

X

इंटरनेट

# Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार" Mazdoor Kisan Shakti Sangathan "The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ" Jawaharlal Nehru "Step Out From the Old to the New"

मानक

IS 277 (2003): Galvanized Steel Sheets (Plain and Corrugated) [MTD 4: Wrought Steel Products]



511 11/S

Made Available By Public.Resource.Org

 $\star \star \star \star \star \star \star$ 



 $\star \star \star \star \star \star \star \star$ 

"ज्ञान से एक नये भारत का निर्माण″ Satyanarayan Gangaram Pitroda "Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता Bhartrhari-Nītiśatakam "Knowledge is such a treasure which cannot be stolen"



# BLANK PAGE



PROTECTED BY COPYRIGHT

# भारंतीय मानक जस्तीकृत इस्पात की चददें (सादी एवं नालीदार)—विशिष्टि ( छठा पुनरीक्षण )

# Indian Standard GALVANIZED STEEL SHEETS (PLAIN AND CORRUGATED)— SPECIFICATION

# (Sixth Revision)

First Reprint JUNE 2007 (Including Amendment No. 1)

ICS 77.140.50

∜ BIS 2003

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

**Price Group 4** 

#### FOREWORD

This Indian Standard (Sixth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1951 and subsequently revised in 1962, 1969, 1977, 1985 and 1992. While reviewing this standard in the light of experienced gained during these years, the Committee decided to revise the standard. In this revision, following changes have been made:

- a) Amendments number 1, 2, 3, 4 and 5 have been incorporated.
- b) Table 1 has been modified, interstitial free grade of base metal has been included.
- c) Clause 7.1 has been modified.
- d) Clause 2 have been updated.

Galvanized steel sheets covered by this standard are intended to be used for purposes such as panelling, roofing, lock forming etc.

For all tests specified in this standard (chemical/physical/others), the method as specifies in relevant ISO standard may also be followed as an alternate method.

The composition of Committee responsible for formulation of this standard is given in Annex A.

For the purpose of deciding whether 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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# AMENDMENT NO. 1 JULY 2005 TO

# IS 277 : 2003 GALVANIZED STEEL SHEETS ( PLAIN AND CORRUGATED ) --- SPECIFICATION

# (Sixth Revision)

(Page 1, clause 6) — Substitute the following for the existing table:

# Table 1 Classification of Grades of GP/GC Coils and Sheets

(Clause 6)

SEN	o. Type	Designation	Grade Reference of Base Metal in IS 1079/IS 513
(1)	(2)	(3)	(4)
i)	Deep drawing	GPD	Grade DD
ii)	Extra deep drawing	GPED	Grade EDD
iii)	Corrugated ordinary	GC	Grade O

NOTES

1 Spangles shall not be allowed to form on the surface of zero spangled strips/ sheets during galvanizing.

2 If grade designation GP is required by the purchaser, it may be manufactured from Grade O of IS 513.

(Page 2, clause 8.1, last line) — Substitute the following for the existing:

'However, bend test shall not be applicable to GC grade of sheets intended for corrugation.'

(MTD 4)

1-76 BIS/ND/07

# AMENDMENT NO. 2 AUGUST 2008 TO IS 277 : 2003 GALVANIZED STEEL SHEETS (PLAIN AND CORRUGATED) — SPECIFICATION

(Sixth Revision)

[Page 1, clause 6 (see also Amendment No.1)] — Insert the following grades in the existing table:

SI Na	Туре	Designation	Grade Reference of Base Metal IS 1079/IS 513
(1)	(2)	(3)	(4)
v)	Ordinary	GP	Grade O
vi)	Ordinary-Hard	GPH	Grade O
⊴ii)	Lock Forming	GPL	Grade D

(Page 1, clause 5.2) - Insert the following new clause after 5.2:

5.3 Passivation shall be carried out on the surface, if agreed to between the purchaser and the manufacturer.'

(Page 2, clause 7.4) — Insert the following new clause after 7.4:

Grade of Coating	Minimum Average Coating Triple Spot Test g/m <sup>2</sup>	Minimum Coating Single Spot Test g/m <sup>2</sup>
(1)	(2)	(3)
100	100	90
80	80	75

NOTE - For the above grade of coating, the mandrel diameter for bend test for adhesion of zinc coating shall be subject to mutual agreement between the purchaser and the manufacturer.

