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भारतीय मानक प्रारूप
विद्युत् अपघटनी ज़िंक - निकल मिश्रधातु लेपित इस्पात की चद्दर एवं पत्ती - विशिष्टि

Draft Indian Standard
ELECTROLYTIC ZINC-NICKEL ALLOY COATED STEEL SHEET AND STRIP — SPECIFICATION

ICS 77.140.50

Wrought Steel Products Sectional Committee, MTD 04	Last date of comments: **11 July 2025**

FOREWORD

(Formal clauses of the foreword will be added later.)

Zinc-Nickel electroplated steel sheets and strips are widely used in industries like automotive, aerospace, and electronics due to its high corrosion resistance and environmentally friendly alternative to cadmium plating. This standard has been formulated to cover the various technical requirements for the same.

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 : 2022 'Rules for rounding off numerical values (second revision). The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ELECTROLYTIC ZINC-NICKEL ALLOY COATED STEEL SHEET AND STRIP — SPECIFICATION

1 SCOPE

This standard covers the requirements of hot-rolled and cold-reduced carbon steel sheets and strips, electrolytically coated with Zinc-Nickel (Zn-Ni) alloy containing Nickel of 9 to 16 percent, by mass. The product can be coated on one or both the surfaces and with equal or differential coating masses on the two surfaces.

2 REFERENCES

The standards listed in Annex A 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 agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 1956 (Part 4), IS 3531, IS 3554, IS 513 (Part 1), IS 513 (Part 2), IS 1079, IS 5986 and the following shall apply.

3.1 Thickness of Sheet/Strip/Plate — The thickness of the Electrolytic Zinc-Nickel (hereafter Zinc-Nickel referred as Zn-Ni) alloy coated steel sheet and strip may be specified as a combination of the base metal and metallic coating, or as the base metal alone. The purchaser shall indicate in the order which method of specifying thickness is required. In the event that the purchaser does not indicate any preference, the thickness as a combination of a base metal and coating shall be provided.

3.2 Coating Mass — The amount of coating expressed in grams per unit surface area of sheet (g/m^2).

3.3 Product — Hot-rolled or cold-reduced carbon steel sheet, strip (hereafter referred to as steel sheet and strip) coated with Zn-Ni alloy by electrolytic process.

4 DIMENSIONS

4.1 Electrolytic Zinc-Nickel alloy coated steel sheet should be produced in thicknesses from 0.20 mm to 3.2 mm inclusive, after coating, and in widths of 600 mm and over in coils and cut lengths. Electrolytic Zinc-Nickel alloy coated steel coil and sheet less than 600 mm wide are slit from a wide coil and further cut into required lengths.

5 DESIGNATIONS

5.1 Base Metal Grade

Electrolytic Zn-Ni alloy coated steel sheets and strips covered in this standard shall be designated by the type of base metal used for coating. The grades, therefore, are classified as given in Table 1 for coated steels with cold-rolled substrate and Table 2 for coated steels with the hot-rolled substrate. The nomenclature of the base metal grade is as below:

