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मानक

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IS 513 (2008): Cold reduced low carbon steel sheets and strips [MTD 4: Wrought Steel Products]



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भारतीय मानक
अतप्त लघुकृत अल्प कार्बन इस्पात की चादर एवं पत्ती
(पाचँवा पुनरीक्षण)

Indian Standard
**COLD REDUCED LOW CARBON STEEL
SHEET AND STRIP**
(*Fifth Revision*)

ICS 77.140.50

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

April 2008

Price Group 5

AMENDMENT NO. 1 JULY 2010
TO
IS 513 : 2008 COLD REDUCED LOW CARBON STEEL SHEET AND STRIP
(Fifth Revision)

(Page 1, clause 3) — Insert 'CR0', before 'CR1'.

(Page 1, clause 4.3) — Substitute the following for the existing first para:

'Sheets and strips of CR2, CR3, CR4 and CR5 grade shall be supplied in annealed and skin passed condition. Grade CR0 shall be supplied in hard condition. Sheets and strips of CR1 grade may be supplied in any of the following condition:'

(Page 2, clause 5.2) — Substitute the following for the existing:

'CR0 and CR1 grade sheets and strips may be supplied rimmed, semi-killed, killed or as agreed between the purchaser and the manufacturer. However, other grades shall be supplied only in fully killed condition. CR4 and CR5 grade sheets and strips shall be supplied only in fully aluminium killed condition.'

(Page 2, Table 1) — Substitute the following for the existing:

Table 1 Chemical Composition
(Clauses 6.1 and 6.2)

SI No.	Quality		Constituent, Percent, Max			
	Designation	Name	Carbon	Manganese	Sulphur	Phosphorus
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	CR0	Hard	0.25	1.7	0.045	0.050
ii)	CR1	Commercial	0.15	0.60	0.040	0.050
iii)	CR2	Drawing	0.12	0.50	0.035	0.040
iv)	CR3	Deep Drawing	0.10	0.45	0.030	0.025
v)	CR4	Extra Deep Drawing Aluminium Killed (Non-ageing)	0.08	0.40	0.030	0.020
vi)	CR5	Extra Deep Drawing (Stabilized Interstitial Free)	0.06	0.25	0.020	0.020

NOTES

1 Restricted chemistry may be mutually agreed between the purchaser and the supplier.

2 When the steel is killed by aluminium alone the total aluminium content shall be 0.020 - 0.070 percent. When steel is silicon killed, the silicon content shall not be less than 0.1 percent. When the steel is aluminium-silicon killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.

3 The nitrogen content of the steel shall not be more than 0.007 percent. However for CR0 and CR1, the nitrogen content shall not exceed 0.012 percent. This shall be ensured by the manufacturer by occasional check analysis.

4 The material may be supplied in the copper bearing quality in which case the copper shall be between 0.20 and 0.35 percent on ladle analysis. In case of product analysis, the copper content shall be permissible in between 0.17 and 0.38 percent.

5 The steel can be made with micro-alloying elements like niobium, vanadium, titanium and boron either individually or in combination, on mutual agreement in which case the total micro-alloying elements shall not exceed 0.2 percent in ladle analysis. However, in case of boron, the limit shall be 0.006 percent.

(Page 5, Table 3) — Substitute the following for the existing:

Table 3 Mechanical Properties at Room Temperature in as Delivered Condition
(Clauses 7.1.2, 7.1.5, 7.3, 7.5.2 and 7.6.2)

Sl No.	Quality		Yield Stress R_e MPa	Tensile Strength R_m MPa	Elongation Percent, A, Min		Hardness Max		Bar, r Min	Bar, n Min
	Designation	Grade			$Lo = 80 \text{ mm}$	$Lo = 50 \text{ mm}$	HRB	HR(30T)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	CR0	H	—	—	—	—	See Table 5		—	—
ii)	CR1	O	—	—	—	—	See Table 5		—	—
		340	260 <i>Min</i>	340 <i>Min</i>	26	29	—		—	—
		390	300 <i>Min</i>	390 <i>Min</i>	23	26	—		—	—
		440	350 <i>Min</i>	440 <i>Min</i>	20	23	—		—	—
iii)	CR2	D	240 <i>Max</i>	370 <i>Max</i>	30	31	65	60	—	—
iv)	CR3	DD	220 <i>Max</i>	350 <i>Max</i>	34	35	57	55	—	—
v)	CR4	EDD	210 <i>Max</i>	350 <i>Max</i>	36	37	50	50	—	—
vi)	CR5	IF	190 <i>Max</i>	350 <i>Max</i>	38	40	—	—	1.7	0.22
		IF340	125-225	340 <i>Min</i>	30	34	—	—	1.4	0.21
		IF390	165-245	390 <i>Min</i>	27	31	—	—	1.3	0.2
		IF440	185-295	440 <i>Min</i>	24	28	—	—	1.2	0.19
		BH270	225-345	270 <i>Min</i>	31	35	—	—	1.4	0.21
		BH320	150-200	320 <i>Min</i>	28	32	—	—	1.3	0.2
		BH370	180-250	370 <i>Min</i>	25	29	—	—	1.2	0.19

