REVISION OF SPECIFICATION / STR

Ref: Current Spec. No. – IRSM:41-97, Amendment-1 – Corrosion Resistant Structural Steel required for Rolling Stock.

1. RDSO is reviewing the specification/STR to cater to the latest technological developments in the field, modify clauses not relevant in the present context and making them more enabling with focus on functional requirements.

2. It is requested that your comments / suggestions with regard to improvements / modifications in specification / STR of this item may be submitted in the following format along with the justification for the changes required.

Part A: Basic Information

SN	Particulars	Information
1	Name	
2	Designation	
3	Professional Qualification	
4	Organization / Firm's Name	
5	Address for Correspondence	
6	Contact No.	
7	Email ID	
8	**In case of Firm / Individual:** Manufacturing experience of item (or similar Item) on which comments are offered	
9	**Where relevant:** Whether any technical document to support suggested changes is available / enclosed for better appreciation	

Part B: Comments / suggestions on the specification

SN	Clause No. of RDSO STR / Spec	Clause, as exists in RDSO STR / Spec	Clause , as it should read after incorporation of comments / suggestions in the RDSO Spec / STR	Justification for changes

Comments may be sent to:

Director/CD/Carriage
Research Designs and Standards Organization
Manak Nagar, Lucknow – 226011

Email: edcar.rdso@gmail.com Or jdircd@gmail.com

IRS : M-41-97

INDIAN RAILWAYS

CORROSION RESISTANT STRUCTURAL STEEL REQUIRED FOR ROLLING STOCK

SERIAL NO. IRS : M-41-97 (with 2 corr.)

JUNE - 97

ISSUED BY
RESEARCH DESIGNS AND STANDARDS ORGANISATION
MINISTRY OF RAILWAYS
MANAK NAGAR,LUCKNOW - 226 011

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

INDIAN RAILWAY FOR CORROSION RESISTANT STRUCTURAL STEEL REQUIRED FOR ROLLING STOCK SERIAL NO. IRS:M-41-97

0. FOREWORD

0.1 This specification is issued under the fixed serial number M-41, the final number indicates the year of original adoption as standard, or in the case of revision, the year of last revision.

PROVISIONALLY ADOPTED 1974, REVISED 1993 AND 1997:

0.2 This specification has been revised to:

i) Cater to cold rolled finished products also.
ii) Cater to supply of sheets & plates in coil form also.

0.3 This issue supersedes 1974 edition, its corrigendum No.1 of Nov.1990 and corrigendum No.2 of Dec.1990 and 1993 edition.

0.4 This specification draws reference to the following specifications (latest versions).

Sl No.	Specification No.	Description
a.	IS:228	Methods for chemical analysis of steel
b.	IS:513	Specification for cold rolled low carbon steel sheets and strips (Third Revision)
c.	IS:1599	Method of bend test (Second Revision)
d.	IS:1608	Method for tensile testing of steel products (First Revision)
e.	IS: 1663	Method for tensile testing of steel sheet and strip of thickness 0.5 mm

		to 3 mm (First Revision)
f.	IS: 1730	*Dimensions for steel plate, sheet* and strip for structural and general engineering purposes. Part-I Plate (First Revision) Part-II Sheet (First Revision)
g.	ISO:5952	Continuously hot rolled steel sheet of structural quality with improved atmospheric corrosion resistance
h.	IS:2062-1984	Specification for weldable structural steel
i.	IS:9595-1980	Welding procedure (4th Revision)

1. SCOPE

1.1 This specification covers the requirements for corrosion resistant steel sheets (below 5 mm thick) and plates (5 mm to 12.5 mm thick) in two grades and sections as follows:

1.1.1 Sheets and Plates (In Flat or Coil Form)

Grade-I : Intended for structural purposes where guaranteed mechanical properties, weldability and suitability for forming simple cold pressed parts are required.

Grade-II: Intended for general engineering purposes with guaranteed mechanical properties and weldability .

1.1.2 Sections:

Intended for general engineering purposes with guaranteed mechanical properties and weldability.

1.2 The manufacturer can supply sheets, plates and sections either in hot rolled and if required in as skin passed or cold rolled and annealed condition only or hot rolled followed by cold finishing or cold rolled and annealed . In case of cold rolled finished supply, there shall, however, be no adverse effects on the properties of the product. The manufacturing process adopted for cold rolling/finishing shall be furnished in detail by the supplier.