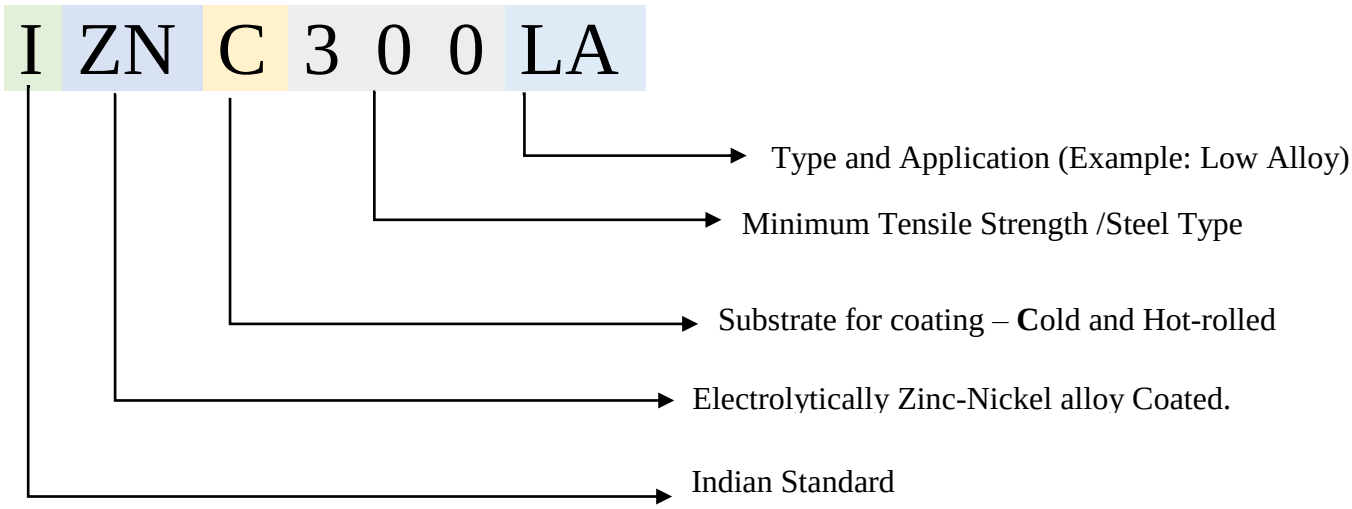


Table 1 Type and Designation (Cold-Rolled Substrate)
(*Clause* 5.1)

Sl No.	**Type and Designation** (For cold-rolled Substrate)		**Thickness,** mm
(1)	(2)	(3)	(4)
i)	Mild Steel	IZNCCR0	0.20-3.00
		IZNCCR1	0.20-3.00
		IZNCCR2	0.40-3.00
		IZNCCR3	0.40-3.00
		IZNCCR4	0.40-3.00
		IZNCCR5	0.40-3.00
ii)	Bake-hardening type steel	IZNC270B	0.40-2.30
		IZNC290B	0.40-2.30
		IZNC320B	0.40-2.30
		IZNC340B	0.40-2.30
		IZNC360B	0.40-2.30
		IZNC400B	0.40-2.30
		IZNC440B	0.40-2.30
iii)	Interstitial Free - High Strength	IZNC300P	0.40-2.30
		IZNC330P	0.40-2.30
		IZNC340P	0.40-2.30
		IZNC370P	0.40-2.30
		IZNC390P	0.40-2.30
		IZNC440P	0.40-2.30
iv)	C-Mn Steel (Solid Solution strengthening)	IZNC340W	0.40-3.00
		IZNC370W	0.40-3.00
		IZNC390W	0.40-3.00
		IZNC440W	0.40-3.00
v)	High Strength Low Alloy	IZNC310LA	0.40-3.00
		IZNC320LA	0.40-3.00
		IZNC340LA	0.40-3.00
		IZNC370LA	0.40-3.00
		IZNC410LA	0.40-3.00
		IZNC440LA	0.60-3.00
		IZNC470LA	0.60-3.00
		IZNC590LA	0.60-3.00
NOTE — Products of any other thickness not specified above can also be supplied upon mutual agreement between the manufacturer and the purchaser. Acceptance criteria for the range out of the available product range shall be as agreed upon between the purchaser and the manufacturer.			

Table 2 Type and Designation (Hot-Rolled Substrate)
(*Clause* 5.1)

Sl No.	**Type and Designation** (For Hot rolled Substrate)		**Thickness,** mm
(1)	(2)	(3)	(4)
i)	Mild Steel	IZNHHR1	1.60 -3.20
		IZNHHR2	1.60 -3.20
		IZNHHR3	1.60 -3.20
		IZNHHR4	1.60 -3.20
ii)	C-Mn Steel (Solid Solution strengthening)	IZNH310W	1.60 -3.20
		IZNH370W	1.60 -3.20
		IZNH400W	1.60 -3.20
		IZNH440W	1.60 -3.20
iii)	High Strength Low Alloy	IZNH490LA	1.60 -3.20
		IZNH540LA	1.60 -3.20
		IZNH590LA	1.60 -3.20
NOTE — Products of any other thickness not specified above can also be supplied upon mutual agreement between the manufacturer and the purchaser. Acceptance criteria for the range out of the available product range shall be as agreed upon between the purchaser and the manufacturer.			

