IS : 4824 - 1973

Indian Standard

SPECIFICATION FOR BEAD WIRE FOR TYRES

(First Revision)

UDC 669·14-426 : 629·11·012·5

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110001

Price Rs 6·00

September 1973

Indian Standard

SPECIFICATION FOR BEAD WIRE FOR TYRES

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Indian Standard

SPECIFICATION FOR BEAD WIRE FOR TYRES

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 15 March 1973, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard was first published in 1968. As a result of experience gained during these years, it has been decided to include a compulsory additional test requirement for bead wire. The elongation percent for bead wire and the weight of coating in the case of copper and bronze finishes have been modified.

0.3 Bead wire is used for the reinforcement of cycle and automobile tyres.

0.4 This standard is based on the manufacturing and trade practices followed in the country in this field.

0.5 This standard contains clauses **3.1, 8.1, 10.1, 13.1, 14.1, A-1.1.1, A-3.1.1, A-4.1** and **B-2.1** which permit the purchaser to use his option or to agree with the manufacturer for selection to suit his requirements.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard covers the requirements for bead wire in four nominal sizes 0·965, 1·80, 1·83 and 2·49 mm for use in tyre reinforcement.

2. SUPPLY OF MATERIAL

2.1 General requirements relating to the supply of material shall conform to IS : 1387-1967†.

*Rules for rounding off numerical values (*revised*).

†General requirements for the supply of metallurgical materials (*first revision*).

3. MANUFACTURE

3.1 The wire shall be manufactured from steel made by open-hearth, electric, acid bessemer, duplex, basic oxygen or a combination of these processes. In case any other process is employed for the manufacture of steel by the manufacturer, prior approval of the purchaser should be obtained. If basic oxygen process is employed for manufacture, the nitrogen content of the steel shall not exceed 0·007 percent.

NOTE — The nitrogen content shall be ensured by the manufacturer by occasional product analysis.

3.1.1 Steel shall be of killed type.

3.2 A sufficient discard shall be made from each ingot to ensure freedom from piping, segregation and other harmful defects.

3.3 The ingots, blooms or billets shall be rough machined, chipped, ground or otherwise prepared to remove all surface imperfections likely to produce defects in the finished wire.

4. CHEMICAL COMPOSITION

4.1 The wire, when analyzed in accordance with IS : 228-1959*, shall have the chemical composition as given below:

Constituent	*Percent*
Carbon	0·50 to 0·78†
Manganese	0·50 to 0·85
Sulphur, *Max*	0·045
Phosphorus, *Max*	0·045

NOTE — When the steel is silicon-killed, the product analysis shall show a minimum of 0·10 percent silicon. When steel is silicon-aluminium-killed or aluminium-killed the requirements for silicon content shall not apply.

5. TENSILE TEST

5.1 The tensile properties when determined in accordance with IS : 1521-1972‡ shall be as given in Table 1.

5.1.1 The proportional limit of the bead wire shall be not less than 80 percent of the tensile strength.

*Methods of chemical analysis of pig iron, cast iron and plain carbon and low-alloy steels (*revised*).

†Restricted carbon range may be specified by the purchaser to suit his requirements.

‡Method for tensile testing of steel wire (*first revision*).

TABLE 1 TENSILE TEST

(*Clause* 5.1)

SIZE	TENSILE STRENGTH	ELONGATION AT 200 mm GAUGE LENGTH	BREAKING LOAD
(1)	(2)	(3)	(4)
	Min	*Min*	*Min*
mm	*N/mm²	Percent	N
0·965	1 860	3	1 360
1·80	1 720	3	4 377
	1 470	3	3 740
1·83	1 720	3	4 524
2·49	1 420	4	6 915

NOTE — Bronze, brass and copper plated wires shall be heated in superheated steam at 150°C for one hour before testing.

*1 N/mm² = 1 MN/mm² = 0·102 0 kgf/mm².

