



**PRODUCT MANUAL FOR
Steels for Hardening and Tempering
According to IS 5517:1993**

1.	Product	:	IS 5517:1993
	Title	:	Steels for Hardening and Tempering
	No. of amendments	:	3
2.	Sampling Guidelines		
a)	Raw material	:	No specific requirement for raw material
b)	Grouping Guidelines	:	Please refer Annex - A
c)	Sample Size	:	For Chemical tests: i) For instrumental chemical analysis- 5pcs of length 5 cm each in Flat form (bars/rods of dia >3mm) or 5 pcs of 5cm (L)×5cm (H)(plates/flats etc..) ii) For Wet Chemical analysis - 50 gm drillings For physical and metallurgical tests: 1 m
3.	List of Test Equipment	:	Please refer Annex - B
4.	Scheme of Inspection and Testing	:	Please refer Annex - C
5.	Possible tests in a day	:	All tests can be performed in a day except for additional test as per clause 16 of IS 5517:1993
6.	Scope of the Licence :		
	License is granted to use Standard Mark as per IS 5517:1993 with the following scope:		
	Name of the product	Steels for Hardening and Tempering	
	Steel Designation	30C8,..	
	Delivery Condition	A,B,..	
	Finish	As rolled/forged,..	
	Shape(Size)	Bars(.....mmupto and includingmm), Rods(.....mmupto and includingmm), etc...	
	Optional Requirements	With or Without Ultrasonic test, ..	

ANNEXURE A
TO PRODUCT MANUAL FOR
Steels for Hardening and Tempering
IS 5517:1993
GROUPING GUIDELINES

Grouping of different steel designations has been done on the basis of chemical composition/alloying elements and condition of supply. Guidelines for drawing of samples from each group are as under:

Group	Steel Designation	Remarks
1	30C8,35C8, 40C8,45C8, 50C8,55C8	Two samples each from the group with one designation of minimum carbon limit and one designation of maximum carbon limit, of any size, shape, finish and delivery condition may be tested to cover all steel designations, conditions, finishes, sizes and shapes within the group.
2	Steel Designations other than that covered in Group-1	As variety of steels mentioned in the standard can also be supplied in various delivery conditions, it is observed that steel covered is atypical /unique. Therefore, all grades that are required to be included in scope should be tested from any one size offered by the firm. i.e To cover any grade, sample of the grade is required to be tested of any one size, shape, finish and delivery condition offered by the firm.

1. However, it shall be ensured that the firm is having all the necessary manufacturing and testing facilities for the manufacture and testing of the sizes/grade designations /finishes of Steel bars Flats, rods, plates, forgings etc. to be included in the licence.
2. During the operation of licence, BO shall ensure that all the sizes/grade designations/ delivery conditions/finishes covered in the license are drawn for independent testing on rotation over a period of time.

ANNEXURE B
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LIST OF TESTING EQUIPMENT

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Major test equipment essentially required to test as per requirements of Indian Standard.

Sr. No	Test Equipment/Chemicals	Tests Used in with Clause Reference
1.	Rough Polishing Machine, Abrasive Cutting Machine, Fine Polishing Machine, Grinding Machine, Molding machine, Longitudinal cutting machine	Preparation of specimen
2.	<p>Instrumental methods Spectrometer: atomic-absorption spectrometry, inductively coupled plasma atomic emission, inductively coupled plasma mass spectrometry techniques, spark source optical emission spectrometry. spectro polisher(sample preparation)</p> <p>Spectrophotometer</p>	6.1,6.2,6.3 (C,S,P,Mn,Si, Ni, Cr, Mo, V, Al, Cu, B, Sn)
3.	<p>Strohlein or Leco apparatus with all attachments Barometer with chart, Hot plate, Muffle furnace, Complete range of glass wares, measuring cylinders, Desiccator, porcelain boats or ceramic crucibles, Thermometer, Electronic Balance, Distilled Water, Hot air oven, Oxygen - 99.5 percent minimum purity, ether or acetone, Standard Reference Material (NML) with certificate</p> <p>Reagents for C: tin granules or pure iron fillings, acidulated water/brine water, methyl red, caustic potash</p> <p>Reagents for S: Ceramic boats/crucibles – desiccators, Fluxes -Low sulphur copper, tin or iron, Dilute hydrochloric acid, Starch Iodide solution, Potassium iodate</p>	6.1,6.2,6.3 (for C& S, chemical method, alternative to instrumental method)
4.	<p>Weighing balance, Heater/ Heating element along with energy regulator, Ice water bath, Vol Flask Cap – 1 litre, (Whatman) filter paper No. 040,Suction Filtration Facility, Filter paper pulp pad, Standard Reference Material (NML) with certificate</p> <p>Potassium Permanganate (KMnO₄), Sodium Nitrite (Na₂NO₃), Ammonium Molybdate [(NH₄)₂ Mo₂O₇], Ammonium Phosphate [(NH₄)₃ PO₄], Potassium Nitrate (K₂NO₃), Phenolphthalein Solution, Rectified spirit or methyl alcohol, Sodium Hydroxide (NaOH), Hydrofluoric Acid (HF), Perchloric Acid (HClO₄), Sulphurous Acid,Hydrobromic Acid (HBr) , other chemicals and reagent as applicable</p>	6.1,6.2,6.3 (Phosphorus content , chemical method, alternative to instrumental method)