NOTES

1 1 MPa = 1 N/mm² = 1 MN/m² = 0.102 0 kgf/mm².

2 For materials up to and including 0.6 mm in thickness, the elongation values in the table shall be reduced by 1.

3 Equivalent Vickers hardness values are allowed on agreement between the interested parties at the time of ordering. The hardness of sheet thinner than 0.6 mm shall be measured exclusively in compliance with the HR 30T scale.

4 Mechanical properties are not generally done on Commercial Quality Products and the values in this table are for information only.

5 For CR4 Grade, Bar r can be given based on mutual agreement between the purchaser and the supplier.

(Page 6, Table 5, Title) — Insert 'CR0 and' before 'CR1'.

(Page 6, Table 6, Row 1) — Delete.

(Page 7, Table 7, Title) — Insert 'CR0 and' before 'CR1'.

FOREWORD

This Indian Standard (Fifth 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 1954 and revised in 1963, 1973, 1986 and 1994. While reviewing this standard, in the light of experience gained during these years, the Committee decided to revise it to bring in line with the present manufacturing and trade practices being followed in the country in this field.

In the present revision, the following modifications have been made:

- a) ISO designations have been adopted,
- b) Table 1 and Table 3 have been modified,
- c) New grade CR5 Extra Deep Drawing (stabilized interstitial free) has been added,
- d) Correlation of old designations with new designations has been given for information (*see Annex A*),
- e) A new clause on references has been incorporated,
- f) Amendments No. 1 and 2 have been incorporated,
- g) IS 8910 : 1978 has been adopted for general technical delivery requirements,
- h) Clause on retest has been modified,
- j) Values for plastic anisotropy (r) and strain hardening exponent (n) have been incorporated,
- k) Applicable period for mechanical and physical properties has been included,
- m) Requirements of dimensional and shape tolerances have been separated from the standard and adopted IS/ISO 16162 : 2005 'Continuously cold-rolled steel sheet products — Dimensional and shape tolerances', and
- n) A clause for alternate test method specified in relevant ISO/IEC Standard has been added.

Assistance has been derived from the following:

ISO 3574 : 1999	Cold-reduced carbon steel sheet of commercial and drawing qualities
BS EN 10130 : 1991	Cold rolled low carbon steel flat products for cold forming: Technical delivery conditions

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

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 '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.

Indian Standard

COLD REDUCED LOW CARBON STEEL SHEET AND STRIP

(Fifth Revision)

1 SCOPE

This standard covers the requirements of cold reduced low carbon steel sheets and strips for bending and drawing purpose and where the surface is of prime importance. It covers sheets and strips up to 4.50 mm thick, both in coil form and cut lengths.

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
228 (Relevant Parts)	Method for chemical analysis of steel
1501 : 2000/ ISO 6507-1 : 1997	Method for Vickers hardness test for metallic material (<i>third revision</i>)
1586 : 2000	Method for Rockwell hardness test for metallic material (Scales A-B-C-D-E-F-G-H-K) (<i>third revision</i>)
1599 : 1985	Method for bend test (<i>second revision</i>)
1608 : 2005/ ISO 6892 : 1998	Metallic materials — Tensile testing at ambient temperature (<i>third revision</i>)
8910 : 1978	General technical delivery requirements for steel and steel products
10175 (Part 1) : 1993	Mechanical testing of metals — Modified Erichson cupping test — Sheet and strip: Part 1 Thickness up to 2 mm (<i>first revision</i>)
11999 : 1987	Method for determination of plastic strain ratio 'r' for steel sheets
15756 : 2007/ ISO 10275 : 1993	Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent
IS/ISO 16162 : 2005	Continuously cold-rolled steel sheet products — Dimensional and shape tolerances

3 CLASSIFICATION OF GRADES

Sheets and strips shall be classified in the CR1, CR2, CR3, CR4 and CR5 grades/designations.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of cold rolled low carbon steel sheets and strips shall conform to IS 8910.

