



**PRODUCT MANUAL FOR
HIGH STRENGTH DEFORMED STAINLESS
STEEL BARS AND WIRES FOR CONCRETE REINFORCEMENT
ACCORDING TO IS 16651: 2017**

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 16651: 2017
	Title	:	High Strength Deformed Stainless Steel Bars and Wires for Concrete Reinforcement
	No. of Amendments	:	Nil
2.	Sampling Guidelines:		
a)	Raw material	:	As per clause 4.2 and 4.3 of IS 16651: 2017
b)	Grouping guidelines	:	Please refer ANNEX –A
c)	Sample Size	:	For Physical test – 1 m x 3 Nos For Pull out test – 1 m x 3 Nos For Fatigue test - 1 m x 5 Nos For Chemical Tests – 5 nos of 5 cm x 5 cm or 50 gm drilling
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:	:	Please refer ANNEX –D
6.	Scope of the Licence:		
	“Licence is granted to use Standard Mark as per IS 16651: 2017 with the following scope:		
	Name of the product	:	High Strength Deformed Stainless Steel Bars and Wires for Concrete Reinforcement
	Nominal Size	:	
	Steel Designation Numbers	:	
	Strength Grade	:	

ANNEX A**Grouping Guidelines**

1. IS 16651: 2017 covers High Strength Deformed Stainless Steel Bars and Wires for Concrete Reinforcement which are categorized as given below:

Strength Grade	SS 500, SS 550, SS 600, SS 650
Steel Designation Number	A, B, C, D, E, F, G
Nominal Sizes	6 mm, 8 mm, 10 mm, 12 mm, 16 mm, 20 mm, 25 mm, 28 mm, 32 mm. <i>(Other sizes may be supplied by mutual agreement.)</i>

2. Considering the above, following grouping guidelines for GoL/CSoL have been developed:
- a) One sample of highest and lowest size for each strength grade and steel designation number shall be tested to cover stainless steel bars and wires of all nominal sizes in that size range for the particular strength grade and steel designation number.
 - b) If sample of highest strength grade from a steel designation number is tested, lower strength grades for that steel designation number may also be covered in the scope of licence.
3. The Firm shall declare the varieties of stainless-steel bars and wires they intend to cover in the Licence. The Scope of Licence may be restricted based on the Manufacturing and Testing capabilities of the Manufacturer.
4. During the operation of the Licence, BO shall ensure that all varieties covered in the Licence are tested in rotation, to the extent possible.

ANNEX B**List of Test Equipment***Major test equipment required to test as per the Indian Standard*

Sl. No.	Tests used in with Clause Reference	Test Equipment
1.	Deformation and Surface Characteristics (Clause 5.2 to 5.6)	a) Vernier calliper/Depth gauge b) Micrometre c) Angle protector d) Steel scale
2.	Pull-Out Test (Clause 5.7)	a) Tensile testing machine/Suitable Testing Machine b) Steel scale c) Dial Micrometre d) Slip ring cross bar e) Cube moulds f) Tamping rod g) Wire Brush h) Grinding Machine For Testing Compressive Strength of Block: i) Compressive Strength Testing Machine j) Curing Chamber k) Water Bath l) Weighing Machine m) Vibrator (if very dry consistency concrete is used) n) Cement, o) Aggregates p) Sand
3.	Nominal Size, Effective cross-sectional area and Mass of deformed bars and wires, Dimensions and tolerances (Clause 6 and 7).	a) Weighing balance b) Vernier calliper c) Micrometre d) Steel scale e) Measuring tape
4.	Tensile Properties (Clause 8.2 and 9.2)	a) Tensile/Universal Testing Machine b) Outside/Inside caliper c) Punch and Hammer d) Measuring steel tapes e) Marking tool f) Vernier caliper g) Stop watch h) Extensometer i) Air Conditioner
5.	Bend Test (Clause 8.3 and 9.3)	a) Bend test arrangement b) Mandrels (of suitable sizes) for bend tests c) Vernier caliper d) Micrometer e) Thermometer f) Air Conditioner