5.	Hot plate, Conical flask Reagents: silver nitrate, ammonium persulphate sodium arsenite solution, Dilute Nitric Acid, Phosphoric Acid, Dilute Sulphuric Acid, Concentrated Nitric Acid, NaCl Solution, Permanganic acid	6.1,6.2,6.3 (Manganese content, chemical method, alternative to instrumental method)
6.	Medium textured filter paper, Porcelain casserole, platinum crucible, filter paper pulp, hot plate, hot air oven, muffle furnace Reagents: Silver nitrate solution, concentrated nitric acid, concentrated sulphuric acid, Dilute Hydrochloric Acid, Dilute Sulphuric Acid, Perchloric Acid, Tartaric acid and hydrofluoric acid	6.1,6.2,6.3 (Silicon content, chemical method, alternative to instrumental method)
7.	Plate, Muffle Furnace, porcelain or silica crucible, Reagents: Hot Wash Solution (dilute sulphuric acid solution 1: 99 v/v with hydrogen sulphide), dilute sulphuric acid, hydrogen sulphide, Dilute Nitric Acid, Sodium Fluoride, solid, Dilute Ammonium Hydroxide, Acetic Acid, Potassium Iodide, Starch Solution, Sodium Thiosulphate Solution, Ammonium Bifluoride Solution	6.1,6.2,6.3 (Cu content, chemical method, alternative to instrumental method)
8.	Hot plate, stop watch Reagents: dilute sulphuric acid and phosphoric acid mixture, concentrated nitric acid, ammonium persulphate, silver nitrate, dilute hydrochloric acid, ferrous ammonium sulphate, standard potassium permanganate solution.	6.1,6.2,6.3 (Cr content, chemical method, alternative to instrumental method)
9.	Reagents: Perchloric Acid, Phosphoric Acid, Nitric Acid, Hydrochloric Acid, Dilute sulphuric acid, potassium thiocyanate solution, stannous chloride solution, n-butyl acetate, Iron-Mo free, molybdenum metal (99.9 pc pure) Spectrophotometer, Volumetric flask, conical flask, titration apparatus (burette, pipette etc.), hot plate, thermometer, separating funnel, dry filter paper and other laboratory glassware and apparatus	6.1,6.2,6.3 Mo content (for determination of Mo by thiocyanate photometric method) method in low and high alloy steels for Mo 0.01 to 1.50 percent)
10.	Reagents: Dilute sulphuric acid, conc nitric acid, hydrofluoric acid, boric acid solution, potassium bisulphite, ferrous sulphate solution, Alpha-Bentoinoxime Solution, Bromine Water, Sulphuric Acid-Benzoinoxime Wash Solution, Dilute Ammonium Hydroxide Solution, Concentrated Hydrochloric Acid, Dilute Hydrochloric Acid, Tartaric Acid, solid, Hydrogen Sulphide, gas, Hydrogen sulphide Wash Solution, Cinchonine Solution Platinum crucible, Volumetric flask, conical flask, titration apparatus (burette, pipette etc.), hot plate, thermometer, separating funnel, ashless filter paper and other laboratory glassware and apparatus	6.1,6.2,6.3 Mo content (for determination of Mo by Alpha-benzoinoxime method in alloy steels for Mo > 1 percent and not containing Tungsten)
11.	Vision-based inspection system (10X magnifying glass), Stereo microscope	5 (Freedom from defects)
12.	Vernier Calipers, Micrometer, tape	13 (Dimensions and Dimensional Tolerances)