5.2 Coating Class

The requirements of coating mass shall be as per Table 3. Coating class shall be designated as per Table 4**.**

Table 3 Coating Mass Requirement on each side
(*Clauses* 5.2 *and* 9.1)

Sl. No.	**Coating Mass Designation**	**Minimum Coating Mass Triple Spot Test,** g/m^2
(1)	(2)	(3)
i)	EZN000	00
ii)	EZN015	15
iii)	EZN017	17
iv)	EZN020	20
v)	EZN025	25
vi)	EZN030	30
vii)	EZN035	35
viii)	EZN040	40
ix)	EZN050	50
NOTES **1** Equivalent coating thickness of 1 µm corresponds to a coating mass of approximately $7.32 g/m^2$. **2** Other coating mass designations can be produced by agreement between the manufacturer and the purchaser. However, minimum coating of 15 gm/m^2 shall be maintained on the coated surfaces. **3** Single- spot test≅0.85×Triple-spot test.		

Table 4 Representation of Coating Mass
(*Clauses* 5.2 *and* 9.1)

Sl No.	Type	Description	Example
(1)	(2)	(3)	(4)
i)	Equally coated Surface (XX/XX)	Coating mass designation of top surface of sheet/outer surface of strip over coating mass designation of bottom surface of sheet/inner surface of strip	EZN020/ EZN020
ii)	Differentially Coated Surface	Coating mass designation of top surface of sheet/outer surface of strip over coating mass designation of bottom surface of sheet/inner surface of strip	EZN020/ EZN015
iii)	Single Side Coated Surface	Coating mass designation of top surface of sheet/outer surface of strip over no coating on the bottom surface of sheet/inner surface of strip or vice versa	EZN020/ EZN000
NOTE — The product shall be coated on at least one surface; therefore, the combination. EZN000/ EZN000 shall not be specified.			

5.3 Surface Finish

The surface finish designation and requirements shall be as per Table 5.

Table 5 Surface Finish Designation and Requirement
(*Clause* 5.3)

Sl No.	Class	Roughness (µm)
(1)	(2)	(3)
i)	Dull Finish (D)	As coated Finish
ii)	Restricted Finish (R)	$0.50 \leq Ra^1 \leq 1.20$
NOTES **1** Ra → Arithmetic average roughness. **2** Roughness check shall be carried out in accordance with the IS 18432 (Part 3) **3** Other Surface classes with required roughness (Ra) can be as per the agreement between the purchaser and the manufacturer.		

5.4 Surface Treatment

The surface treatment and oiling requirements shall be as per Table 6.

Table 6 Surface Treatment Designations
(*Clause* 5.4)

Sl No.	Symbol	Designation
(1)	(2)	(3)
i)	C	Mill Passivation
ii)	P	Mill Phosphating
iii)	O	Oiling
iv)	CO	Mill Passivation and Oiling
v)	S	Thin Organic Film (or Sealing)
vi)	U	Un-Treated
NOTE — Based on the mutual agreement between the purchaser and manufacturer, in addition to the above-mentioned treatment or stand-alone, other surface treatments can also be applied.		

6 SUPPLY OF MATERIAL

The general requirements relating to the supply of electrolytic Zn-Ni alloy coated steel sheets and strips shall conform to IS 8910.

7 MANUFACTURE

7.1 Processes used in steel making, rolling, and manufacturing process of electrolytic Zn-Ni alloy coated steel sheets and strips shall be left to the discretion of the manufacturer unless there is a restriction on the steel grades or as per mutual agreement between purchaser and manufacturer.

7.2 For the electrolytic coating process, hot-rolled or cold-rolled substrates shall be used. The substrate shall be free from defects that are harmful to the Zn-Ni coating. The hot-rolled strip shall be pickled first before the electrolytic coating process.

8 CHEMICAL COMPOSITION

8.1 Ladle Analysis

The ladle analysis of the base metal of steel sheet and strip shall be as per the requirements given in Table 7A and Table 7B for the cold-rolled substrate and the hot-rolled substrate respectively, when carried out either by the method specified in the relevant parts of IS 228 or any other national/international standard for instrumental/chemical method. In case of dispute, the procedure given in the relevant part of IS 228 shall be the referee method. One sample is to be tested for a ladle.