## Amend No. 2 to IS 277 : 2003

[Page 2, clause 8.1, last sentence (see also Amendment No.1)] — Substitute the following for the existing:

'However, bend test shall not be carried out on sheets intended for corrugation.'

(*Page* 4, *clause* 14.1.2) — Substitute the following informal table for the existing:

Grade	Depth of Corrugation mm	Pitch of Corrugation mm
A	17.5	75
В	12.5	75
С	19.0	70
D	17.5	70

NOTE-On agreement between the purchaser and the manufacturer sheets of other profile, depth and pitch of corrugation may also be supplied subject to required condition for imposed load on roofs as per 4.2 of IS 875 (Part 2): 1987

(Page 4, clause 14.1.3, first sentence) — Substitute the following for the existing:

'The number of corrugations shall be as per the table given below, depending on the width of the sheet.'

(*Page 4*, *Table 5*) — Substitute the following table given on page 3 for the existing:

Amend No. 2 to IS 277 : 2003

SI No.	No. of	Grade	Overall Widt	th of Sheet (mm)
	Corrugation		Before Corrugation	After Corrugation
(1)	(2)	(3)	(4)	(5)
i)	8	٨	750	660
ii)	10	A	900	810
iii)	11	Α	1 000	910
iv)	13	A	1 200	1 1 10
V)	14	A	1 220	1 125
vi)	16	A	1 350	1 220
vii)	18	A	1 500	1 370
viii)	20	A	I 650	1 520
ix)	8	В	750	680
x)	10	B	900	830
xi)	11	B	1 000	930
xii)	13	В	1 200	1 130
xiii)	16	B	1 350	1 240
xiv)	18	В	1 500	1 390
xv)	20	В	1 650	1 540
xvi)	10	С	840	720
xvii)	12	D	1 000	875

# Table 5 Overall Widths and Corrugations of Sheets (Clause 14.1.3)

(MTD 4)

Reprography Unit, BIS, New Delhi, India

3

# AMEND. 'T NO. 3 FEBRUARY 2009 TO IS 277 : 2003 GALVANIZED STEEL SHEETS (PLAIN AND CORRUGATED) - SPECIFICATION

## (Sixth Revision)

(Page 3, clause 11.1) -- Substitute the following for the existing:

'Galvanized plain sheets, corrugated sheets and coils shall be reasonably flat and free from bare spots, pin holes, tears and other harmful defects. However, imperfections such as rough/non-uniform coating, minor dents, water/passivation marks, etc, may be present at certain portions which are not harmful for intended use.'

(MTD 4)

Reprography Unit, BIS, New Delhi, India

# Indian Standard GALVANIZED STEEL SHEETS (PLAIN AND CORRUGATED) — SPECIFICATION (Sixth Revision)

# **1 SCOPE**

This standard covers the requirements of plain galvanized steel sheets and strips (coils) and corrugated galvanized sheets.

# **2 REFERENCES**

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
209 : 1992	Zinc ingot — Specification (fourth revision)
513 : 1994	Cold-rolled low carbon steel sheets and strips (fourth revision)
1079 : 1994	Hot-rolled carbon steel sheet and strip ( <i>fifth revision</i> )
1956 (Part 4) : 1975	Glossary of terms relating to iron and steel : Part 4 Steel sheet and strip (first revision)
2629 : 1985	Recommended practice for hot dip galvanizing on iron and steel (first revision)
6745 : 1972	Method for determination of mass of zinc coating on zinc coated iron and steel acticles
8910 : 1978	General technical delivery require- ments for steel and steel products
13229 : 1991	Zinc for galvanizing

#### **3 TERMINOLOGY**

**3.1** For the purpose of this standard, the definition given in IS 1956 (Part 4) and the following shall apply.

**3.2 Black Sheet** — Hot rolled steel sheet prior to pickling operation.

**3.3 Cold Rolled Sheet or Coll**—Cold-rolled sheet or coil prior to continuous galvanizing process.

**3.4 Thickness of Sheet** — Thickness of hot-rolled or cold-rolled sheet in cut length or coil form.

# **4 SUPPLY OF MATERIAL**

The general requirements relating to the supply of galvanized sheets and strips shall conform to 1S 8910.

