

**PRODUCT MANUAL FOR
Specification for Case Hardening Steels
according to IS 4432:1988**

This Product Manual shall be used as reference material by all Regional/Branch Offices & licensees to ensure coherence of practice and transparency in operation of certification under Scheme-I of Bureau of Indian Standards (Conformity Assessment) Regulations, 2018 for various products. The document may also be used by prospective applicants desirous of obtaining BIS certification licence/certificate.

1.	Product	:	IS 4432:1988
	Title	:	Specification for Case Hardening Steels
	No. of amendments	:	1
2.	Sampling Guidelines		
a)	Raw material	:	No specific requirement
b)	Grouping Guidelines	:	For covering different sizes/shapes of the product, sample of any size can be tested and other sizes may be covered in the scope based on the available manufacturing and testing infrastructure with the manufacturer.
c)	Sample Size	:	Mechanical: 1m X 2 No.s (subjected to simulated case hardening and tempering) Physical Properties: 1m X 2 No.s(as delivered condition) Chemical: 5pcs of length 5 cm each or 50 gm drillings
3.	List of Test Equipment	:	Please refer Annex – A
4.	Scheme of Inspection and Testing	:	Please refer Annex – B
5.	Possible tests in a day	:	All tests are possible in a day
6.	Scope of the Licence :		
	Licence is granted to use Standard Mark as per IS 4432:1988 with the following scope:		
	Name of the product	Specification for Case Hardening Steels	
	Steel Designation	10C4,..	
	Condition	R,..	
	Type of Condition for Delivery	A,..	
	Variety(Size)	Bars: ..X ...mm upto and including ..X ...mm, Rods:..mm upto and including ...mm, Billets : ..mm upto and including ...mm,....	

ANNEXURE A
TO PRODUCT MANUAL FOR
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LIST OF TEST EQUIPMENTS

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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, Cutting Machine, Micro Polisher, Grinder Machine, Automatic Mount Press, Surface grinder to remove burr, Lathe/Shaper Machine	(chemical composition, Inclusion content, grain size, hardenability) Preparation of specimen
2	<p>Instrumental methods</p> <p>Spectrometer: atomic-absorption spectrometry, inductively coupled plasma atomic emission, inductively coupled plasma mass spectrometry techniques, spark source optical emission spectrometry.</p> <p>Spectrophotometer</p>	C, S, P, Mn, Si, Ni,Cr, Mo, Mn, S, P,Si, Mo.(5.1,5.2,5.3)
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</p> <p>-Low sulphur copper, tin or iron, Dilute hydrochloric acid, Starch Iodide solution, Potassium iodate</p>	C& S
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>	Phosphorus content (chemical method, alternative to instrumental method- 5.1,5.2,5.3)

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	Manganese content (chemical method, alternative to instrumental method- 5.1,5.2,5.3)
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	Silicon content (chemical method, alternative to instrumental method- 5.1,5.2,5.3)
7	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	Mo content (for determination of Mo by thiocyanate photometric method - 5.1,5.2,5.3)
8	Ashless paper pulp, paper pulp pad, hot plate, dessicator, Reagents: ammonium nitrate, methyl red, dilute ammonium hydroxide, Concentrated hydrochloric acid Concentrated nitric acid, Perchloric acid, Hydrofluoric Acid	Ni content (chemical method, alternative to instrumental method- 5.1,5.2,5.3)
9	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.	Cr content (chemical method, alternative to instrumental method- 5.1,5.2,5.3)
10	Brinell Hardness Tester with Tungsten Carbide Indenter	Hardness(7)
11	Universal Testing Machine	Mechanical Properties (6.1, 6.2, 8.1, 8.2)
12	Laboratory Furnace, Metallographic Sample Preparation Equipment, Etching Reagent(either nital or picral), Metallurgical Microscope	Grain Size(9)
13	Microscope with Magnification (100x, 200x, 500x, 1000x)	Cleanliness (10)
14	Measuring Tape, Vernier caliper, Micrometer, ruler, Straight Edge, Spirit Level	Dimensional Tolerance (11)

15	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.	Hardenability(14)
16	Izod Impact Machine consisting of a pendulum with a determined weight scale and pointer, fixed base to cantilever test specimen,V-notch maker	Impact Test(8.4)
17	Upset Machine Heating furnace and quenching media	Hot upset for Forgeability (14)
18	Equipment for specimen preparation by machining, magnifying glass(15X), Surface Roughness Tester (in-house Calibration using roughness block)	Blue-fracture Test (14)
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	Macro etch test (14)
20	Ultrasonic flaw detector with amplifier/attenuator calibrated in steps of at least 2dB, CRT/Monitor, Double Crystal probes, calibration blocks	Ultrasonic test (14)
21	Alternating current (a.c.)/ single phase half-wave rectified alternating current (HW) / three phase fullwave rectified direct current (FWDC) induced magnetization, Magnetic powder suspended in an aqueous or a well refined, light petroleum distillate.	Magnetic Particle Inspection test (14)

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

ANNEXURE B
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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 equipment.