4.2 Sheets and strips may be supplied either with mill or trimmed edges.

4.3 Sheets and strips of CR1 grade may be supplied in any of following tempers. Sheets and strips of CR2, CR3, CR4 and CR5 grade shall be supplied in annealed and skin-passed condition:

Temper Designation	Temper	Processing
H	Hard	Produced by heavy cold rolling
1/2H	Half Hard	Produced by cold rolling followed by annealing and further cold rolling to give strip of intermediate hardness
1/4H	Quarter Hard	do
SP	Skin Passed	Produced by light cold rolling after annealing
A	Annealed	Produced by a final annealing process

For specific applications, sheets and strips may also be supplied in any other temper subject to agreement between the supplier and the purchaser.

4.4 Non-ageing Characteristics

4.4.1 The manufacturer shall guarantee the absence of stretcher strains on being cold worked in the case of non-ageing quality with a non-ageing guarantee for six months from the date of dispatch.

4.4.2 CR4 and CR5 grade sheets and strips shall be supplied only in non-ageing quality with a non-ageing guarantee for six months from the date of dispatch.

IS 513 : 2008

4.4.3 A stability test as per Annex B may be carried out to assess the non-ageing characteristics of skin passed stabilized steels with mutual agreement between the manufacturer and the purchaser.

4.4.3.1 The steel shall be considered stabilized if the percentage increase in load does not exceed 6 when tested as per Annex B.

5 MANUFACTURE

5.1 The method of manufacture of the steel for sheets and strips shall be left at the discretion of the manufacturer.

5.2 Sheets and strips shall be supplied rimmed, semi-killed or killed as agreed between the purchaser and the manufacturer. However, CR4 and CR5 grades shall be supplied only in fully aluminium killed or in a fully stabilized condition.

6 CHEMICAL COMPOSITION

6.1 Ladle Analysis

The ladle analysis of steel, when carried out either by

the methods specified in relevant parts of IS 228 or any other established instrumental/chemical method, shall be as given in Table 1. In case of any dispute, the procedure given in relevant parts of IS 228 shall be the referee method.

6.1.1 Alternatively, the method specified in relevant ISO/IEC standard may be used.

6.2 Product Analysis

Permissible variation in the case of product analysis from the limits specified in Table 1 shall be as given in Table 2.

7 MECHANICAL AND PHYSICAL PROPERTIES

7.1 Tensile Test

7.1.1 Tensile test shall be carried out only, if specified by the purchaser.

7.1.2 When specified, the tensile test shall be carried out in accordance with IS 1608 as applicable, and the values of tensile strength, yield stress and percentage

Table 1 Chemical Composition
(Clauses 6.1 and 6.2)

Sl No.	Quality		Constituent, Percent, Max				
	Designation	Name	Carbon	Manganese	Sulphur	Phosphorus	Titanium
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	CR1	Commercial	0.15	0.60	0.035	0.050	—
ii)	CR2	Drawing	0.12	0.50	0.035	0.040	—
iii)	CR3	Deep Drawing	0.10	0.45	0.030	0.025	—
iv)	CR4	Extra Deep Drawing Aluminium Killed (Non-ageing)	0.08	0.40	0.030	0.020	—
v)	CR5	Extra Deep Drawing (Stabilized Interstitial Free)	0.06	0.25	0.020	0.020	0.15

NOTES

- 1 Restricted chemistry for CR4 and CR5 grade may be mutually agreed between the purchaser and the supplier.
- 2 When the steel is killed by aluminium alone the total aluminium content should be 0.020-0.070 percent. When steel is silicon killed, the silicon content shall not be less than 0.1 percent. When the steel is aluminium-silicon killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.
- 3 The nitrogen content of the steel shall not be more than 0.007 percent. However for CR1, the nitrogen content shall not exceed 0.012 percent. This shall be ensured by the manufacturer by occasional check analysis.
- 4 The material may be supplied in the copper bearing quality in which case the copper shall be between 0.20 and 0.35 percent on ladle analysis. In case of product analysis, the copper content shall be permissible in between 0.17 and 0.38 percent.
- 5 The steel can be made with micro-alloying elements like niobium, vanadium, titanium and boron either individually or in combination, on mutual agreement in which case the total micro-alloying elements should not exceed 0.2 percent in ladle analysis. However, in case of boron, the limit shall be 0.006 percent.
- 6 The titanium may be replaced totally or partially by niobium or vanadium and may be completely stabilized.