6. TORSION TEST

6.1 Bead wire of size 0·965 mm, when subjected to torsion test in accordance with IS : 1717-1971*, shall withstand a minimum number of 30 turns in a length equivalent to 100 diameters without any sign of failure.

7. BEND TEST

7.1 The bend test shall be carried out in the case of bead wire of size 1·80, 1·83, and 2·49 mm. The wire, when tested in accordance with IS : 1716-1971†, shall withstand without any sign of failure being bent forward and backward to the number of bends indicated in Table 2.

8. DEAD WIRE TEST

8.1 The wire shall lie flat without any tendency to spiral and shall be free from twists. The dressing diameter shall be as agreed to between the purchaser and the manufacturer.

9. WEIGHT OF COATING

9.1 The weight of coating for wires of different finishes shall be as given in Table 3.

*Method for simple torsion testing of steel wire (*first revision*).

†Method for reverse bend testing of steel wire (*first revision*).

TABLE 2 BEND TEST

(*Clause* 7.1)

Size	Number of Bends		Mandrel, Radius *Min*
	*For 180° Bend, in Accordance with Present Method *OR*	For 90° Bend, to be Altered to	
(1)	(2)	(3)	(4)
mm			mm
1·80	10	21	5·0
1·83	10	21	5·0
2·49	5	11	7·5

*The first bend of 90° shall not be counted.

TABLE 3 WEIGHT OF COATING

(*Clause* 9.1)

Type of Finish	Weight of Coating g/kg of Wire for Size	
	0·965 mm	1·80, 1·83 and 2·49 mm
(1)	(2)	(3)
Zinc-copper finish:		
a) Zinc	4·5 to 18·5	4·5 to 18·5
b) Copper	0·55 „ 1·55	0·55 „ 1·55
Copper finish	0·3 „ 1·5	0·3 „ 1·0
Bronze finish	0·3 „ 1·5	0·3 „ 1·0
Brass finish	0·3 „ 1·5	0·3 „ 1·0

10. PROTECTIVE COATING

10.1 If agreed to between the supplier and the purchaser, a resinous coating shall be applied to wires to protect them from corrosion. The solvent used shall contain no substituted hydrocarbon components of chlorine.

11. FREEDOM FROM DEFECTS

11.1 The finished wire shall be circular in section and free from scales, splits, spills and other harmful defects. The coating shall be smooth and uniform.

12. TOLERANCES ON SIZES

12.1 Bead wire shall be supplied with a maximum tolerance of ± 0·025 mm.

13. FINISH

13.1 The wire shall have one of the following finishes as specified by the purchaser:

a) Zinc-copper plated,
b) Copper plated,
c) Bronze plated, or
d) Brass plated.

13.2 The finish of the wire shall be such as to give satisfactory adhesion. The bead wire shall be subjected to an adhesion test as given in Appendix A.

14. PACKING

14.1 Each coil of wire shall be suitably bound and fastened compactly and shall be suitably wrapped as mutually agreed to between the supplier and the purchaser.

15. MARKING

15.1 Each coil of wire shall carry a tag which shall be legibly marked with the following:

a) Manufacturer's name or trade-mark,
b) Finish, and
c) Size and weight of the wire.

15.1.1 The material may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

16. SAMPLING AND CRITERIA FOR CONFORMITY

16.1 The method of drawing representative samples of the material and the criteria for conformity shall be as prescribed in Appendix B.

APPENDIX A

(*Clause* 13.2)

METHOD OF TEST FOR ADHESION OF VULCANIZED RUBBER TO BEAD WIRE

A-1. APPARATUS

A-1.1 Mould — The mould is designed for a 13 mm thick block of rubber, 205 mm long and 50 mm wide across the short dimension of the mould, thus giving a 50 mm length of embedment; bevelled slots shall be located for spacing 15 wires 13 mm apart and at the middle of the block thickness. In addition to the mould itself, top and bottom plates shall be provided. The mould and plates are shown in Fig. 1.

