

**PRODUCT MANUAL FOR
Steel Wire for Mechanical Springs
Part 2 Oil Hardened and Tempered Steel Wire
According to IS 4454(Pt.2):2001**

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 4454 Pt.2 : 2001
	Title	:	Steel Wire for Mechanical Springs Part 2 Oil Hardened and Tempered Steel Wire
	No. of amendments	:	0
2.	Sampling Guidelines		
a)	Raw material	:	No specific requirement
b)	Grouping Guidelines	:	Please refer Annex – A
c)	Sample Size	:	For physical tests: 1 m X 4 No.s (for tensile test, two samples within a coil are to be drawn for determining range of tensile strength. Please refer Cl. 10.1.1 of IS 4454 Pt.2:2001) For chemical tests : 5 Pcs of 5 cm or 50 gm cut pieces of wire
	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 Physical and Chemical tests
6.	Scope of the Licence :		
	Licence is granted to use Standard Mark as per IS 4454(Pt.2):2001 with the following scope:		
	Name of the product	Steel Wire for Mechanical Springs Part 2 Oil Hardened and Tempered Steel Wire	
	Grade	TDSiCr, ...	
	Sizes	1.30 mm upto and including 10.00 mm	

ANNEXURE A
To PRODUCT MANUAL for
Steel Wire for Mechanical Springs Part 2 Oil Hardened and Tempered Steel Wire
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GROUPING GUIDELINES

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1. Grouping has been done on the basis of Chemical Composition as tensile strength is dependent on chemistry and size of wire. Within a group, grade with stricter limits for S% and P% and higher fatigue strength is considered as higher grade. The following may be followed for considering grant of licence/inclusion as per IS 4454 (Pt-2):2001 :

Group	Grades	Sampling
1	FDC TDC VDC	One sample of any size, preferably of lowest size, may be drawn. If sample of higher grade is tested then recommendation may include lower grades also alongside the higher grade. Eg: VDC is superior grade in group-1
2	FDCrV-A TDCrV-A VDCrV-A	One sample of any size, preferably of lowest size, may be drawn. If sample of higher grade is tested then recommendation may include lower grades also alongside the higher grade. Eg: VDCrV-A is superior grade in group-2
3	FDCrV-B TDCrV-B VDCrV-B	One sample of any size, preferably of lowest size, may be drawn. If sample of higher grade is tested then recommendation may include lower grades also alongside the higher grade. Eg: VDCrV-B is superior grade in group-3
4	FDSiCr TDSiCr VDSiCr	One sample of any size, preferably of lowest size, may be drawn. If sample of higher grade is tested then recommendation may include lower grades also alongside the higher grade. Eg: VDSiCr is superior grade in group-4

2. The following tests, as applicable, may be carried out in factory itself on coils of samples being drawn for independent testing:

- i) **Cast of the wire** ; property to be tested when a ring is cut from coil.
- ii) **Eddy current test for VD grades** ; as this test is performed during in-line inspection of wires.

Note: Eddy current test be carried out only if applicant has facilities for the test. In such case a declaration on test method is to be obtained from applicant, alongside agreed upon values for VD grades.

3. If sample passes, licence/inclusion can be granted for all grades and sizes mentioned in the specification and as applied by the applicant/licensee, provided that the firm is having all necessary manufacturing and testing facilities for manufacturing and testing of the sizes of wires proposed to be included in the licence.

4. During the operation of licence, BO shall ensure that all the finishes and sizes of wires covered in the license are drawn for independent testing on rotation over a period of time.

ANNEXURE B
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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, Abrasive Cutting Machine, Fine Polishing Machine, Grinding Machine, Molding machine, Longitudinal cutting machine	Preparation of specimen
2	Optical microscope	6.2 (Manufacture)
3	<p>Instrumental methods Spectrometer: atomic-absorption spectrometry, inductively coupled plasma atomic emission, inductively coupled plasma mass spectrometry techniques, spark source optical emission spectrometry.</p> <p>Spectrophotometer</p>	<p>7, 7.1, 7.2 (C,S,P,Mn,Si,V,Cu,Cr)</p> <p>Mn,S,P,Si</p>
4	<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>	<p>7, 7.1, 7.2 (for C& S, chemical method, alternative to instrumental method)</p>
5	<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>	<p>7, 7.1, 7.2 (Phosphorus content , chemical method, alternative to instrumental method)</p>

6	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	7, 7.1, 7.2 (Manganese content, chemical method, alternative to instrumental method)
7	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	7, 7.1, 7.2.1 (Silicon content, chemical method, alternative to instrumental method)
8	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	7, 7.1, 7.2 (Cu content, chemical method, alternative to instrumental method)
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.	7, 7.1, 7.2 (Cr content, chemical method, alternative to instrumental method)
10	Vision-based inspection system	8 (Freedom from defects)
11	Vernier Calipers, Micrometer	9 (Dimensions and Dimensional Tolerances)
12	UTM Machine (LC 0.1KN, Range:0-400KN)	10.1 (Tensile Test)
13	Wrapping Machine, 10X magnifying glass	10.2 (Wrapping Test)
14	Torsion Testing Machine	10.3 (Torsion Test)
15	Bend test arrangement with mandrel for all sizes above 6mm	10.4 (Bend Test)
16	test arrangement with suitable mandrels and provision for applying reasonably uniform tension on wires less than 0.7mm.	10.5 (Coiling and stretching test)
17	Vernier Calipers	10.6 (Cast of the wire)
18	Deep etch testing HCL tank, Heater, Acid container, Thermocouple, Lead bath, Stop watch	10.7 (Deep Etch Test)
19	Instrument for detecting defects using eddy current method	10.8 (Eddy Current Test)
20	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	10.9 (Decarburization, Using Microscopic method)