Table 2 Permissible Variation for Product Analysis
(Clause 6.2)

Sl No.	Constituent	Variation Over Specified Limit Percent, Max
(1)	(2)	(3)
i)	Carbon	0.02
ii)	Manganese	0.03
iii)	Sulphur	0.005
iv)	Phosphorus	0.005

NOTE — Product analysis shall not be applicable to rimming steel.

elongation shall conform to the requirements specified in Table 3.

7.1.3 Tensile test values apply to transverse specimen in case of sheet/strips. Strips having a width of 250 mm and below shall be tested longitudinally.

7.1.4 The yield strength values apply to the 0.2 percent proof stress, if the yield strength is not clearly distinctive, otherwise the values apply to lower yield strength.

7.1.5 The values specified in Table 3 are applicable for the period indicated in Table 4 from the time that the steel is available for shipment.

7.2 Cupping Test

7.2.1 Cupping test shall be applicable only for sheets, strips and coils of CR2, CR3 and CR4 grades having thickness from 0.5 mm up to 2.00 mm.

7.2.2 Cupping test shall be carried out in accordance with IS 10175 (Part 1), and the minimum Erichson cupping test values shall be as given in Fig. 1.

NOTE — The shape of the cup fracture may be as mutually agreed between the purchaser and the supplier.

7.3 Hardness Test

Cold rolled sheets and strips shall conform to the hardness requirements specified in Table 3 and Table 5, when tested in accordance with IS 1586 and IS 1501 as applicable. However, by way of departure from these standards, a visible deformation on the back side of the specimen is permitted. The values determined in this way shall be identified by using symbols HRBm and HR30Tm, so as to differentiate these from the hardness values determined on thicker products (which are not allowed to exhibit a visible deformation on the back side of the specimen).

7.4 Bend Test

7.4.1 Bend test shall be carried out in accordance with IS 1599.

7.4.2 The angle of bend and the internal diameter of the bend for the different grades of material shall be as given in Tables 6 and 7. The axis of the bend shall be in the direction of rolling. The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks.

7.5 Plastic Strain Ratio, r

7.5.1 The plastic strain ratio is an index of drawability (r), shall be applicable only to thicknesses between 0.5 to 2.0 mm. For thicknesses more than 2.0 mm, the r value is reduced by 0.2.

7.5.2 The plastic strain ratio shall be checked in accordance with IS 11999, and the minimum r value shall be as given in Table 3.

7.6 Tensile Strain Hardening Component, n

7.6.1 The tensile strain hardening component is an index of the stretchability (n), shall be applicable only to thicknesses between 0.5 mm and 2.0 mm. For thicknesses more than 2.0 mm the n value is reduced by 0.02.

7.6.2 The tensile strain hardening component shall be checked in accordance with IS 15756 and the minimum n value shall be as given in Table 3.

7.7 Retest

If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard, otherwise, the lot shall be rejected.

8 SURFACE FINISH

8.1 Cold-Reduced Steel Sheet

This product is normally supplied skin passed (see 8.2) but may be supplied annealed last (that is without a skin pass), if specified by the purchaser on his order.

8.2 Skin Pass

The purpose of skin passing is one or more of the following:

- To temporarily minimize the appearance of coil breaks, stretcher strains (Luders lines) or fluting during fabrication of finished parts,
- To obtain the required surface finish suitable for ordinary decorative painting, and
- To control the shape.

Some increase in hardness and some loss in ductility will result from skin passing.