13.	UTM Machine (LC 0.1KN, Range:0-400KN)	9 (Tensile Test)
14.	Unit having Quenching fixtures, arrangement for keeping specimen in place wait water jet emerging from cone at the bottom to touch the lower end of the sample. Muffle furnace, safety equipment, Rockwell hardness tester	12 (Hardenability)
15.	Brinell Hardness Tester with Tungsten Carbide Indenter	8 (Hardness)
16.	Metallurgical Microscope with image analyzer or Metallurgical Microscope (100 X or better resolution), Heating furnace suitable for normalizing or annealing, sample preparation using compression mounting, 3 % Nital as etchant Band saw machine, Belt grinder, micro polisher, sample polishing machine, auto mount,	10 (Grain Size), 11.1 (Cleanliness of steel) 16 (Microstructure)
17.	Alternating current (a.c.)/ single phase half wave rectified alternating current (HW) / three phase full wave rectified direct current (FWDC) induced magnetization, Magnetic powder suspended in an aqueous or a well refined, light petroleum distillate.	11.2(Magnetic Particle Inspection Test) alternative to 11.1 (Inclusion rating)
18.	Equipment for specimen preparation by machining, magnifying glass(15X), Surface Roughness Tester (in-house Calibration using roughness block)	11.2(Blue-fracture Test) alternative to 11.1 (Inclusion rating)
19.	Machine grinding unit with metallographic polish paper No. 00, 000 for finer finish, etchant (see Table-1&2 of IS 7739 Pt.3), glycerin, photographic paper, 2 percent aqueous solution of sulphuric acid, hypo, ammonium molybdate (5 g per 100 ml of water), nitric acid (r.d. 1.2) , developer-made up of 5 ml of saturated stannous chloride solution, 50 ml hydrochloric acid, 100 ml water and 1 g alum. Caustic resistant filter paper, 5 percent caustic soda, 5 percent sodium sulphide solution, distilled water	16 (Macro etch test)
20.	Ultrasonic flaw detector with amplifier/attenuator calibrated in steps of at least 2dB, CRT/Monitor, Double Crystal probes, calibration blocks	16(Ultrasonic test)
21.	Upset Machine Heating furnace and quenching media	16 (Hot upset for forgeability)
22.	Izod Impact Machine consisting of a pendulum with a determined weight scale and pointer, fixed base to cantilever test specimen, V-notch maker	9 (Impact Test)

Note: The above is an indicative list for the purpose of guidance only

ANNEXURE C
To PRODUCT MANUAL FOR
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According to IS 5517:1993

SCHEME OF INSPECTION AND TESTING

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1. LABORATORY - A laboratory shall be maintained which shall be suitably equipped (as per the requirement given in column 2 of Table 1) and staffed, where different tests given in the specification shall be carried out in accordance with the methods given in the specification.

1.1 The manufacturer shall prepare a calibration plan for the test equipments.

2. TEST RECORDS – The manufacturer shall maintain test records for the tests carried out to establish conformity.

3. LABELLING & MARKING – The Standard Mark as given in the Schedule of the license and Licence Number (i.e. CM/L.....) shall be incorporated, labelling and the marking shall be done as per the provisions of the Indian Standard, provided always that the product thus marked conforms to all the requirement of the specification. In addition, details of BIS website shall be marked as follows: “For details of BIS certification please visit www.bis.gov.in”, on metal tags tied to bundles.

4. CONTROL UNIT – For the purpose of this Scheme, a control unit is defined as material of same cast, finish, & shape and processed to same dimensions under uniform conditions(heat treatment, if any) of production in a day in the same place.

5. LEVELS OF CONTROL - The tests as indicated in column 1 of Table 1 and the levels of control in column 3 of Table 1, shall be carried out on the whole production of the factory which is covered by this plan and appropriate records maintained in accordance with paragraph 2 above.

5.1 All the production which conforms to the Indian Standards and covered by the licence should be marked with Standard Mark.

5.2 General requirements relating to the supply of material shall conform to IS 8910. Records of order from the Purchasers are to be maintained. Material shall be manufactured as per Cl 4 of IS 5517 and supplied as per in any of the basis given in Table-1 of IS 5517. The colour scheme can be followed in accordance with IS 2049 or as per purchaser’s agreement.

6. TEST CERTIFICATE- For each consignment of BIS Certified material conforming to IS 5517:1993 there shall be a test certificate which shall contain the Standard Mark, the cast/Control Unit number and the corresponding test results (as given in Annexure-I, enclosed)

7. REJECTIONS – Disposal of non-conforming product shall be done in such a way so as to ensure that there is no violation of provisions of BIS Act, 2016. Any rejected material which is potentially re-salable be sheared or cut or deformed in such a manner that it cannot be used for any other purpose except re-melting. A separate record shall be maintained giving information on quantity and cast number/coil number/control unit number, as applicable, relating to all such rejections/defective/sub-standard material of the production not conforming to the requirements of the Specification and the method of its disposal. Such material shall in no case be stored together with that conforming to the Specification. The Standard Mark (if already applied) on rejected material should be defaced.