## **5 MANUFACTURE**

**5.1** The base metal of plain galvanized sheets and coils shall conform to IS 1079 or IS 513 as the case may be.

5.1.1 When it is not possible to test the base metal before galvanizing, the base metal may be tested after stripping off the zinc coating.

**5.1.2** For corrugated sheets, the maximum phosphorus content may be 0.09 percent.

**5.2** Galvanizing shall be carried out by first pickling the black sheets or by cleaning the cold-rolled coils in the line and then dipping them in a bath of molten zinc at a temperature suitable to produce a complete and uniformly adhesive zinc coating (*see* 1S 2629). The zinc ingots used for galvanizing shall conform to any of the grades specified in 1S 209 or 1S 13229.

#### **6 CLASSIFICATION**

Base metal of galvanized plain coils and sheets (spangled and zero spangled) as well as corrugated sheets are classified as per Table 1.

# Table 1 Classification of Grades of GP/GC Coils and Sheets

(Clause 6)

SI No.	Туре	Designation	Grade Reference of Base Metal IS 1079/IS 513
(1)	(2)	(3)	(4)
1)	Deep Drawing	GPD	Grade DD
ii)	Extra Deep Drawing	GPED	Grade EDD
iii)	Interstitial Free	GPIF	Grade IF
iv)	Corrugated Ordinary	GC	Gradě O

NOTE Spangles should not be allowed to form on the surface of strips/sheets during galvanizing.

#### **7 ZINC COATING**

Unless otherwise agreed to between the purchaser and the manufacturer, the zinc coating shall conform to the requirement of any one of the grades prescribed in Table 2.

7.1 The zinc coating shall conform to the requirement of any of the grades prescribed in Table 2. The mass of coating referred to in this standard shall represent the total mass of zinc, both sides inclusive.

7.2 Any other mass of coating, than those specified in Table 2, may be supplied, if agreed to between the purchaser and the manufacturer.

7.3 The following are recommended grades of zinc coating for the various thickness of sheets:

SI No.	Thickness	Grade of Zinc Coating
(1)	(2)	(3)
i)	0.18 to 0.28 (both inclusive	) 200
ii)	0.30 to 0.55 (both inclusive	) 220
iii)	0.63 to 1.0 (both inclusive)	275
iv)	above 1.0 mm	350

NOTES

1 The recommended thickness for roofing application is 0.63 mm and corresponding recommended grade of coating shall be minimum 275 g/m<sup>2</sup>.

2 If agreed to between the manufacturer and the purchaser for thickness 0.18 mm to 0.28 mm (both inclusive), other coating grades 180 and 120 may be used.

7.4 In addition X-ray fluorescence method (on line/off line) can also be used for the same.

### Table 2 Mass of Coating (Total Both Sides)

#### (Clauses 7 and 9.2)

SI No.	Grade of Coating	Minimum Average Coating Triple Spot Test g/m <sup>2</sup>	Minimum Coating Single Spot Test <sup>11</sup> g/m <sup>2</sup>
(1)	(2)	(3)	(4)
i)	600	600	510
11)	450	450	380
นึ่ง)	350	350	300
iv)	275	275	235
v)	220	220	190
vi)	200	200	170
vii)	180	180	155
viii)	120	120	100

#### 8 BEND TEST

#### 8.1 Test Samples

Bend test for the purpose of conformity shall be carried out at the rate of one set of 2 samples for every 1 000 plain sheets or part thereof. However, bend test shall not be applicable to GPH, GC and GCH grades of sheets intended for corrugation

8.1.1 One bend test shall be conducted for every coil.

**8.1.2** For bend test, the test piece shall be 230 mm long and 75 mm to 100 mm wide cut across the direction of rolling.

