

PM/4431/1
June 2022



उत्पाद मैनुअल
Carbon and Carbon Manganese Free Cutting Steels
IS 4431:1978 के अनुसार

PRODUCT MANUAL
FOR Carbon and Carbon Manganese Free Cutting Steels
ACCORDING TO IS 4431:1978

विभिन्न उत्पादों के लिए भारतीय मानक ब्यूरो (अनुरूपता मूल्यांकन) विनियम, 2018 की योजना- I के तहत प्रमाणन के संचालन में अभ्यास और पारदर्शिता के संचालन में पारदर्शिता सुनिश्चित करने के लिए इस उत्पाद मैनुअल का उपयोग सभी क्षेत्रीय / शाखा कार्यालयों और लाइसेंसधारियों द्वारा संदर्भ सामग्री के रूप में किया जाएगा। दस्तावेज़ का उपयोग बीआईएस प्रमाणन लाइसेंस/प्रमाणपत्र प्राप्त करने के इच्छुक संभावित आवेदकों द्वारा भी किया जा सकता है।

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.	उत्पाद Product	:	IS 4431:1978
	शीर्षक Title	:	Specification for Carbon and Carbon Manganese Free Cutting Steels
	संशोधनों की संख्या No. of amendments	:	02
2.	नमूना दिशानिर्देश Sampling Guidelines		
a)	कच्चा माल Raw material	:	No specific requirement
b)	समूहीकरण दिशानिर्देश Grouping Guidelines	:	Please refer Annex-A
c)	नमूने का आकार Sample Size	:	Chemical: 100 g drilling (for chemical method), or 5 pcs of 5 cm x 5 cm size for billets and blooms, or 5 pcs of 5 cm length for bars (for instrumental method e.g. OES) Mechanical: 500 mm length X 2 Nos. or 1 pc of 1 m length For samples drawn from dispatch point or market, 1 piece of 1 m length or 2 pcs of 500 mm length may be drawn

3.	परीक्षण उपकरणों की सूची List of Test Equipment	:	Please refer Annex-B
4.	निरीक्षण और परीक्षण की स्कीम Scheme of Inspection and Testing	:	Please refer Annex-C
5.	एक दिन में संभावित परीक्षण Possible tests in a day		
	All tests		
6.	लाइसेंस का दायरा /Scope of the Licence:		
	“Licence is granted to use Standard Mark as per IS 4431:1978 with the following scope:		
	Name of the product	Carbon and Carbon Manganese Free Cutting Steels	
	Steel Grades /Designation	10C8S10, 14C14S14, 25C12S14, 40C10S18, 11C10S25, 40C15S12	
	Heat/Thermomechanical Treatment condition	Hot-rolled, normalized , Forged, Cold-Drawn, hardened and tempered	
	Finish	Hot-rolled, forged, cold-drawn, Turned or Machined, Rough Ground, Centre-less Ground, Polished (Rounds only),	
	Form and Size	Blooms: ..X ...mm upto and including ..X ...mm, Billets: ..X ...mm upto and including ..X ...mm, Bars: ..X ...mm upto and including ..X ...mm	

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN,9, BAHADUR SHAH ZAFAR MARG,
NEW DELHI-110002

ANNEX – A**GROUPING GUIDELINES**

IS 4431:1978 classifies Carbon and Carbon Manganese Free Cutting Steels according to

- i) Grade Designation: 10C8S10, 14C14S14, 25C12S14, 40C10S18, 11C10S25, 40C15S12
- ii) Nature of heat/thermomechanical treatment: Hot-rolled, normalized , Forged, Cold-Drawn, hardened and tempered
- iii) Finish: Hot-rolled, forged, cold-drawn, Turned or Machined, Rough Ground, Centre-less Ground, Polished (Rounds only),
- iv) Form and Size: Billets, Blooms and Bars of different sizes

Accordingly, the following grouping guidelines shall apply for Grant of Licence and Change in Scope of Licence:

Group No.	Form	Condition (Thermomechanical/Heat treatment condition)	Samples to be tested from each group
I	Billets and Blooms	Hot Rolled/Forged/Normalized	Sample of each grade designation, each condition and of any finish and any form and size intended to be covered in the scope of licence shall be tested.
II	Bars	Hot Rolled/ Forged/Cold Drawn/Normalized/Hardened and Tempered	Sample of each grade designation, each condition and of any finish and any size intended to be covered in the scope of licence shall be tested.

Scope of the licence shall be restricted based on the manufacturing and testing facilities available.

During operation of the licence, samples of each variety covered in the scope of the licence shall be drawn and tested in rotation, to the extent possible.