6.	Rebend Test (Clause 8.3 and 9.4)	<ul style="list-style-type: none"> a) Re-bend testing arrangement b) Mandrels for re-bend testing c) Temperature controlled water bath d) Vernier caliper e) Micrometer f) Angle protector g) Stop watch h) Magnifying glass
7.	Charpy Impact Test (Clause 8.6)	<ul style="list-style-type: none"> a) Charpy Impact Testing Machine b) Machining Arrangement for Samples c) Solution Annealing Furnace [If required as per Clause 8.6 of IS 1757(Part 1)]
8.	Inter Granular Corrosion Test (Clause 8.7)	<ul style="list-style-type: none"> a) Conical Flask (1 lit, fitted with 4 ball rising condenser) b) Support for Test Piece c) Heating Device d) Heat Treatment Chamber e) 'Grade 120 Abrasive Paper or Cloth' or 'Hydrochloric Acid, Nitric Acid, Water'. f) Trichloroethylene g) Copper Fillings h) Bending Test Arrangement i) Bending Mandrel of Suitable Size [as per Clause 5.5.2 as per IS 10461 (Part 2)] j) Magnifying Glass (magnification not greater than 10x) k) Copper Sulphate Pentahydrate l) Distilled Water m) Sulphuric Acid
9.	Preparation of Samples	<ul style="list-style-type: none"> a) Rough Polishing Machine, b) Abrasive Cutting Machine c) Fine Polishing Machine d) Grinding Machine e) Moulding machine, f) Longitudinal cutting machine (as required)
10.	Ladle Analysis/Product Analysis for elements: Carbon, Silicon, Manganese, Sulphur, Chromium, Nickel, Molybdenum, Phosphorous, Copper and Nitrogen (Clause 4.3)	<ul style="list-style-type: none"> a) Any Established Instrumental method including Spectrometer: atomic-absorption spectrometry, inductively coupled plasma atomic emission, inductively coupled plasma mass spectrometry techniques, spark source optical emission spectrometry, Standard Reference Material with certificate b) Chemical methods: Laboratory reagents and apparatus as per parts of IS 228 (indicative list given below)

INDICATIVE LIST OF TEST APPARATUS, CHEMICALS AND REAGENTS FOR CHEMICAL ANALYSIS THROUGH CHEMICAL METHODS AS PER IS 228		
1.	Carbon & Sulphur	Strohlein or Leco apparatus with all attachments Barometer with chart, Hot plate, Muffle furnace, Complete range of glass wares, measuring cylinders, Desiccators, 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
2.	Phosphorous	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 (Na ₂ NO ₃), Ammonium Molybdate [(NH ₄) ₂ Mo ₂ O ₇], Ammonium Phosphate [(NH ₄) ₃ PO ₄], Potassium Nitrate (K ₂ NO 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
3.	Manganese	Hot plate, Conical flask Reagents: silver nitrate, ammonium persulphate sodium arsenite solution, Dilute Nitric Acid, Phosphoric Acid, Dilute Sulphuric Acid, Concentrate Nitric Acid, NaCl Solution, Permanganic acid
4.	Silicon	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
5.	Copper	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.	Nickel	ashless paper pulp, paper pulp pad, hot plate, desiccators, Reagents: ammonium nitrate, methyl red, dilute ammonium hydroxide, concentrated hydrochloric acid Concentrated nitric acid, Perchloric acid, Hydrofluoric Acid

7.	Chromium	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, and standard potassium permanganate solution.
8.	Molybdenum (for determination of Mo by thiocyanate (photometric method) method in low and high alloy steels for Mo 0.01 to 1.50 percent) as per IS 228 Part 10	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
9.	Molybdenum (for determination of Mo by Alpha-benzoinoxime method in alloy steels for Mo > 1 percent and not containing Tungsten)	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
10.	Nitrogen	250 ml flask carrying 45 cm long air condenser, Steam Distillation Assembly, Nessler's Reagent, Ammonia Free Water, Potassium Sulphate Crystals, Copper Sulphate Crystals, Dilute Sulphuric Acid (1:4), Barium Chloride Solution, Sulphuric Acid rd=1.84, Mixed Indicator Solution, Devarda's Alloy Boric Acid Solution (0.1% in Ammonia Free Water), Sodium Hydroxide Tartaric Acid Solution, Standard Sodium Hydroxide solution, Standard Sulphuric Acid (0.01 N), Standard Sulphuric Acid (1 ml=0.0007 g of N)(0.008 N)