**8.1.3** Specimens for bend tests shall be free from burrs. Filling or machining to remove burrs is permitted. Cracks of the base metal developing at the edge of the specimen or coarse grain developing at the line of the bend shall be disregarded.

#### 8.2 Requirements

Samples of galvanized steel sheets selected as described in 8.1 shall withstand bending through 180° around a mandrel having diameter specified in Table 3 without peeling or flaking of zinc coating. Crack or fracture of base metal, except those indicated in 8.1.3, shall not be permitted.

#### **9 COATING TEST**

#### 9.1 Test Samples

One set of three samples each 50 mm<sup>2</sup> or 50 mm diameter, shall be selected at random from one sheet for every 1 000 galvanized sheets or part thereof. In the case of the galvanized sheets produced from black sheets, one set of three samples shall be taken, two from each extremities of a diagonal and one from the middle of the sheet. Whereas in the case of galvanized sheet produced from cold-rolled coils, one set of three samples shall be taken from the middle of the width of the sheet and one from each side of the sheet. The sample from extremities, diagonal or from the side of the sheet shall not be closer than 75 mm from the edge of the sheet.

9.1.1 In case of galvanized sheet supplied in coils, one set of 3 samples, each 50 mm<sup>2</sup> or 50 mm diameter shall be selected from one end of each coil across the width.

#### 9.2 Determination of Mass of Zinc Coating

The average masses of zinc coating of samples as selected under 9.1 and determined by the method given in IS 6745 or by any other established instrumental or chemical method shall conform to both the values specified in Table 2.

### **10 RETESTS**

10.1 If any test sample fails to meet test requirements

## Table 3 Mandrel Diameters for Bend Test

11	71		2
(C	. ши	se a	.41

All dimensions in millimetres.

SI No.	Grade of Coating	Diameter" of Mandrel for Thickness of Sheet										
		Over 3	Over 2.3 Up to 3	Over 1 6 Up to 2.3	Over 1.25 Up to 1.6	Over 1.0 Up to 1.25	Over 0.8 Up to 1.0	Over 0.5 Up to 0.8	Over 0.4 Up to 0.5	Over 0.3 Up to 0.4	Over 0.22 Up to 0.3	Over 0.16 Up to 0.22
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	600	4	6	8	8	9	10	1!	12	-	-	-
ii)	450	3	4	6	6	7.	8	8	8	9	10	11
iii)	350	3	4	4	4	5	6	6	7	8	8	9
iv)	275	3	4	4	4	5	6	6	6	7	7	8
v)	220	2	3	3	3	4	4	4	4	5	5	5
vi)	200	2	2	2	3	3	3	3	3	4	4	4
vii)	180	2	2	2	3	3	3	3	3	3	4	4
viii)	120	2	2	2	3	3	3	3	3	3	4.	4
<sup>ty</sup> Exp	pressed as nun	nber of tin	nes the thi	ckness of s	heet							

given in 8.2 and 9.2, two more set of test samples shall be taken for the specific test requirements from the same lot.

10.2 If any of the retest sample fails to meet the requirements of this standard, the entire batch of the sheets represented by the sample shall be deemed as not conforming to the standard.

#### **11 FREEDOM FROM DEFECTS**

11.1 Galvanized plain sheets, corrugated sheets and coils shall be reasonably flat and free from bare spots, holes, tears and other harmful defects.

11.2 Coils, however, may contain some abnormal imperfections which render a portion of the coil unusable since the imperfections in the coil cannot be removed as in the case with cut length.