21	Heating furnace and quenching media(non hardened material), Vickers or Knoop Hardness tester	10.9 (Decarburization Using micro-indentation hardness traverses)
22	Stereo microscope	11(Surface finish)

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

**ANNEXURE C
TO PRODUCT MANUAL FOR
Steel Wire for Mechanical Springs
Part 2 Oil Hardened and Tempered Steel Wire
According to IS 4454(Pt.2):2001**

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, 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”

4. CONTROL UNIT – For the purpose of this Scheme, a control unit is defined as steel wire of same cross-sectional dimensions and same grade manufactured by using steel of same heat and manufactured under uniform conditions of production in a day.

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.

6. TEST CERTIFICATE- For each consignment of BIS Certified material conforming to IS 4454(Pt.2):2001 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.

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SCHEME OF INSPECTION AND TESTING

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TABLE 1: LEVELS OF CONTROL

(1)			(2)	(3)		(4)
TEST DETAILS				LEVELS OF CONTROL		REMARKS
Clause	Requirements	Test Method	Test equipment requirement R: required (or) S: Sub-contracting permitted	No. of Samples	Frequency	
		Clause	Reference			
6	Manufacture	6.1 6.2	IS 4454(Pt.2): 2001 IS 4163	R		i) Adequate inspection as agreed to between manufacturer and purchaser. ii) Records shall be maintained for allowable level of inclusions for grade VD as agreed between manufacturer and purchaser. iii) Also See Note-3
7	Chemical Composition					
	Ladle Analysis	7.1 Table-2	IS 4454(Pt.2) : 2001 & IS 228	R	One	Each Heat Applicable for manufacturers with steel making facilities
	Product Analysis	7.2 Table-2 & 3	(Various Parts) / any established Chemical/ Instr. Method.	R	i) Nil	i) Nil i) Applicable for primary steel producers with steel making and rolling facilities, wherever traceability to the heat is ensured by manufacturer.
				S	ii) One	ii) Each Cast ii) Applicable for manufacturers feeding to rolling mills/ drawing dies (see Note-3)
8	Freedom from Defects	8	IS 4454(Pt.2) : 2001	R		Adequate inspection to ensure each item to be free from defects
9	Dimensions & Tolerances	9.1, 9.2 & 9.3	IS 4454(Pt.2) : 2001	R		Adequate inspection to ensure each item to be within the limits of specification. Records shall be maintained for sizes & tolerances other than those specified in Table-4 and as agreed between manufacturer & purchaser.

10.1	Tensile Test	10.1, 10.1.1, Table-5, 6	IS 4454(Pt.2) : 2001 IS 1608	R	2	Each Coil	
10.2	Wrapping Test	10.2	IS 1755	R	1	1 in every 5 coils or part thereof	Refer Note-5
10.3	Torsion Test	10.3.1, 10.3.2, 10.3.3	IS 4454(Pt.2) : 2001 IS 1717	R	-do-	-do-	-do-
10.4	Bend Test	10.4	IS 4454(Pt.2) : 2001	R	-do-	-do-	-do-
10.5	Coiling and Stretching Test	10.5	IS 4454(Pt.2) : 2001	R	-----	-----	
10.6	Cast of the Wire	10.6	IS 4454(Pt.2) : 2001	R	1	1 in every 5 coils or part thereof	Refer Note-5
		10.6.1	IS 4454(Pt.2) : 2001	R	-----	-----	
10.7	Deep Etch Test	10.7, 10.7.1, 10.7.2	IS 4454(Pt.2) : 2001	R	1	1 in every 5 coils or part thereof	Refer Note-5
10.8	Eddy Current Test	10.8	IS 4454(Pt.2) : 2001	S	-----	-----	Records of test method and values as agreed between shall be maintained.
10.9	Decarburizati on Test	10.9.1 & Table-9	IS 4454(Pt.2) : 2001 IS 6396	R	1	1 in every 5 coils or part thereof	Refer Note-5
11	Surface Finish	11	IS 4454(Pt.2) : 2001	R	Each Coil	Each Coil	

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 is required if material fed to rolling mills/drawing dies is ISI marked and received with test certificate mentioning the requirement.

Note -4 : ----- means the levels of control in Column(3) of Table-1 are as agreed to between the manufacturer and purchaser.

Note-5: When any sample fails in respect of a given requirement, four previous coils of the same control unit shall be subjected to test or inspection of that requirement and the defective material so found shall be sorted out and rejected.

Annexure-I**Page 4 of 4**

(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 Steel Wire for Mechanical Springs
Part 2 Oil Hardened and Tempered Steel Wire**BIS
STANDARD
MARK

TEST CERTIFICATE No. _____

DATE _____

To M/s _____

We certified that the material described below fully conforms to IS 4454(Pt.2):2001 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 4454(Pt.2):2001 FOR DETAILS OF SPECIFICATION REQUIREMENTS)

TEST RESULTS

Order No. & Date	(nom Size)	Cast/ Control Unit No.	Grade	Quantity	CHEMICAL COMPOSITION								MECHANICAL PROPERTIES		Bend Test	Torsion test	Wrapping Test	Decarburization	Condition	#Other tests
					C %	S %	P %	Si %	Mn %	Cu %	V %	Cr %	TS	Reduction in area						

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