8.3 Strain Ageing

Cold reduced sheet in qualities CR1, CR2 and CR3

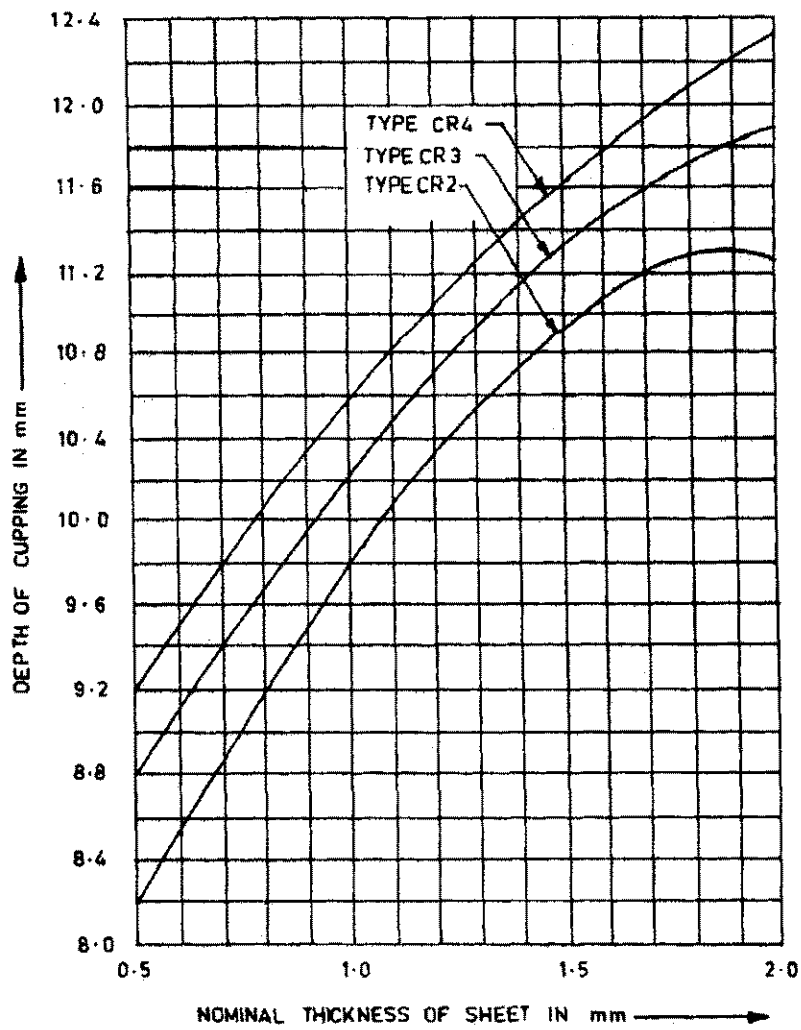


FIG. 1 MINIMUM ERICHSON VALUES

Table 3 Mechanical Properties at Room Temperature in as Delivered Condition for Annealed/Skin Passed Sheets and Strips (Cut Lengths and Coils)

(Clauses 7.1.2, 7.1.5, 7.3, 7.5.2 and 7.6.2)

Sl No.	Quality		Yield Stress	Tensile Strength	Elongation Percent		Hardness		r-Bar	n-Bar
	Designation	Name	R_e MPa	R_m MPa	A Min		Max		Min	Min
			Max		$L_0 = 80 \text{ mm}$	$L_0 = 50 \text{ mm}$	HRB	HR (30T)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	CR1	Commercial	280	410	27	28	See Table 4		—	—
ii)	CR2	Drawing	240	370	30	31	65	60	—	—
iii)	CR3	Deep Drawing	220	350	34	35	57	55	—	—
iv)	CR4	Extra Deep Drawing Aluminium Killed (Non-ageing)	210	350	36	37	50	50	—	—
v)	CR5	Extra Deep Drawing (Stabilized Interstitial Free)	190	350	38	40	—	—	1.7	0.22

NOTES

1 1 MPa = 1 N/mm² = 1 MN/m² = 0.102 0 kgf/mm².

2 The minimum tensile strength for qualities CR2, CR3 and CR4 would normally be expected to be 270 MPa. All tensile strength values are determined to the nearest 10 MPa. For designing purposes, the lower limit for R_e may be assumed to be 140 MPa for grades CR1, CR2, CR3 and CR4 and 120 MPa for grade CR5.

3 For materials up to and including 0.6 mm in thickness, the elongation values in the table shall be reduced by 1.

4 Equivalent Vickers hardness values are allowed on agreement between the interested parties at the time of ordering. The hardness of sheet thinner than 0.6 mm shall be measured exclusively in compliance with the HR 30T scale.

5 Mechanical properties are not generally done on Commercial Quality Products and the values in this table are for information only.

6 For CR4 Grade r bar value can be given based on mutual agreement between the purchaser and the supplier.

supplied in the skin-passed condition tends to strain-age and this may lead to the following:

- Surface markings from stretcher strains (Luders lines) or fluting when the steel is formed, and
- Deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Stocking of such steels for extended periods of time should be avoided; for optimum performance the period should not exceed six weeks.

For skin-passed sheet in qualities CR1, CR2 and CR3 and with due regard to the foregoing precautions, reasonable freedom can be achieved by effective roller levelling immediately prior to fabrication at the purchaser's plant. Freedom from stretcher strain and fluting for a period of six months can be achieved by the supply of skin-passed non-ageing steels. Grades CR4 or CR5 shall be specified in such cases where

Luder's lines are not acceptable and where roller levelling is not possible.