#### 12 MASS

**12.1** Mass of sheets and coils shall be given in kg, of actual or calculated mass.

**12.2** The mass of sheets and coils shall be calculated as given in Table 4 on the basis of nominal dimensions and mass of zinc coating

# 13 DIMENSIONS AND TOLERANCES OF PLAIN SHEETS/COILS

### 13.1 Sizes of Plain Sheets

The plain sheets shall be supplied in any combination

of the following lengths, widths and thicknesses:

- a) Length 1 800, 2 200, 2 500, 2 800 and 3 000 mm
- b) Width 750, 900, 1 000 and 1 200 mm
- c) Thickness 0.18, 0.22, 0.25, 0.28, 0.32, 0.40, (uncoated 0.45, 0.50, 0.55, 0.63, 0.70, 0.80, sheets) 0.90, 1.00, and 1.60 mm

NOTE — Sheets for other sizes (length, width and thickness) may also be supplied subject to the mutual agreement between the purchaser and the manufacturer.

13.1.1 Unless otherwise agreed, the internal nominal diameter of sheet supplied in coil shall be 450, 510 or 610 mm.

#### 13.2 Tolerances

#### 13.2.1 Length

No sheet shall be smaller in length than that specified. Tolerances on length on plus side shall be 15 mm or 0.5 percent of length whichever is greater.

**13.2.2** The diagonal distance between opposite corners of any sheet shall not differ by more than 20 mm.

#### 13.2.3 Width

No plain sheet shall be smaller in width than that specified. The positive tolerances on width shall be 10 mm.

SI No.	Type of Material	Order of Calculation	Method of Calculation	Number of Numerals in Resultant Value
(1)	(2)	(3)	(4)	(5)
i)	Sheet	Mass of single sheet	Nominal mass of single sheet plus mass of zinc coating	Rounded off to 4 effective figures
		Total mass	Mass of single sheet (kg) × Number of sheets	Rounded off to integral value of kg
ii)	Coil	Unit mass of coil	Unit mass of sheet (kg/m²) × Width (mm) × 10 <sup>-1</sup>	Rounded off to 3 effective figures
		Mass of single coil	Unit mass of ooil (kg/m) × Length (m)	-
		Total mass (kg)	Total mass of each coil	Integral number of kg

# Table 4 Calculation of Mass of Sheets or Coils

(Clause 12.2)

NOTES

1 Nominal mass of single sheet shall be calculated by calculating the volume of the sheet and multiplying the same with density of sheet (density 7.85 g/cm<sup>3</sup>) and rounding the same to 4 effective figures.

2 Mass of the coating shall be calculated by multiplying the surface area of the single sheet with indicated nominal coating mass (g/m<sup>2</sup>) as shown for triple spot test (see Table 2)...

3 For calculation of corrugated sheet mass, the width before corrugation considered while calculating the area.

## 13.2.4 Thickness

The tolerance on thickness of sheet and coil shall be according to IS 1079 or IS 513 as applicable.

# 13.2.5 Tolerance on Mass

The tolerance on mass of individual sheets calculated in accordance with 12.2 shall be within.±10 percent and tolerance on mass of each bundle of sheet shall be ±5 percent.

### 14 DIMENSIONS AND TOLERANCES OF **CORRUGATED SHEETS**

#### 14.1 Sizes of Corrugated Sheets

# 14.1.1 Length

The length of the corrugated sheets shall be as follows:

1 800, 2 200, 2 500, 2 800, 3 000 and 3 050 mm.

NOTE --- Sheets of other lengths may also be supplied subject to the mutual agreement between the purchaser and the manufacturer.

14.1.2 Depth and Pitch of the Corrugations

The depth and pitch of corrugation shall be as follows (see Fig. 1):

Grade	Depth of	Pitch of	
	Corrugation	Corrugation	
	mm	mm	
Α	17.5	75	
В	12.5	75	

## 14.1.3 Number of Corrugations

The number of corrugations shall be 8, 10, 11 and 13

depending on the width of the sheet. The overall width of the corrugated sheets before and after corrugation shall be as shown in Table 5.