A-1.1.1 *Testing Machine* — A suitable tension testing machine shall be used. The machine shall be of such capacity that the maximum load required to pull out the wires shall not exceed 85 percent nor be less than 15 percent of the rated capacity. The rate of travel of the power actuated grip shall be 50 ± 5 mm/min. Other rates of travel up to 150 ± 15 mm/min may be used by agreement between the purchaser and the manufacturer.

A-1.2 Grips — The top grip shall be of a special holder made for the cured block sample with a slot in the bottom to permit the block to be inserted with the wire protruding. The closed end of the slot shall be centred at the line of pull of the tester (*see* Fig. 2). The bottom grip shall be a wedge type designed to exert increasing tightening as the wire is pulled.

A-1.3 Press — A curing press, large enough to take the mould, and capable of at least 90 kN total pressure to the mould. Electrical or steam heat for the top and bottom plates shall be of sufficient capacity to maintain the mould components at the required temperature for the rubber compound being used.

A-2. MATERIALS

A-2.1 Solvent — The solvent used for the preparation of the rubber and wire in this method shall be such that the surface of the rubber will be freshened without adversely affecting the adhesion. A suitable solvent has been found to be a special lead free gasoline, with distillation range from 40 to 141°C and minimum recovery of 97 percent.

A-2.2 Rubber — The rubber stock used shall be furnished by the purchaser of the wire together with pertinent information on the temperature and time for the cure of that particular rubber as well as ageing time limits for holding the block between curing and testing. Since the efficiency of the uncured rubber is affected by its storage and age, the purchaser of the wire shall also specify the conditions of storage and any time limit for such storage of the batch. The rubber stock shall be provided, stored and used uncured in sheet form, between 7 and 8 mm thick without any remilling before using. It has been found convenient to store the rubber already cut to size for the mould.

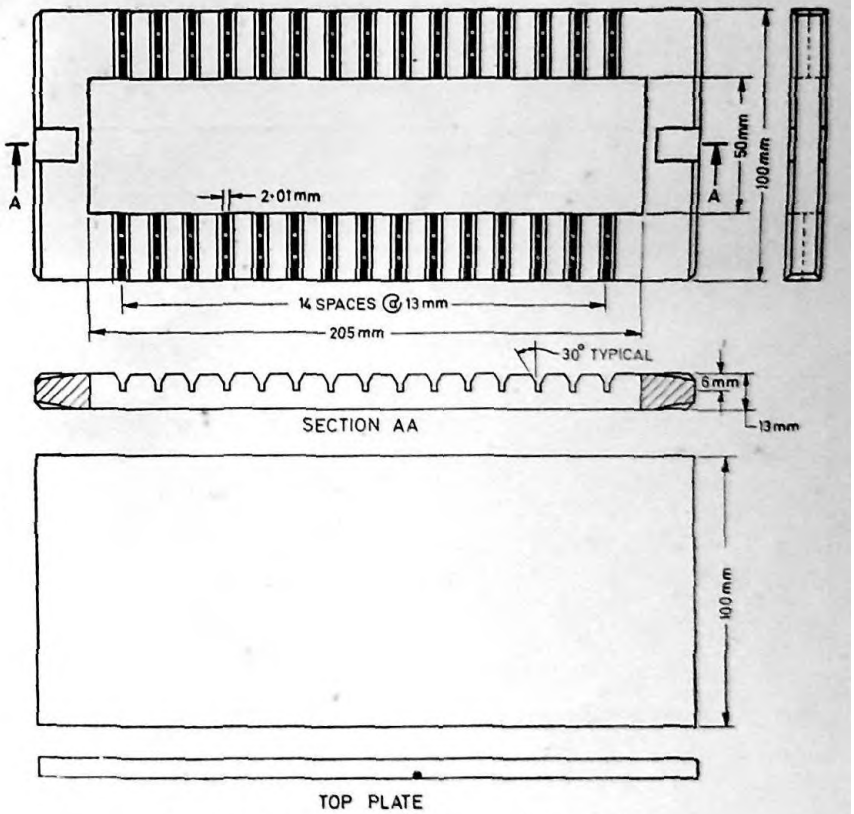

FIG. 1 MOULD WITH TOP AND BOTTOM PLATES (FOR WIRE 1·83 mm DIA) — (*Continued*)