2. MANUFACTURE

Steel shall be manufactured by the electric, basic oxygen or a combination of these processes. in case any other process is employed by the manufacturer, prior approval of the purchaser shall be obtainbed.

3. CHEMICAL COMPOSITION

3.1 Ladle Analysis:

The ladle analysis of steel when carried out either by the methods specified in relevant parts of IS:228 or by any other established instrumental/chemical method, shall be as per Table-I. In case of any dispute the procedure given in relevant parts of IS:228 shall be the reference method.

TABLE - 1

CHEMICAL COMPOSITION %

C	Mn	Si	Ni	Cu	Cr	S	P	Incidental Elements
0.10	0.25	0.28	0.20	0.30	0.35	0.03	0.075	Mo= 0.05 max
max.	to	to	to	to	to	max	to	V = 0.05 "
	0.45	0.72	0.47	0.60	0.60		0.140	Al= 0.08 "
								N= 0.04 "

(Total incidental elements = 0.15 max)

3.2 Product Analysis:

An analysis from each cast of the poduct shall be done. Permissible variation from the limits specified in Table - 1, shall be as given below:

Constituent	Variation over the specified limits percent	Constituent	Variation over the specified limits percent
C	+ 0.02	Cu	± 0.05
Mn	± 0.05	Cr	± 0.05
Si	± 0.03	S	+ 0.005
Ni	± 0.03	P	+0.005

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4. TENSILE TEST

4.1 Number of Tensile Tests:

4.1.1 One tensile test shall be taken from each lot of 50 tonnes or part thereof from each cast. However, in the case of sheets supplied after heat treatment, one tensile test shall be conducted for each heat treated batch or a lot of 50 tonnes, or part thereof per cast.

4.1.2 Where plates or sections of more than one thickness are rolled from the same cast, one additional tensile test shall be made from the material in each class of product for each

variation in thickness of 6 mm above or below the thickness of the test piece first selected in such a class.

4.1.3 Where sheets of more than one thickness are rolled from the same cast, one additional tensile test shall be made for every thickness.

4.2 TENSILE TEST PIECES

4.2.1 Test specimen shall be prepared from the sheets, plates and sections in finished condition and tested for plates and sections in accordance with IS:1608 and for sheets in accordance with IS:1663.

4.2.2 Test sample shall be cut length-wise and cross-wise to the direction of rolling from plates and sheets and length-wise from sections.

4.3 MECHANICAL PROPERTIES

4.3.1 The tensile stength, yield stress and elongation percentage shall be as follows:

	Hot rolled	Cold rolled
Tensile strength	480 MPa min.	440 MPa min
Yield strength	340 MPa min	300 MPa min

Elongation

On GL $5.65\sqrt{So}$	22% min	26% min

GL is gauge length
SO is cross sectional area

4.3.2 If the percentage of elongation of any tensile test piece is less than that specified in clause 4.3.1 and any part of the fracture is outside the middle half of the gauge length, the test shall be discarded and a retest shall be made.

5. BEND TEST

5.1 One bend test shall be taken from each lot of 50 tonnes of sheets and 50 tonnes of plates and sections or part thereof from each cast. However, in the case of sheets supplied after heat treatment,one bend test shall be conducted for each heat treated batch or a lot of 50 tonnes or part thereof per cast.

5.2 Where plates, sheets and sections or more than one thickness are rolled from the same cast, one additional bend test shall be made from every thickness.

5.3 BEND TEST PIECES

5.3.1 The test pieces shall be cut lengthwise and crosswise to the direction of rolling from plates and sheets and lengthwise from sections.

5.3.2 The rough edge or arris resulting from shearing may be removed by filing or grinding or machining. Test pieces shall receive no other preparation.

5.3.3 Bend test shall be conducted in accordance with IS:1599 (Method of test).

5.3.4 The bend test specimen shall withstand being bend at ambient temperature in any direction through 180 degree around a former of diameter equivalent to the thickness of the material without cracking on the outside of the bent portion.

6. LOCATION OF TESTS SAMPLE

6.1 Samples for chemical analysis and test pieces for tensile and bend test shall be drawn from standard location for plates and sections as given in IS:2062 and for sheets from any conventional location.