14.1.3.1 Sheets of sizes other than those specified above may be supplied, if agreed to between the contracting parties.

# **Table 5 Overall Widths and Corrugations** of Sheets

# (Clause 14.1.3)



SI Number of Grade Corrugation No

**Overall Width of Sheet** 

140.	COLLARMON				
			Before Corrugation mm	After Corrugation mm	
(1)	(2)	(3)	(4)	(5)	
i)	8	٨	750	660	
ii)	10	۸	900	810	
iii)	11	Α	1 000	910	
iv)	13	Α	1 200	1 1 1 0	
V)	8	В	750	680	
vi)	10	В	900	830	
vii)	11	В	1 000	930	
viii)	13	В	1 200	1 130	
_					



FIG. 1 DEPTH AND PITCH OF CORRUGATIONS

### 14.2 Tolerances

14.2.1 The tolerances on dimensions of corrugated sheet shall be as given in Table 6.

### **15 MARKING**

15.1 Manufacturer's name or trade-mark, grade of coating, length, width, thickness and number of corrugations, grade in case of corrugated sheets and material identification (grade, quality, etc) shall legibly be marked on top of each sheet or shown on a tag attached to each bundle.

**15.1.1** The material may also be marked with the Standard Mark.

**15.1.2** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

# Table 6 Tolerance on Dimension of Corrugated Sheets

SI No.	Dimensions	Tolerance <sup>1)</sup>
(1)	(2)	(3)
i)	Depth of corrugation	± 2.5 mm
ii)	Pitch of corrugation	+ 5 mm
iii)	Overall width after corrugation	± 25 mm

# ANNEX A

#### (Foreword)

#### **COMMITTEE COMPOSITION**

Wrought Steel Products Sectional Cominittee, MTD 4

#### Organization

The Tata Iron and Steel Co Ltd, Jamshedpur All India Induction Furnace Association of India, New Delhi Bharat Heavy Electicals Ltd, Bhopal/Haridwar

Central Boilers Board (DIPP), New Delhi

Consumer Protection Council, Rourkela Convetry Coil-O-Matic (Haryana) Ltd, Riwari

Development Commissioner (Iron & Steel), Kolkata Directorate General of Supplies & Disposals, New Delhi

Escorts R&D Centre, Faridabad EBG India (P) Ltd, Nasik

GKW1td, Mumbai Institute of Steel Development and Growth, Kolkata

Ispat Industries 1 td, Mumbai

Jindal Iron Steel Co Ltd, Vasind, Thane

Jindal Vijaynagar Steel Co Ltd, Vijaynagar

M. N. Dastur & Co Etd, Kolkata

Mahindra Ugine Steel Co I td. Raigad

Ministry of Defence (DGQA), Ishapore

Ministry of Defence (OFB), Kolkata Ministry of Railways, RDSO, Lucknow

Ministry of Steel, New Delhi-

Mukand Etd, Thane

National Metallurgical Laboratory, Jamshedpur

Rashtriya Ispat Nigam Ltd (VSP), Visakhapatnam SAIF, Bhitai Steel Plant, Bhilai

SAIL, Bokaro Steel Plant, Bokaro

SAIL, Central Marketing Organization, Kolkata

SAH., Durgapur Steel Plant, Durgapur SAH., Rourkela Steel Plant, Rourkela

SAIL, R&D Centre for Iron & Steel, Ranchi

SAIL, Salem Steel Plant, Salem

Steel/Furnace Association of India, New Delhi Steel Re-rothing Mills Association, Mandi Gobind Garh/ Delhi