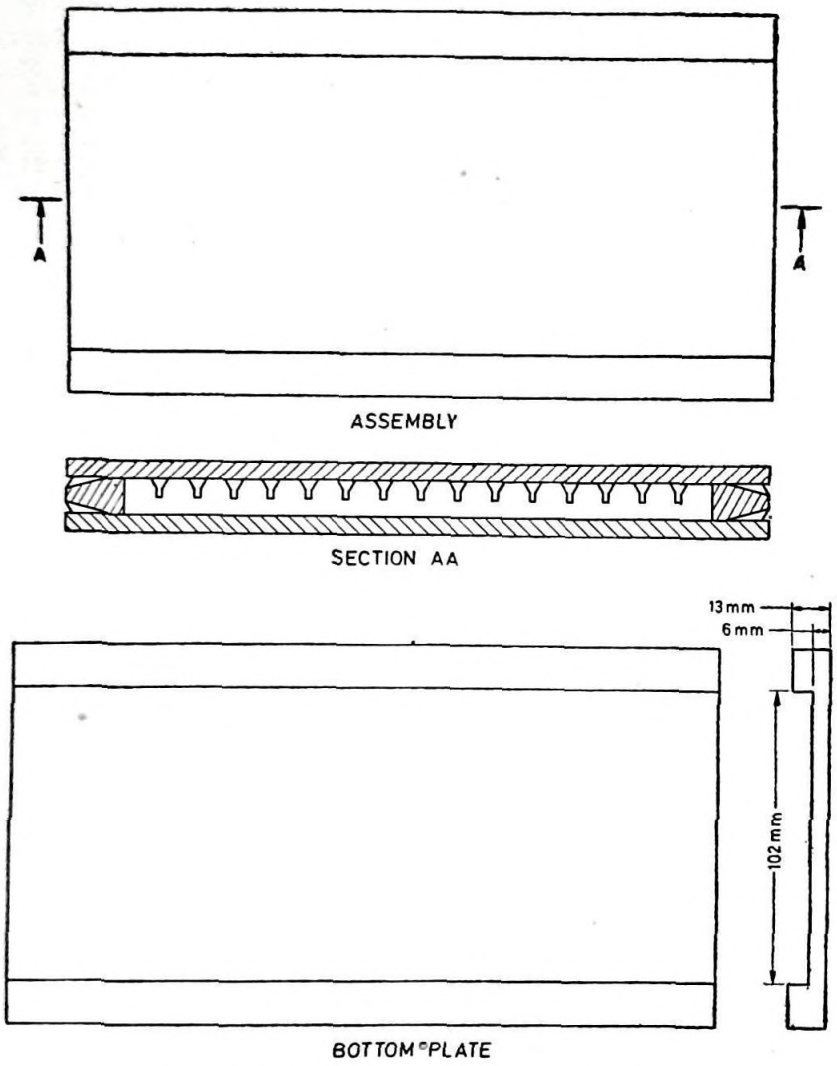

FIG. 1 MOULD WITH TOP AND BOTTOM PLATES
(FOR WIRE 1·83 mm DIA)