8.4 Surface Condition

8.4.1 The condition of the surface of cold-reduced steel sheet of drawing qualities (CR2, CR3, CR4 and CR5) is not required to be same for unexposed parts as it is for exposed parts.

8.4.2 Surface condition of sheet for unexposed parts may contain pores, some slight pitting, small markings, scratches, other minor defects and a light discoloration. The surface of sheet for exposed parts shall be reasonably free of these conditions. Unless otherwise agreed, only one side is inspected.

8.5 Surface Finish

8.5.1 Cold-reduced steel sheet may be supplied in a smooth finish and matt finish, dull in appearance, which is suitable for ordinary decorative painting but is not recommended for electroplating. Surface

Table 4 Applicable Period for Values Specified in Table 3
(Clause 7.1.5)

Sl No.	Designation	Period
(1)	(2)	(3)
i)	CR2	8 days
ii)	CR3	8 days
iii)	CR4	6 months
iv)	CR5	6 months

Table 5 Hardness of Different Tempers at Room Temperature for CR1 Grade
(Clause 7.3)

Sl No.	Temper	Hardness HRB	
		Min	Max
(1)	(2)	(3)	(4)
i)	Hard (H)	85	—
ii)	Half Hard (1/2 H)	75	85
iii)	Quarter Hard (1/4 Hard)	60	75
iv)	Skin Passed (SP)	—	70
v)	Annealed (A) (Dead Soft)	—	68

NOTES

1 For tempers other than those mentioned in this table, the values shall be as agreed to between the contracting parties.

2 Equivalent Vickers hardness values are allowed on agreement between the interested parties at the time of ordering. The hardness of sheet thinner than 0.6 mm shall be measured exclusively in compliance with the HR30T scales.

Table 6 Bend Test for Sheets/Strips in Cut Lengths and Coils in Annealed and Skin Pass Condition
(Clause 7.4.2)

Sl No.	Steel Grade	Angle of Bend Degree	Internal Diameter of Bend
(1)	(2)	(3)	(4)
i)	CR1	180	<i>t</i>
ii)	CR2	180	Close
iii)	CR3	180	Close
iv)	CR4	180	Close
v)	CR5	180	Close

Where *t* is the thickness of test piece.

roughness value μ_{ra} may be given subject to mutual agreement between the supplier and the purchaser.

8.5.2 When cold-reduced steel sheet is deformed during fabrication, localized areas may roughen to some degree and such affected portions of the part may require hand finishing to prepare the surface for the intended application.

8.6 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals. The product may be ordered not oiled, if required, in which case, the supplier has limited responsibility, if oxidation occurs.

9 FREEDOM FROM DEFECTS

9.1 The finished sheets and strips shall be free from harmful defects, such as scale, rust, blisters, lamination, pitting, porosity, cracked or torn edges or any other defects which are harmful to the intended use.

9.2 The degree or amount of surface defects in a coil may be expected to be more than in cut lengths because of the impossibility of rejecting portions of a coil. This shall be taken into account by the purchaser in his assessment of the material. An excessive amount of defects may be a cause for rejection.

9.3 The sheets shall be reasonably flat and edges cleanly sheared and squared to the specified dimensions.

10 DIMENSIONS AND TOLERANCES

10.1 Unless otherwise agreed to between the manufacturer and the purchaser, standard dimensions of cold rolled sheets and strips shall be as given below:

Thickness, mm = 0.18, 0.20, 0.22, 0.25, 0.28, 0.30, 0.32, 0.35, 0.40, 0.45, 0.50, 0.55, 0.63, 0.70, 0.80, 0.90, 1.00, 1.20, 1.25, 1.40, 1.50, 1.60, 1.80, and 2.00.

The following are the preferred thicknesses for sheets above 2.00 mm:

2.50 mm, 2.65 mm, 3.00 mm, 3.25 mm, 3.50 mm, and 4.00 mm.

10.2 Unless otherwise specified, the dimensional and shape tolerances applicable to cold rolled sheets and strips shall be as given in IS/ISO 16162 : 2005.