7. RETEST

7.1 Should any of the test pieces first selected fail to pass any of the tests specified in this standard, two further samples shall be selected from the same lot for testing in respect of each failure. Should the test piece from both these additional samples pass, the material represented by the test samples shall be deemed to comply with the requirement of that particular test. Should the test pieces from either of these additional samples fail the material represented by the test samples shall be deemed to be not conforming to this standard and shall be rejected.

8. FREEDOM FROM DEFECTS

8.1 All finished material shall be well and cleanly rolled to the dimensions and weights specified. The finished material shall be free from cracks. surface flaws, laminations, rough jagged and imperfect edges and all other harmful defects. The sheets shall be reasonably flat and the edges cleanly sheared and truly squared to the specified dimensions. The coil shall be supplied with edges trimmed. The trimming of edges may be carried out either by the supplier or the coach/wagon builders which may be decided between the purchaser and the supplier.

9. SURFACE FINISH

9.1 Plates and Sections:

The plates and sections shall be well and cleanly rolled. Minor surface defects may be removed by the manufacturer by grinding, provided the thickness is not reduced locally by more than 4 percent.

9.2 Sheets:

Sheets may be supplied in any of the following surface conditions as stipulated by the purchaser.

9.2.1 Surface Finish SF1:

Uniform dull finish to surface roughness range 0.6 to 1.8 microns and free from rust and scales. Pits grooves, scratches and pores are permissible to a limited extent so that on viewing with naked eye, uniformly smooth appearance is not impaired. The surface finish may be obtained if required through a suitable combination of pickling and skin passing or pickling,cold rolling and annealing.

9.2.2 Surface Finish SF 2:

Rolled condition with reasonably smooth surface free from harmful surface defects.

10. WELDABILITY

10.1 The plates and sections shall be suitable for gas and metal arc welding.

10.2 The sheets shall be suitable for gas and metal arc welding as suitable for spot and seam welding processes.

11. DIMENSIONS AND TOLERANCES:

11.1 Dimensions of steel plates, sheets in flat form, shall conform to the dimensions specified in IS:1730 unless otherwise agreed to between the purchaser and the manufacturer/supplier.

11.2 The plates and sheets in coil form shall have:

Inner dia of coil	450 - 850 mm
Outer dia of coil	700 - 1600 mm
Weight of coil	10 t max.
Width of coil	As per purchaser's requirement

11.3 Unless otherwise agreed to between the purchaser and the manufacturer/supplier, the tolerances for plates, sheets and sections for thickness , width with mill edge and sheared edge, length, camber , out of square and flatness shall be as per Annexure I.

11.4 The telescopicity of the coil shall not exceed more than 50 mm.

12. INSPECTION

12.1 The purchaser or his Inspecting Officer shall have free access to the works of the manufacturer at all reasonable times and he shall be at liberty to inspect the manufacture at any stage and to reject material that does not conform to the terms of this specification.

12.2 Testing Facilities:

12.2.1 The manufacturer shall supply the material required for testing free of charge and shall at his own cost, furnish and prepare the necessary test pieces and supply labour and appliances for such testing as may be carried out on his premises in accordance with this specification. Failing to provide the facilities at his own works for making the prescribed tests, the manufacturer shall bear the cost of carrying out the tests in a laboratory/test house selected by the Inspecting Officer or the purchaser.

13. MARKING

13.1 Each product shall be stamped /painted with material specification, code of surface finish, the cast number and the manufacturer's name or trade mark. In case of sheets, the bundle shall carry a metal tag bearing the above. Alternatively , the top sheet shall be legibly marked material specification cast number and manufacturer's name or trade mark.

14. PROTECTION AND PACKING

14.1 Packing method for plates above 5 mm:

14.1.1 Plates supplied shall be provided with reasonable packing with metal strapping for handling during transit and storage.

14.2 Plates/Sheets in Flat Form:

14.2.1 The sheets of 1.6 mm , 2 mm , 3.15 mm , and 4 mm and plate of 5 mm thickness shall be supplied in bundles with double layer of water proof paper or single layer of coated hessain

cloth or HDPE cloth and metal protection in edges. All the sheets shall be protected against corrosion and rust with suitable mineral oil or other temporary rust preventive coating.

14.2.2 All bundles shall have a minimum of 2 hoops upto 1.2 metre in length and one extra hoop for every additional metre. The bundles shall also be provided with skid (wooden packing underneath) to facilitate handling.