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

ANNEX C

Scheme of Inspection and Testing

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 AND MARKING – As per the requirement of IS 16651: 2017.

3.1 For each consignment of BIS certified material conforming to IS 16651: 2017, a test certificate as per clause 11.4 of IS 16651: 2017 and Annex 1 of SIT shall be issued.

4. CONTROL UNIT – All bars/wires of same size and strength grade and processed from an identical heat or cast 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.

6. 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.

TABLE 1

(1)				(2)	(3)		
Test Details				Test equipment requirement R: required (or) S: Sub-contracting permitted	Levels of Control		
Cl.	Requirement	Test Method			No. of Sample **	Frequency	Remarks
		Clause	Reference				
4.3	Chemical Composition						
	a. Ladle Analysis	4.3.1	IS 16651 IS 228	R	Two Three	Each heat/cast less than or equal to 100 MT Each heat/cast above 100 MT	No testing is required if the consignment is received with a test certificate.
	b. Product Analysis	4.3.2	IS 16651 IS 228	R	One	100 MT or less from each control unit	-
4.4	Surface Quality	4.4	IS 16651	R	All	Each Control Unit	Adequate inspection to ensure that each item is free from defects.
5.2	Deformation and surface characteristics.	5.2 to 5.6, 8.4	IS 16651	R	Two	100 MT or less from each control unit	-
5.7	Pull-out Test	5.7, 8.4	IS 16651 IS 2770 (Part 1)	S	a) The frequency of bond test as required in 5.7 shall be as agreed to between the manufacturer and the purchaser. b) Pull out test in accordance with 5.7 shall be done in addition to 5.2 for approval of new or amended geometry for first time.		
6 and 7	Nominal Size, Effective cross-sectional area, Mass of deformed bars and wires, Dimensions and tolerances	6, 7	IS 16651	R	Adequate inspection to ensure that each item is within the limit of Standard.		

8.2	Tensile Properties	8.2, 9.2	IS 16651 IS 1608	R	Two	100 MT or less from each control unit	-
8.3	Bend and Rebend Properties						
	a. Bend Test	8.3, 9.3	IS 16651 IS 1599	R	Two	100 MT or less from each control unit	-
	b. Rebend Test	8.4, 9.4	IS 16551	R	Two	100 MT or less from each control unit	-
8.5	Fatigue Test	8.5, Annexure B	IS 16651	S	Every five years or after 1000 tonne are produced for each diameter, steel designation and strength grade manufactured, whichever occurs sooner.		
8.6	Charpy Impact Test	8.6	IS 16651 IS 1757	R	One	Each Control unit	-
8.7	Inter-Granular Corrosion Test	8.7	IS 16651 IS 10461 (Part 2)	R	One	Each Control unit	-

** If the samples drawn fail in any requirement, two additional samples from same control unit shall be drawn for testing in respect of each failure. If both samples pass, the control unit represented by these test samples shall be marked with Standard Mark. Retesting for fatigue test shall be done as per Annex B of IS 16651:2017.

Note-1: 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.

ANNEX D

Possible Tests in a Day

- (i) Chemical Composition (Clause 4.3)
- (ii) Surface Quality (Clause 4.4)
- (iii) Deformation and surface characteristics (Clause 5.2 to Clause 5.6)
- (iv) Nominal size (Clause 6)
- (v) Effective cross sectional area and mass (Clause 6.3)
- (vi) Specified length (Clause 7.1)
- (vii) Tensile Properties (Clause 8.2)
- (viii) Bend and Re-bend test (Clause 8.3)