11 SAMPLING FOR TESTS

11.1 One representative sample from a coil or a lot of sheets shall be taken for tensile testing. A lot consists of 50 tonnes or less of sheets or strips of the same quality

Table 7 Bend Test for Sheets/Strips of 'CR1' Grade

(Clause 7.4.2)

Sl No.	Steel Grade	Angle of Bend Degree	Internal Diameter of Bend
(1)	(2)	(3)	(4)
i)	Hard (H)	—	—
ii)	Half Hard (1/2 H)	180	3 <i>t</i>
iii)	Quarter Hard (1/4 Hard)	180	2 <i>t</i>
iv)	Skin Passed (SP)	180	<i>t</i>
v)	Annealed (A) (Dead Soft)	180	<i>t</i>

Where *t* is the thickness of test piece.

rolled to the same thickness and condition. If the lot consists of more than one heat, samples from each heat shall be tested.

11.2 For cupping, hardness and bend tests, one sample from each lot of 50 tonnes of the same heat or part thereof or one sample from each coil shall be taken.

11.2.1 The specimens shall not undergo any treatment on either surface before testing. In the case of coils, samples shall be taken from the beginning or end of the coil.

12 MARKING

12.1 The following shall be legibly marked on the top of each bundle of package of sheets or shown on a tag attached to each coil:

- Manufacturer's name or trade-mark,
- Quality designation,
- Product dimensions,
- Cast or identification mark by which the sheet or strip may be traced to cast or casts from which they were made,
- Mass/Net weight, and
- Date of dispatch.

12.2 BIS Certification Marking

The material may also be marked with the Standard Mark.

12.2.1 The use of the Standard Mark is governed by the provisions of *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 Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

12.3 Packing

12.3.1 Each sheet shall be treated on both sides with non-hardening type rust preventive oil, which can be easily washed with aqueous alkali solution.

12.3.2 Sheets and strips shall preferably be supplied in bundles or packages not weighing more than 3 tonnes or as agreed to between the purchaser and the manufacturer.

12.3.3 Sheets and strips shall be securely packed in waterproof material and covered all over with steel envelope and securely tied round with steel straps and preferably with wooden battens underneath to prevent the sheets from rusting and damage during transit.

ANNEX A*(Foreword)***CORRELATION OF OLD AND NEW GRADES/DESIGNATIONS**

<i>Old Designation</i>		<i>New Designation</i>	
Designation	Name	Designation	Name
O	Ordinary quality	CR1	Commercial
D	Drawn quality	CR2	Drawing
DD	Deep drawn quality	CR3	Deep drawing
EDD	Extra deep drawn quality	CR4	Extra deep drawing Aluminium killed (Non-ageing)
—	—	CR5 (New grade added)	Extra deep drawing (Stabilized interstitial free)

ANNEX B*(Clauses 4.4.3 and 4.4.3.1)***STABILITY TEST**

B-1 A tensile test piece shall be subjected to a total strain of 10 percent and the load (P_1) required to produce this strain shall be noted. The test piece shall then be subjected to an accelerated ageing treatment by heating at a nominal temperature of 100°C for 30 min. The test piece shall thereafter again be strained to 10 percent, calculated on the original (unstrained)

gauge length, and the load (P_2) noted.

The steel shall be considered stabilized, if the percentage increases in load = $\frac{P_2 - P_1}{P_1} \times 100$ does not exceed 6.

ANNEX C

(Foreword)