ANNEX B

LIST OF TEST EQUIPMENTS

Major test equipment required to test as per the Indian Standard

Sl. No.	Test Equipment/Chemical	Tests Used In With Clause Reference
1	Rough Polishing Machine, Abrasive Cutting Machine, Fine Polishing Machine, Grinding Machine, Molding machine, Longitudinal cutting machine, Lathe Machine,	Preparation of specimen
2	Instrumental methods Spectrometer: atomic-absorption spectrometry, inductively coupled plasma atomic emission, inductively coupled plasma mass spectrometry techniques, spark source optical emission spectrometry. spectropolisher(sample preparation) Spectrophotometer	6.1, 6.2, 6.3 C, Si, Mn, S, P, Cr, Ni, Mo, Cu, V, Pb
3	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 Reagents for C: tin granules or pure iron fillings, acidulated water/brine water, methyl red, caustic potash Reagents for S: Ceramic boats/crucibles – desiccators, Fluxes -Low sulphur copper, tin or iron, Dilute hydrochloric acid, Starch Iodide solution, Potassium iodate	6.1, 6.2, 6.3 C & S (chemical method, alternative to instrumental method)
4	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 Potassium Permanganate (KMnO ₄), Sodium Nitrite (NaNO ₂), Ammonium Molybdate [(NH ₄) ₂ MoO ₇], Ammonium Phosphate [(NH ₄) ₃ PO ₄], Potassium Nitrate (KNO ₃), Phenolphthalein Solution, Rectified spirit or methyl alcohol, Sodium Hydroxide (NaOH), Hydrofluoric Acid (HF), Perchloric Acid (HClO ₄), Sulphurous Acid, Hydrobromic Acid (HBr), other chemicals and reagent as applicable	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	6.1, 6.2, 6.3 Manganese content (chemical method, alternative to

	Acid, NaCl Solution, Permanganic acid	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-Benzoinoxime 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	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	6.1, 6.2, 6.3 Ni content (chemical method, alternative to instrumental method)
12	Vision-based inspection system (10X magnifying glass), Stereo microscope	5 (Freedom from defects)

13	Universal Testing Machine	8 (Mechanical Properties – Tensile Test)
14	Izod Impact Machine consisting of a pendulum with a determined weight scale and pointer, fixed base to cantilever test specimen, V-notch maker	8 (Mechanical Properties – Impact Test)
15	Measuring Tape, Vernier caliper, Micrometer, ruler, Straight Edge, Spirit Level	9 (Dimensions and Dimensional Tolerances)
16	Heating furnace suitable for normalizing or hardening & tempering	7 (Heat Treatment)

The list above is indicative only and may not be considered as exhaustive

ANNEX C**SCHEME OF INSPECTION AND TESTING**

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

1.1 The manufacturer shall prepare and implement a calibration plan for the test equipment.

2. **TEST RECORD-** The manufacturer shall maintain test records for the tests carried out to establish conformity.

3. **PACKING AND MARKING** - The Standard Mark as given in the Schedule of the licence shall be incorporated legibly and indelibly on the tag attached to and/or the packing of and/or the test certificate accompanying each consignment of the material provided always that the material so marked conforms to each requirement of the specification.

3.2 Each bloom, bar, billet shall be colour coded as per IS 2049 and shall also be marked with the following:

- a) Manufacturer's Name or Trade Mark
- b) Cast Number or the batch or control unit number by which the cast can be traced

5. **CONTROL UNIT-** For the purpose of this scheme, the entire material of the same designation, condition/finish, form and size and made from the same material under similar conditions in a day on the same production line shall be taken as one control unit.

6. **TEST CERTIFICATE** - For each consignment of BIS Certified material conforming to IS 4431:1978 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. **LEVELS OF CONTROL** :- The tests as indicate in Table 1 and at the levels of controls in column 3 of Table 1, shall be carried out on the whole production of the factory which is covered by this plan and records maintained in accordance with paragraph 2 above.

7.1 All the production which conforms to the Indian Standard and covered under the scope of this licence shall be marked with the Standard Mark.

8. **REJECTION** - 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.

TABLE1
LEVELS OF CONTROL

(1)				(2)	(3)		
Test Details				Test equipment requirement R: required (or)S: Sub-contracting permitted	Levels of Control		
Cl.	Requirement	Test Methods Clause Reference			No. of Sample	Frequency	Remarks
5	Freedom from Defects	5	IS 4431	R	Adequate inspection		
6	Chemical Analysis						
6.1	Ladle Analysis		IS 228/Any other established chemical or instrumental method	R	One	Each heat	Applicable only for manufacturers with steelmaking facilities. Manufacturers who procure steel for further rolling/forging into the product shall maintain records of the ladle analysis based on the test certificate of the manufacturer.
6.2	Check Analysis		-do-	R	One	Each heat	Applicable only for manufacturers procuring steel from outside for rolling/forging into the final product. No testing is required if material is ISI marked.
8	Mechanical properties (Tables 3,4,5)						
i)	Tensile Strength		IS 1608 (Part 1)	R	One	Each control unit	
ii)	Yield Strength		-do-	R	One	Each control unit	If specified

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iii)	Elongation		-do-	R	One	Each control unit	
iv)	Izod Impact value		IS 1598	R	One	Each control unit	For bars and forgings in the hardened and tempered condition, if specified
9	Dimensions and Tolerances		IS 3749/ IS 3469 (Parts 1 to 3)	R	Adequate inspection		

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: Levels of control given in column 3 are only recommendatory in nature. The manufacturer may define the control unit/batch/lot and submit his own levels of control in column 3 with proper justification for approval by BO Head.

Annexure-I
Format for test certificate
 (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 CARBON AND CARBON MANGANESE FREE CUTTING STEELS

TEST CERTIFICATE No.
To M/s

DATE

We certify that the material described below fully conforms to IS 4431:1978 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 Licence No. CM/L are as indicated below against each order No.

(PLEASE REFER TO IS 4431:1978 FOR DETAILS OF SPECIFICATION REQUIREMENTS)
 TEST RESULTS

Order no and date	Size/ Shape /Type	Designation/ Condition	Cast	Quantity	Chemical Composition											Mechanical properties			
					C	Si	Mn	P	S	Cr	Ni	Mo	Cu	V	Pb	Other element(s)	YS	TS	Elonga tion

REMARKS WAGON NO.
TRUCK NO.

(It is suggested that size A4 paper be used for this test certificate)

FOR XYZ IRON AND STEELCOMPANY