14.3 Sheets in Coil Form:

The coils shall be protected in reasonably good condition to withstand normal handling hazard during transit with the following provisions as the barest minimum.

i) Plastic laminate paper or hessain cloth around the coil

ii) Steel angle .4 - 1.0 x50 x100 mm on the outer and inner corner/metal ring in the eye.

iii) Coils to be securely strapped with 4 bands through the eyes of the coil and 3 bands on the circumference of the eye

iv) Hot Rolled Coils shall be supplied with rust preventive oil coating on the outer layer ,inner layer and on both edges.

v) Coils processed through pickling and or skin passing or cold rolling shall be supplied with rust preventive oil coating on both surfaces and edges.

14.4 Due care shall also be taken to avoid mechanical damage and corrosion during transit.

Annexure

TABLE - I

Thickness tolerances for hot/cold rolled steel sheet (including descaled sheet), coils and cut lengths

Specific width (mm)	Thickness tolerances over and under, for specified thickness (values in millimetres)								
	< 2.0	> 2.0 2.5	> 2.5 3.0	> 3.0 4.0	> 4.0 5.0	> 5.0 6.0	> 6.0 8.0	> 8.0 10.0	> 10 12
>600 - ≤1200	0.13	0.14	0.15	0.17	0.19	0.21	0.23	0.26	0.28
>1200 - ≤1500	0.14	0.15	0.17	0.18	0.21	0.22	0.24	0.25	0.29
>1500 - ≤1800	0.14	0.17	0.19	0.21	0.22	0.23	0.25	0.27	0.30
>1800		0.20	0.21	0.22	0.23	0.25	0.28	0.32	0.30

The values specified do not apply to the uncropped ends for length of a mill edge coil. The length would be calculated using the following formula

$$\text{Length in metres} = \frac{90}{\text{Thickness in mm}}$$

provided that the result was not greater than 20 m, inclusive of both ends.

Thickness is measured at any point on the sheet not less than 40 mm from a side edge. Measurement on an untrimmed edge sheet nearer to an edge then 40 mm.

TABLE - II

Hot rolled coils/sheets with mill edge, and cut lengths width tolerances

Specified width (mm)	Tolerance over specified width (No tolerance under) (mm)
Upto and including 1200	20
Over 1200 upto and including 1500	20
Over 1500	25

The values specified do not apply to the uncropped ends for a length of a mill edge coil. Length would be calculated using the following formula:

$$\text{Length in metres} = \frac{90}{\text{Thickness in mm}}$$

Provided that the result was not greater than 20 m, inclusive of both ends.

TABLE - III

Hot rolled coils/sheet (including descaled sheet), sheared edge, not resquared, coils and cut lengths . Width tolerances.

Specified width (mm)	Tolerance over specified width (No tolerance under) (mm)
Upto and including 1200	3
Over 1200 upto and including 1500	5
Over 1500	6

Tolerances for sheared edges apply to products with nominal thickness < 10. mm For nominal thickness > 10 mm the upper tolerances shall be agreed at the time of enquiry and order.

TABLE - IV

Hot rolled sheet (including descaled sheet), not required . Length tolerances.

Specified width (mm)	Tolerance over specified width (No tolerance under) (mm)
Upto and including 2000	10
Over 2000 upto and including 8000	0.5% x length
Over 8000	40

TABLE - V

Hot rolled steel sheet (including descaled sheet), not required . Camber tolerances.

Form	Maximum tolerance (mm)
Coils	25 in any 5000 length
Cut lengths	0.5 % x length

See figure 1
The values do not apply to the uncropped ends of mill edge within 7 m inclusive of both ends.

FIGURE I Measurement of camber

Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge.