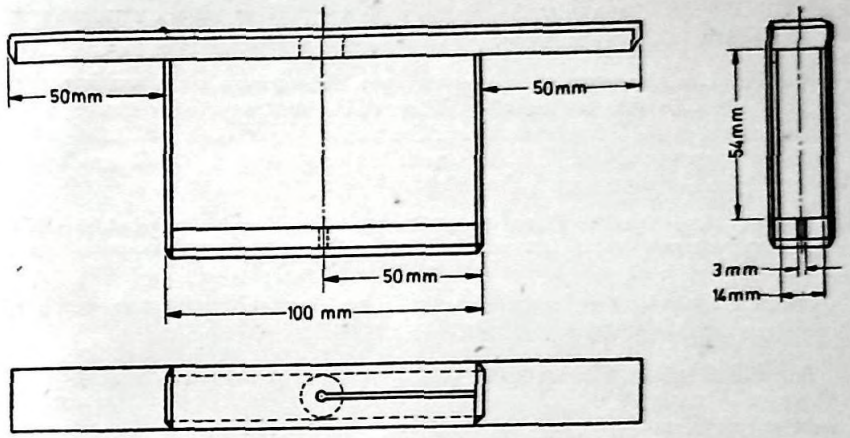

FIG. 2 TOP GRIP

A-3. PROCEDURE

A-3.1 Preparation of Materials — It is necessary that all the materials be prepared in advance of the building step so that the mould can be filled quickly at the proper time. Prepare these materials as follows.

A-3.1.1 *Wire Specimens* — Lay out 250 to 300 mm cut lengths of wire specimens on a clean surface, such as cloth or paper. The wires should be touched only at their ends. Unless otherwise specified the wires shall be tested 'as is' representing the condition in which the wire lot and samples were received. If 'washing' the surface of the wire before test is specified, gently wipe the wire with a soft cloth dampened with solvent.

A-3.1.2 *Rubber Stock* — Cut the rubber sheet stock to the size of the mould cavity, unless the stock has been pre-cut to that size for storage; two pieces are required for each block. Lay these out and freshen their top surface with the solvent, applied with a soft cloth or brush. Plan the freshening so that a drying time of at least 10 but not more than 20 minutes will have elapsed at the building step of the procedure.

A-3.2 Preparation of the Mould — Preheat the mould including top and bottom plates to the cure temperature of the rubber used.

A-3.3 Build Up of the Block

A-3.3.1 Remove the mould from the preheating and take off the top plate.

A-3.3.2 Press down into the mould with a metal or rubber wooden peg, or knife butt, the bottom piece of rubber, with freshened side up.

A-3.3.3 Lay the wires, one by one, into the tapered slots making note of their identification for later moulding of the test remelts. Position the wires so that about 2·5 mm sticks out from one side of the mould and about 150 mm from the other. Do not touch the wires within the 50 mm length that will be in contact with the rubber.

NOTE — Slots 1 and 15 should be filled with dummy length of wire which will be subsequently pulled, but their test values should not be recorded nor included in the calculations.

A-3.3.4 Press down firmly with knife butt or roller the top piece of rubber, with freshened side down.

A-3.3.5 Replace the top plate, put the mould in the press, and apply a pressure of at least 90 kN to the mould. Excessive pressures are not necessary and may damage the mould.

A-3.3.6 It is important that the entire sequence of steps takes not over 3 minutes, from the removal of the mould from the heat and replacing it in the press. This time limit also applies during the building of blocks subsequent to the first one, where the mould is already hot and when a cured block must be removed from the mould before it can be filled.

A-3.4 Cure — Cure the block under pressure for the time and temperature conditions of the rubber being used.

A-3.5 Preparation of the Cured Block — Remove the mould from the press and push out the cured block. If there are other blocks to prepare proceed with the building operations as outlined in **A-3.3**. Age the cured block at room temperature ($23 \pm 2{\cdot}8°C$) for the required time limits specified by the rubber stock supplier. Cut off the 25 mm lengths of protruding wire close to the edge of the block. Pull off any extraneous flesh from both edges of the block.

A-3.6 Testing — Push the block into the top grip of the testing machine until the first wire meets the stop. This will centre that wire at the line of pull of the tester. Clamp the first wire in the wedge clamp, make sure reading attachment of tester is at zero, and start the machine (*see* Fig. 3). When the wire pulls out, note the pull out load to the nearest 5 N and release the wedges. Pull the tested wire out of the block by hand and slide the block in the holder until the next wire hits the stop. Clamp it in the wedges and note its pull out load. Repeat the procedure with the other wires of the block. There is no need to stop the lower jaw after each wire pull. Continue sliding each subsequent wire into the wedges until they lower too for to grasp the wire length. Then return the lower grips to its highest position and start it down again.