COMMITTEE COMPOSITION

Wrought Steel Products Sectional Committee, MTD 4

<i>Organization</i>	<i>Representative(s)</i>
Tata Steel Ltd, Jamshedpur	DR D. BHATTACHJEE (<i>Chairman</i>) SHRI INDRANIL CHAKRABORTY (<i>Alternate I</i>) DR A. N. BHAGAT (<i>Alternate II</i>)
All India Induction Furnace Association, New Delhi	SHRI R. P. VARSHNEY SHRI L. N. GOSWAMI (<i>Alternate</i>)
Central Boilers Board, New Delhi	SHRI V. K. GOEL
Central Public Works Department (CPWD), New Delhi	CHIEF ENGINEER (NDZ) V SUPERINTENDING ENGINEER (Central Store) (<i>Alternate</i>)
DGS&D, Bhilai Nagar/Delhi	REPRESENTATIVE SHRI B. S. RANA (<i>Alternate</i>)
Escorts Knowledge Management Centre, Faridabad	SHRI ALOK NAYAR
Institute of Steel Development & Growth, Kolkata	DR R. K. P. SINGH SHRI JAYANTA K. SAHA (<i>Alternate</i>)
JSW Steel Ltd, Vasind	SHRI M. K. MAHESHWARI
M. N. Dastur & Co Ltd, Kolkata /Delhi	SHRI SUBHABRATA SENGUPTA SHRI V. K. TYAGI (<i>Alternate</i>)
Ministry of Defence (DGOFB), Kolkata	SHRI TAPABRATA BASU SHRI S. BHATTACHARYA (<i>Alternate</i>)
Ministry of Defence [DQA (M&E)], Ichapur	ADDITIONAL DIRECTOR DEPUTY DIRECTOR (Met/PSCO) (<i>Alternate</i>)
Ministry of Railways (RDSO), Lucknow	DIRECTOR (M&C) ASSISTANT RESEARCH OFFICER (Met-II) (<i>Alternate</i>)
Ministry of Steel (Government of India), New Delhi	SHRI S. S. SAHA SHRI A. C. R. DAS (<i>Alternate</i>)
National Physical Laboratory, New Delhi	DR ANIL KUMAR GUPTA SHRI R. C. ANANDANI (<i>Alternate</i>)
Rashtriya Ispat Nigam Ltd (VSP), Visakhapatnam	SHRI R. RANJAN SHRI S. MANDAL (<i>Alternate I</i>) SHRI P. SRINIVAS (<i>Alternate II</i>)
SAIL, Bhilai Steel Plant, Bhilai	REPRESENTATIVE SHRI K. K. KUMAR (<i>Alternate I</i>) SHRI P. K. DATTA (<i>Alternate II</i>)
SAIL, Bokaro Steel Plant, Bokaro	SHRI G. B. PRADHAN DR M. M. S. SODHI (<i>Alternate</i>)
SAIL, Central Marketing Organization, Kolkata/Bangalore	SHRI P. C. JHA SHRI B. V. S. PANDIT (<i>Alternate</i>)
SAIL, Durgapur Steel Plant, Durgapur	REPRESENTATIVE
SAIL, Research & Development Center for Iron & Steel, Ranchi	DR S. K. CHAUDHURI DR B. K. PANIGRAHI (<i>Alternate</i>)
SAIL, Rourkela Steel Plant, Rourkela	REPRESENTATIVE
Steel Re-rolling Mills Association of India, Mandi Gobindgarh	REPRESENTATIVE SHRI H. D. KHERA (<i>Alternate</i>)
Tata Consulting Engineers, Jamshedpur	DR M. D. MAHESHWARI
Tata Motors Limited, Pune	SHRI J. D. HARIDAS SHRI B. R. GALGALI (<i>Alternate</i>)
In personal capacity [403, Udaigiri, Kaushambi, Dist Ghaziabad, U.P.]	SHRI N. MITRA
BIS Directorate General	DR (SHRIMATI) SNEH BHATLA, Scientist 'F' & Head (MTD) [Representing Director General (<i>Ex-officio</i>)]

Member Secretary

SHRI DEEPAK JAIN

Scientist 'E' (MTD), BIS

Flat Steel Products Subcommittee, MTD 4 : 3

<i>Organization</i>	<i>Representative(s)</i>
TCE Consulting Engineers, Jamshedpur	DR M. D. MAHESHWARI (<i>Convenor</i>)
Apex Chambers of Commerce, Ludhiana	SHRI P. D. SHARMA
Essar Steels Ltd, Dist Surat	SHRI R. K. BALASUBRAMANIAM
	SHRI S. R. BHATT (<i>Alternate</i>)
Federation of Engineering Industries of India, New Delhi	SHRI H. L. BHARDWAJ
	SHRI H. L. BANSAL (<i>Alternate</i>)
Indian Oil Corporation Limited, Noida	SHRI M. K. JHA
	SHRI T. BANDHOPADHYAY (<i>Alternate</i>)
Ispat Industries Limited, Dolvi	SHRI RAMBRIKSH SINGH
	SHRI RAJENDERA K. VERMA (<i>Alternate</i>)
Maruti Udyog Ltd, Gurgaon	SHRI SRIKANTH SUDHIR
	SHRI SUNIL MALHOTRA (<i>Alternate</i>)
SAIL, R&D Centre for Iron & Steel, Ranchi	DR D. MUKERJEE
Salem Steel Plant, Salem/New Delhi	SHRI S. S. SISODIA
	SHRI H. K. ARORA (<i>Alternate</i>)
Tata Steel Ltd, Jamshedpur	DR N. GOPE
	SHRI M. SHOME (<i>Alternate</i>)
The Tin Plate Company of India Ltd, Jamshedpur	SHRI T. K. GHOSH
	SHRI A. K. GHOSH (<i>Alternate</i>)
Thyssenkrupp Electrical Steel India Pvt Ltd, Nasik	SHRI L. BHASKAR
	SHRI J. SRINIVAS (<i>Alternate</i>)

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