**TABLE 1 LEVELS OF CONTROL
(PARA 5 OF THE SCHEME OF INSPECTION AND TESTING)**

(1)				(2)	(3)		
Test Details				Test equipment requirement R: required (or)S: Sub-contracting permitted	Levels of Control		
Cl.	Requirement	Test Methods			No. of Sample	Frequency	Remarks
		Clause	Reference				
5	Freedom from defects	5.1 5.2	IS 5517:1993	R	Each item	Each item	
6	Chemical Composition	IS 228(in parts) or any other established instrumental/ chemical method. However, records of referee method in case of no referee method in IS 228 and as agreed to between manufacturer & purchaser shall be maintained.					
	Ladle Analysis	6.1, 6.3 Table-2	IS 5517:1993	R	One	Each Heat	Applicable for manufacturers with steel making facilities
	Check analysis	6.2, 6.3, Table-2 & 3 14.1 15.1	IS 5517:1993	R	Nil	Nil	Applicable for manufacturers with steel making facilities
S				One	Each Cast	Applicable for manufacturers without steel making facilities. No testing for check analysis is required if starting material being subjected to processing is ISI marked and received with test certificate	
8	Hardness	8.1, 8.2, 8.3 ,15.2 & Table-6	IS 1500 Pt.1	R	One	Each Control Unit	

9	Mechanical properties	9.1, 9.2, 9.3, 9.4, 15.3 Fig.1, Fig.2 Table-5	IS 1598 IS 1608 Pt.1	R	One	Each Control Unit	
10	Grain Size	10.1, 10.2, 10.3	IS 4748	R	One	Each Control Unit	
11	Cleanliness of steel	11.1	IS 4163	R	As agreed between the manufacturer and the purchaser.		
		11.2	IS 10138 Pt.1 IS 10138 Pt.2 IS 10138 Pt.3	R ^{\$}	As agreed between the manufacturer and the purchaser. See Note-4		
12	Hardenability	12.1, 12.2 Table-7	IS 3848:1988	R ^{\$}	One	Each Control Unit	Applicable for steel ordered on the basis of end quench hardenability.
13	Dimensions & Tolerances	13.1, 13.2, 13.3	IS 3739 IS 3469 (Parts 1 to 3)	R	Adequate inspection to ensure that the products conform to the tolerance specified.		
16	Additional tests a) Macro etch test b) Ultrasonic test c) Blank hardening test d) Microstructure for machinability, including banding e) Hot up-set for forgeability	16.1, 16.2	IS 5517 IS 11371 IS 3664	R ^{\$}	As agreed between the manufacturer and the purchaser. See Note-4		

Note-1: Whether test equipment is required or sub-contracting is permitted in column 2 shall be decided by the Bureau and shall be mandatory. Sub-contracting is permitted to a laboratory recognized by the Bureau or Government laboratories empanelled by the Bureau.

Note-2: The control unit and levels of control as decided by the Bureau are obligatory to which the licensee shall comply with.

Note-3: ----- means the levels of control in Column(3) of Table-1 are as agreed to between the manufacturer and purchaser.

Note- 4: Test equipments to be possessed by the manufacturer only for the conditions (A to V) in which they intend to supply the material.

**Annexure-I
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(Para 6 of the Scheme of Inspection and Testing)
XYZ IRON AND STEEL COMPANY
(Registered office Address and works address)



TEST CERTIFICATE FOR SPECIFICATION FOR Steels for Hardening and Tempering

TEST CERTIFICATE No. _____ DATE _____

To M/s _____

We certified that the material described below fully conforms to IS 5517:1993 Chemical composition and Physical properties of the product, as tested in accordance with the Scheme of Inspection and Testing contained in the BIS Certification Marks LicenceNo.CM/L_____ are as indicated below against each order No.

(PLEASE REFER TO IS 5517:1993 FOR DETAILS OF SPECIFICATION REQUIREMENTS)

TEST RESULTS

Order no and date	Size/ Shape /Type	Designation/ Condition	Cast	Quantity	Chemical Composition											Mechanical properties				Additional # tests/ Remarks																		
					C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Cr	Ti	V	Al	TS	stress		0.2% Proof	elongatio	hardness	impact														

as required by purchaser

REMARKS
WAGON NO.
TRUCK NO.
(It is suggested that size A4 paper be used for this test certificate)

FOR XYZ IRON AND STEEL COMPANY