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

3. MARKING, PACKING – The Standard Mark as given in Column (1) of the First Schedule of the license and Licence Number (i.e. CM/L.....) shall be incorporated, and the marking and packing shall be done as per the provisions of the Indian Standard, provided always that the product thus marked and packed conforms to all the requirement of the specification.

4. CONTROL UNIT – For the purpose of this Scheme, steel bars/billets/rods etc. manufactured from same cast/heat having same chemical composition and processed to same delivery condition under uniform conditions of production in a day shall constitute a control unit.

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 1387 and manufacture of steel shall be as per Cl 3 of IS 4432:1988.

6. TEST CERTIFICATE - For each consignment of BIS Certified material conforming to IS 4432:1988 there shall be a test certificate which shall contain the Standard Mark, the 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.

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TABLE 1: LEVELS OF CONTROL

(1) Test Details				(2) Test equipment requirement R: required (or) S: Sub-contracting permitted	(3) Levels of Control		
Cl.	Requirement	Test Methods Clause Reference			No. of Sample	Frequency	Remarks
4	Freedom from Defects	4, 4.1	IS 4432:1988	R	Adequate inspection to ensure that each Bar/Billet/Rod is free from internal and surface defects. Method of test and allowable limits are as required by the purchaser.		
5	Chemical Composition i) Ladle Analysis	5, 5.1, 12.1 and Table 1	IS 4432:1988 and Relevant parts of IS 228 or any other established	R	One	Each Ladle	Applicable for manufacturers with steel making facilities
	ii) Check Analysis	5.2,5.3 , 12.1.1. 13.1 and Table-1, 2	Instrumental/ chemical method.	S	One	Each Control Unit	Applicable for manufacturers without steel making facilities. (See Note-3)
7	Hardness	7.1, 7.2 , 12.2 , 13.2 and Table-6	IS 4432:1988 IS 1500 Pt.1	R	One	Each Control Unit	Not applicable for delivery condition 'A'
8	Mechanical Properties	8.1 to 8.4 and Table-4,5 Fig.1,2. 12.3 to 12.4, 13.3	IS 4432:1988 IS 1608 Pt.1 IS 1598 IS 3711	R ^s (please see remarks)	One	Each Control Unit	Test equipment is required only for delivery conditions 'C', 'G, and 'H' and only when required. Also See Note-4
9	Grain Size	9.1 to 9.1.2	IS 4432:1988 IS 4748	R ^s (please see remarks)	One	Each Control Unit	Test equipment is required only for delivery conditions 'D', 'H', and 'I'. Also See Note-4

10	Cleanliness of Steel	10.1,10.2	IS 4432: 1988 IS 4163 or IS 10138(Pt 2) & (Pt 3)	R ^s (please see remarks)	One	Each Control Unit	Test equipment is required only for delivery conditions 'F', 'G', and 'I'. Also See Note-4
11	Dimensional Tolerances	11.1, 11.2 and 11.3	IS 4432: 1988 IS 3739 IS 3469 (Part 1 to 3)	R	Adequate inspection to ensure that the products conform to the tolerance specified.		
14	Additional Tests a) Macroetch test b) Ultrasonic test c) Hardenability test d) Blank hardening test e) Blue fracture test f) Microstructure for machinability, including banding g) Hot up-set for forgeability	14,14.1, 14.2 and Table-7	IS 11371 IS 3664 IS 3848 IS 10138 Pt.1 IS 3711	R ^s	As agreed between the manufacturer and the purchaser. Also 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 empaneled 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: No testing for check analysis is required if starting material being subjected to processing is ISI marked and received with test certificate.

^s Note-4: Test equipments to be possessed by the manufacturer only for the conditions [(A to I)] 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 Case hardening Steels

TEST CERTIFICATE No. _____

DATE _____

TO M/s _____

We certified that the material described below fully conforms to IS 4432:1988 Chemical, Physical and Mechanical properties of the product, as tested in accordance with the Scheme of Testing and Inspection contained in the BIS Certification Marks Licence No. CM/L _____ are as indicated below against each order No.

(PLEASE REFER TO IS 4432:1988 FOR DETAILS OF SPECIFICATION REQUIREMENTS)

TEST RESULTS

Order No. & Date	Nominal Dimensions	Control Unit No.	Qty in tonnes	Chemical Composition	Mechanical Properties*	Hardness [#]	Hardenability [#]	Grain Size [#]	Inclusion rating [#]	Additional tests*

[#] as applicable

* 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