36	0.34	0.33	0.32	0.31	0.30

14.2 Testing of elevated temperature properties is optional. If required by the purchaser and specified in the enquiry and order, the manufacturer shall either:

- certify that the castings have the properties as specified in 14.1; or
- hot-test the material at the temperature stated in

the order in which case 0.2 percent proof stress values obtained shall be not less than those calculated on the basis given in 14.1

NOTE — Testing of elevated temperature properties is optional.

15 NON-DESTRUCTIVE TESTS

15.1 Non-destructive testing shall be applied if so specified in the enquiry and order. Under this heading are grouped the tests which aim at revealing defects which cannot be revealed by a simple visual examination, such as penetrant, magnetic particle, ultrasonic X-radiographic or gamma-radiographic inspection; also included under this heading are tests on the surface condition by visual or visual-tactile examination. The purchaser shall specify the following in the enquiry and order:

- The type of non-destructive testing which he intends to carry out or to have carried out;
- The area or areas of the casting to which these tests apply, and the types of discontinuity;
- Whether all, or what proportion, of the castings are to be tested;
- The severity level defining the acceptability or non-acceptability of defect which may be revealed; and
- Whether the manufacturer is or is not contractually responsible for carrying out the tests.

15.2 Unless otherwise agreed upon, when non-destructive testing is to be done the castings shall be examined as follows:

- Ultrasonic examination (see IS 7666),
- Magnetic particle examination (see IS 3703),
- Liquid penetrant examination (see IS 3658), and
- Radiographic examination (see IS 2595).