#### Representative(s)

DR T MUKHERJEE (Chairman) SHRI R. P. VARSHNEY SHRI R. K. SETH SHRI K. K. GUPTA (Alternate) SHRI V K GOEL SHRI M. L. AHUIA (Alternate) SHRI B. VAIDYNATHAN SHRI R. D. B. SINGH SHRI DEVINDER KUMAR (Alternate) SHRI B. D. GHOSH SHRES. K. GANGULY SHRI B. S. RANA (Alternate) SHRI ALOK NAYAR SHRER PRABHAKAR SHRI KAPIL KAPOOR (Alternate) SHRI B. R. BAPAT DR S. R. MEDIRATTA SHRI JAYANATA KUMAR SAHA (Alternate) SHRI ARVIND J. BHIDE SHRI P. U. C. AYYER (Alternate) SHRI M. K. MAHESHWARI SHRI A. K. MISHRA (Alternate) DR.S. K. GUPTA SHRI S. K. HEGDE (Alternate) SHRI BHASKAR ROY SHRI SUBHABRATA SENGUPTA (Alternate) DR S. B. SARKAR SHRI K. G. N. MOHAN (Alternate) JOINT CONTROLLER (CQA MET) SQAE (METALS) (Alternate) REPRESENTATIVE JOINT DIRECTOR (CHEMICAL) JOINT DIRECTOR (1&L) (Alternate 1) DEPUTY DIRECTOR (MET-3) (Alternate II) SHRES S SAHA SHRIACR DAS (Alternate) SHRI C. H. SHARMA SHRI K. R. SRINIVASAN (Alternate) DR S. TARAFDAR SHRI R. GOPAI KRISHAN (Alternate) SHREG TIWARE SHRED, B. SRIVASTAVA SHRI S. K. KOTBAGHI (Alternate) SHREA'S. MATHUR SHRI, G. B. PRADHAN (Alternate) SHREA, K. CHAUDHURE SHRIB. V. S. PANDIT (Alternate) REPRESENTATIVE DR SANAK MISHRA SHRI M. PRASAD (Alternate) SURI SUDHAKAR JHA DR B K PANIGRAHI (Alternate) SHRES, SISODIA SHREH K. ARORA (Alternate) SIRI M. S. UNNINAVAR SHRER P. BHATTA

SURLH D KIURA (Alternate)

(Continued on page 7)

(Continued from page 6)

Organization Structural Engineering Research Centre, Madras

Sunflag Iron and Steel Co Ltd, Faridabad/Bhandara

Tata Motors, Jamshedpur/Pune

The Tata Iron and Steel Co Ltd, Jamshedpur

TOR Steel Research Foundation of India, Kolkata

Usha Beltron Ltd, Kolkata

In personal Capacity (402, Udaigiri, Kaushambi, Distr Ghaziabad, UP) BIS Directorate General Representative(s) SHRI ARUL JAYACHANDRAN SHRI S. J. MOHAN (*Alternate*) SHRI R. K. MALHOTRA SHRI R. K. VERMA (*Alternate*) SHRI J. D. HARIDAS SHRI B. R. GALGALI (*Alternate*) DR. M. D. MAHESHWARI SHRI M. C. SADHU (*Alternate*) SHRI S. K. SENGUPTA DR. P. C. CHOWDHURY (*Alternate*) DR S. CHAKRABORTY SHRI S. N. GUHA (*Alternate*) SHRI N. MITRA

SHRI JAGMOHAN SINGH, Director & Head (MTD) [Representing Director General (*Ex-officio*)]

Member Secretary SHREDEEPAK JAIN Joint Director (MTD), BIS

### Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

# Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

## **Review of Indian Standards**

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc : No. MTD 4 (4374).

## Amendments Issued Since Publication

A	mendment No.	Date of Issue	Text Affected
and and the state of the state of the			
		BUREAU OF INDIAN STANDARDS	
Headqua	rters:		
Manak Bh Telephone	avan, 9 Bahadur Shah 2 s: 2323 0131, 2323 337	Zafar Marg, New Delhi 110 002 5, 2323 9402 <i>Website</i> : www.bis.org.in	
Regional	Offices:		Telephones
Central :	Manak Bhavan, 9 Baha NEW DELHI 110 002	ndur Shah Zafar Marg	<pre>{ 2323 7617 2323 3841</pre>
Eastern :	1/14, C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700 054		{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern :	SCO 335-336, Sector 3	260 3843     260 9285	
Southern :	C.I.T. Campus, IV Cro	ss Road, CHENNAI 600 113	<pre>{ 2254 1216, 2254 1442 2254 2519, 2254 2315</pre>
Western :	rn : Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093		<pre>{ 2832 9295, 2832 7858     2832 7891, 2832 7892</pre>
Branches	: AHMEDABAD. BAN	IGALORE. BHOPAL. BHUBANESHWAR. CO	DIMBATORE. FARIDABAD.

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.