A-4. TEST REPORT

A-4.1 Report individual test results and their mean plus any other calculated data as agreed to between the purchaser and manufacturer.

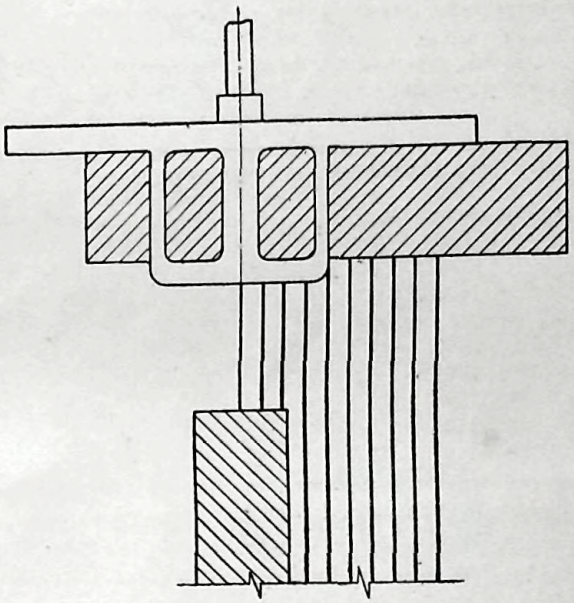

FIG. 3 WIRE ADHESION TEST APPARATUS

APPENDIX B

(*Clause* 16.1)

SAMPLING AND CRITERIA FOR CONFORMITY

B-1. LOT

B-1.1 In any consignment, all the coils of wires of the same diameter manufactured under essentially similar conditions of manufacture shall be grouped together to constitute a lot.

B-2. SAMPLING FOR SIZES AND SURFACE CONDITIONS

B-2.1 The number of coils to be examined from each lot sizes and surface condition and the corresponding criteria for conformity shall be as agreed to between the supplier and the purchaser.

B-3. SAMPLING FOR OTHER CHARACTERISTICS

B-3.1 From each lot, the number of coils specified in col 2 of Table 4 (depending upon the number of coils in the lot) shall be selected at random.

TABLE 4 SCALE OF SAMPLING

No. of Coils in the Lot	No. of Coils to be Selected
(1)	(2)
2 to 8	2
9 „ 15	3
16 „ 25	5
26 „ 40	7
41 „ 65	10
66 „ 110	15
Over 110	20

B-3.2 A test piece, cut from each end of each coil so selected, shall be subjected to the chemical analysis (*see* **4.1**).

B-3.2.1 The lot shall be considered as conforming to the requirements of the chemical composition laid down in this specification if the average of the test results complies with the limits specified in **4.1**.

B-3.3 From each of the coils selected as in **B-3.1**, one test piece for each of the applicable tests given under **5** to **7**, namely, tensile test (*see* **5.1**), torsion test (*see* **6.1**), bend test (*see* **7.1**), shall be cut from each end and subjected to these tests. All the selected coils shall also be subjected to dead wire test after cutting the necessary specimens for the other tests mentioned above.

B-3.3.1 The lot shall be considered as conforming to the requirements of various tests enumerated in **B-3.3**, if each result complies with the relevant requirements specified in the respective clauses.

B-3.3.2 In case there is only one failure in any test, then an equal number of fresh specimens shall be cut from a second set of randomly chosen coils and subjected to the tests in which the failure has occurred. On finding this new set of specimens satisfactory, the lot shall be declared as conforming to the requirements of that test, otherwise not.