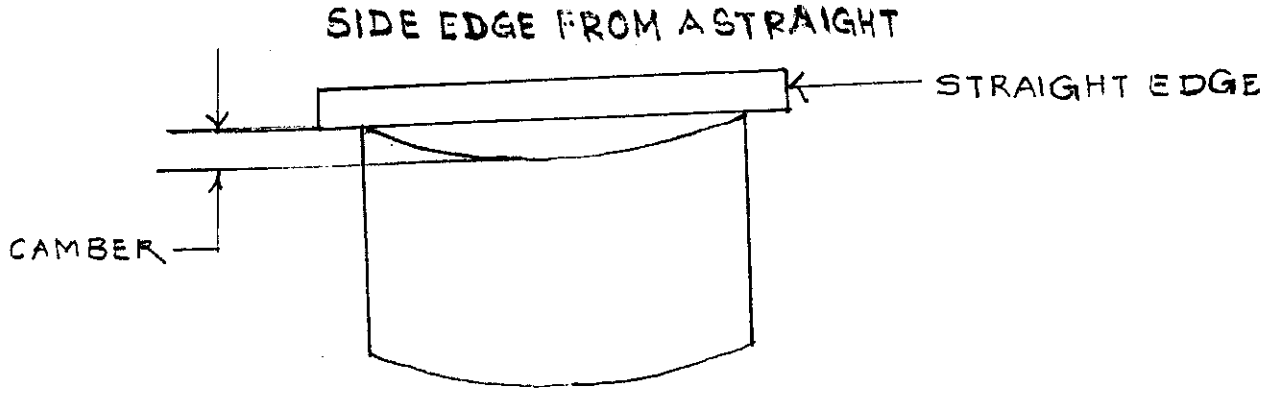


TABLE - VI

Hot rolled /cold rolled plate /sheet in cut length (including descaled sheet), not required . Out -of-square tolerances.

Dimensions	Out-of-square tolerance
All thickness and all sizes	1 % x width

FIGURE 2 Measurement of out-of square

Out-of-square is the greatest deviation of an end edge from a straight line at right angles to a side and touching one corner, the measurement being taken as shown in Figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

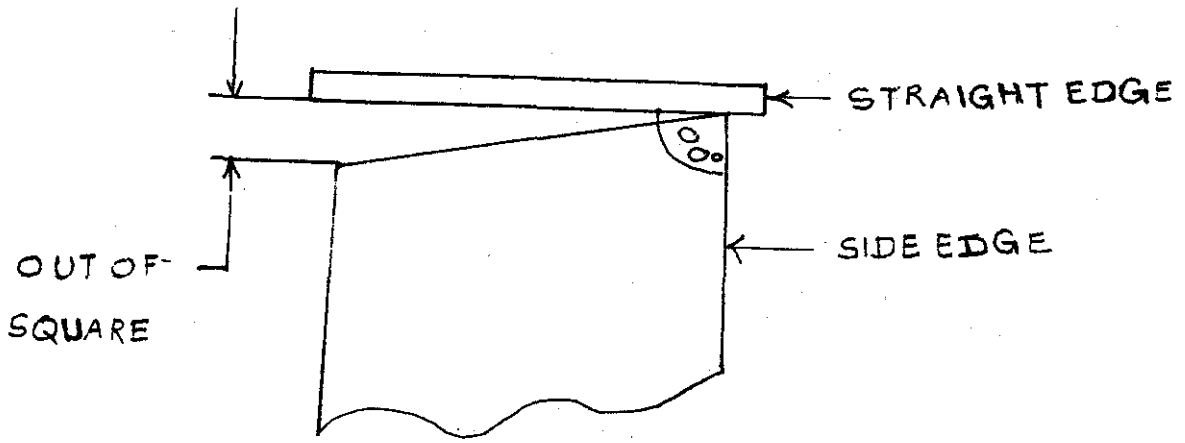


TABLE - VII

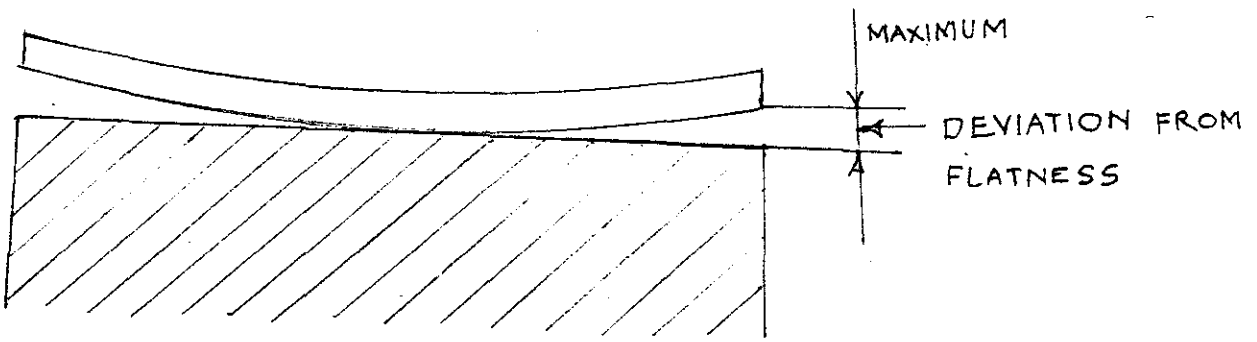
Standard flatness tolerances , cut length