INDIAN STANDARDS

ON

WROUGHT STEEL PRODUCTS

IS:

226-1969 Structural steel (standard quality) (*fourth revision*)
277-1969 Galvanized steel sheets (plain and corrugated) (*second revision*)
279-1961 Galvanized iron and steel wire for telegraph purposes (*revised*)
280-1962 Mild steel wire for general engineering purposes (*revised*)
412-1952 Expanded metal steel sheets for general engineering purposes (*revised*)
513-1973 Cold rolled carbon steel sheets (*second revision*)
597-1962 Black plate for tinning and tin plate (pack rolled) (*revised*)
648-1970 Non-oriented electrical steel sheets for magnetic circuits (*second revision*)
961-1962 Structural steel (high tensile) (*revised*)
1029-1970 Hot rolled steel strips (baling) (*first revision*)
1079-1973 Hot rolled carbon steel sheet and strip (*third revision*)
1148-1973 Rivet bars for structural purposes (*second revision*)
1149-1973 High tensile rivet bars for structural purposes (*second revision*)
1673-1973 Mild steel wire suitable for the manufacture of machine screws (by cold heading process) (*first revision*)
1812-1973 Mild steel wire for the manufacture of wood screws (*first revision*)
1835-1966 Steel wire for ropes (*first revision*)
1977-1969 Structural steel (ordinary quality) (*first revision*)
1990-1962 Steel rivet and stay bars for boilers
1993-1962 Cold-reduced tinplate and cold-reduced blackplate
2002-1962 Steel plates for boilers
2041-1962 Steel plates for pressure vessels
2062-1969 Structural steel (fusion welding quality) (*first revision*)
2073-1970 Carbon steel bars for production of machined parts for general engineering purposes (*first revision*)
2100-1970 Steel billets, bars and sections for boilers (*first revision*)
2255-1969 Mild steel wire rod for the manufacture of machine screws (by cold heading process) (*first revision*)
2385-1965 Hot rolled mild steel strip for cold-reduced tinplate
2507-1965 Cold rolled steel strip for springs
2517-1963 Bright bars for threaded components
2589-1964 Hard-drawn steel wire for upholstery springs
2591-1969 Hot rolled bars for threaded components (*first revision*)
2830-1964 Carbon steel billets for re-rolling into structural steel (standard quality)
2831-1969 Carbon steel billets for re-rolling into structural steel (ordinary quality) (*first revision*)
2879-1967 Mild steel for metal arc welding electrode core wire (*first revision*)
3024-1965 Electrical steel sheets (oriented)
3039-1965 Structural steel (shipbuilding quality)
3195-1965 Steel for the manufacture of volute and helical springs (for railway rolling stock)
3298-1965 Mild steel rivet bars for ship-building
3422-1966 Code of practice for packaging of steel and steel products for export purposes
3431-1965 Steel for volute, helical and laminated springs for automotive suspension

3502-1966 Steel chequered plates

3503-1966 Steel for marine boilers, pressure vessels and welded machinery structures

3747-1966 Steel for flanging and pressing

3835-1966 Aluminized steel core wire for aluminium conductors (ACSR)

3885 (Part I)-1966 Steel for the manufacture of laminated springs (railway rolling stock): Part I Flat sections

3885 (Part II)-1969 Steel for the manufacture of laminated springs (railway rolling stock): Part II Rib and groove sections

3945-1966 Steel for naval purposes

4030-1973 Cold rolled carbon steel strip for general engineering purposes (*first revision*)

4072-1967 Steel for spring washers

4223-1967 Steel wire for umbrella ribs

4224-1967 Steel wire for office staples

4454-1967 Steel wires for cold formed springs

4824-1973 Bead wire for tyres (*first revision*)

4855-1968 Bright steel bars for machining

5239-1969 Wire rod for the manufacture of aluminized steel core wire for aluminium conductors

5272-1969 Carbon steel sheets for integral coaches

5872-1973 Cold rolled steel strips (box strappings) (*first revision*)

5986-1970 Hot rolled steel plates and flats for cold forming and flanging operations

5993-1970 Aluminized steel wire for telegraph and telephone purposes

6240-1971 Hot rolled steel sheets for the manufacture of low pressure gas cylinders

6902-1973 Steel wire for spokes

6914-1973 Carbon steel cast billet ingots for rolling into structural steel (standard quality)

6915-1973 Carbon steel cast billet ingots for rolling into structural steel (ordinary quality)

6967-1973 Steels for electrically welded round link chains