Thickness (mm)	Width (mm)	Flatness tolerances (mm)sq.
Upto and including 2	Upto and including 1200	21
	Over 1200 upto and including 1500	25
	Over 1500	30
Over 2 upto 5 mm	Upto and including 1200	18
	Over 1200 upto and including 1500	23
	Over 1500	28

These tolerances are only applicable to sheet up to and including 5000 mm length. Tolerances for sheet having a length exceeding 5000 mm are subject to agreement . This table also applies to sheet cut to length from coil by the customer when adequate flattening procedures are performed.

Maximum deviation from a flat horizontal surface. With the sheet lying under its own mass on a flat surface, the maximum distance between the lower surface of the sheet and the flat horizontal surface is the maximum deviation from flatness (See Figure 3).

FIGURE 3 Measurement of flatness



Amendment slip no.1 of September 2001 to Specn. IRS-M-41/97 for corrosion resistant structure steel for rolling stock.

Clause No.	Existing Clause	To be read as
(1) MARKING PARTICULARS		
13.1	Each product shall be stamped/painted with material specification, code of surface finish, the cast number and the manufacture's name or trade mark. In case of sheets, the bundle shall carry a metal tag bearing the above. Alternatively, the top sheet shall be legibly marked material specification cast number and manufacturer's name or trade mark	Each product i.e. sheet or plate of corrosion resistant structural steel (corten steel) to IRS-M-41/97 being produced for Indian Railways will bear distinct mark made by inkjet printing with indelible ink. The marking must include the following particulars: i) Product identification i.e. IRS M-41 or CORTEN ii) Heat Number iii) Manufacturer's name or logo having name of manufacturer.
13.2 (New Clause)	Nil	The markings will be made staggered in two rows at a distance of 50cm from each edge along the length. Max. distance between two markings i.e. from the end of one marking to the start of the next should be 75 cms.
13.3(New Clause)	Nil	In case of bundles made out of sheet or plate, each bundle apart from marking particulars on each sheet or plate shall have a metal tag bearing marking particulars as per para 13.1.
13.4(New Clause)	Nil	For easy identification, the top sheet of each bundle shall also be marked legibly indicating marking particulars as per para 13.1
13.5(New Clause)	Nil	In case of sheets supplied in the form of coils, each end of the coil shall bear the marking particulars as per para 13.1 made by inkjet printing with indelible ink. Apart from these marking each coil shall also carry a metal tag bearing the marking particulars mentioned above.

14.3.1	The sheets of 1.6 and 2mm thickness shall be supplied in bundles with double layer of water proof paper or single layer of coated hessain cloth or HDPE cloth and metal protection in edges. All the sheets shall be protected against corrosion and rust with suitable mineral oil or other temporary rust preventive coating	The sheets of 1.6 and 2mm thickness shall be supplied in bundles with double layer of water proof paper or single layer of coated hessain cloth or HDPE cloth and metal protection in edges. All the sheets shall be protected against corrosion and rust by coating corrosion preventive fluid, soft film, solvent deposited, water displacing to IS:1154.
14.4(v)	Coils processed through pickling and or skin passing or cold rolling shall be supplied with rust preventive oil coating on both surfaces and edges.	Coils of 1.6mm to 2.00mm thick sheets processed through pickling and or skin passing or cold rolling shall be supplied by coating corrosion preventive fluid , soft film, solvent deposited, water displacing to IS:1154.
14.4(vi) New Clause	Nil	Prior to grit blasting of coaches the coating of corrosion preventive fluid film is required to be stripped off by petroleum hydrocarbon solvent to IS:1745.

Amendment Slip No. 2: - of March 2006 to specification No. IRS – M – 41/97 for corrosion resistant structural steel required for rolling stock.

Table – VII, Standard flatness tolerances, cut length: -

Thickness (mm)	Width (mm)	Flatness tolerance (mm)	
		Existing Clause	To be read as
Upto and including 2	Upto and including 1200	21	Max. 8
	Over 1200 upto and including 1500	25	
	Over 1500	30	