Table 7A Chemical Composition Requirements (For Cold Rolled Substrate)
(*Clause* 8.1)

Sl No.	Type and Designation (For Cold rolled Substrate)		Thickness mm	Constituents, Percent, *Max*			
				C	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild Steel	IZNCCR0	0.20-3.00	0.20	2.00	0.120	0.035
		IZNCCR1	0.20-3.00	0.18	1.20	0.120	0.035
		IZNCCR2	0.40-3.00	0.10	0.50	0.040	0.030
		IZNCCR3	0.40-3.00	0.08	0.45	0.030	0.030
		IZNCCR4	0.40-3.00	0.06	0.45	0.030	0.030
		IZNCCR5	0.40-3.00	0.02	0.25	0.030	0.020
ii)	Bake-hardening type steel	IZNC270B	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC290B	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC320B	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC340B	0.40-2.30	0.01	1.20	0.100	0.020
		IZNC360B	0.40-2.30	0.01	1.40	0.100	0.020
		IZNC400B	0.40-2.30	0.01	1.60	0.100	0.020
		IZNC440B	0.40-2.30	0.01	1.60	0.100	0.020
iii)	Interstitial Free - High Strength	IZNC300P	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC330P	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC340P	0.40-2.30	0.01	0.80	0.100	0.020
		IZNC370P	0.40-2.30	0.01	1.20	0.100	0.020
		IZNC390P	0.40-2.30	0.01	1.40	0.100	0.020
		IZNC440P	0.40-2.30	0.01	1.60	0.100	0.020
	C-Mn Steel (Solid Solution strengthening)	IZNC340W	0.40-3.00	0.12	0.90	0.030	0.030
		IZNC370W	0.40-3.00	0.15	1.30	0.030	0.030
		IZNC390W	0.40-3.00	0.20	1.50	0.030	0.030
		IZNC440W	0.40-3.00	0.20	1.70	0.030	0.030
iv)	High Strength Low Alloy	IZNC310LA	0.40-3.00	0.10	1.00	0.070	0.025
		IZNC320LA	0.40-3.00	0.10	1.00	0.070	0.025
		IZNC340LA	0.40-3.00	0.10	1.20	0.070	0.025
		IZNC370LA	0.40-3.00	0.12	1.40	0.070	0.025
		IZNC410LA	0.40-3.00	0.12	1.50	0.070	0.025
		IZNC440LA	0.60-3.00	0.12	1.60	0.070	0.025
		IZNC470LA	0.60-3.00	0.14	1.60	0.070	0.025
		IZNC590LA	0.60-3.00	0.16	2.50	0.070	0.025

NOTES

1 The above specified steel grades can be supplied with the addition of micro-alloying elements like Boron, Titanium, Niobium and Vanadium. These elements when added either individually or in combination shall not exceed 0.2%. However, Boron content shall not exceed 0.006 percent.

2 The nitrogen content of the steel shall not exceed 0.009 percent for Si killed. For Al killed or aluminium-silicon killed, the nitrogen content shall not exceed 0.012 percent. This shall be ensured by occasional checking.

3 Other elements like Cr, Mo, Ni, which are not specified in the above table shall not exceed 1.00 percent when added either individually or in combination.

4 Restricted chemical compositions may be mutually agreed upon between the purchaser and the manufacturer.

5 Unless otherwise agreed upon**,** when the steel is Al killed, the total Al content shall not be less than 0.02 percent.

Table 7B Chemical Composition Requirements (For Hot Rolled Substrate)
(*Clause* 8.1)

Sl No.	Type and Designation (For Hot rolled Substrate)		Constituents, Percent, *Max*				
			C	Mn	P	S	Micro Alloy
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild Steel	IZNHHR1	0.15	0.60	0.050	0.035	-
		IZNHHR2	0.10	0.45	0.040	0.035	-
		IZNHHR3	0.08	0.40	0.035	0.030	-
		IZNHHR4	0.08	0.35	0.030	0.030	-
ii)	C-Mn Steel (Solid Solution strengthening)	IZNH310W	0.15	0.80	0.040	0.030	0.150
		IZNH370W	0.17	1.20	0.040	0.030	0.150
		IZNH400W	0.20	1.30	0.040	0.030	0.150
		IZNH440W	0.24	1.50	0.040	0.030	0.150
iii)	High Strength Low Alloy	IZNH490LA	0.20	1.60	0.030	0.020	0.250
		IZNH540LA	0.20	1.70	0.030	0.020	0.250
		IZNH590LA	0.20	1.80	0.030	0.020	0.250

NOTES

1 The above specified steel grades can be supplied with the addition of micro-alloying elements like Boron, Titanium, Niobium and Vanadium. These elements, whether added individually or in combination, must not exceed the values specified in the table or 0.2% in cases where no specific value is provided. However, Boron content shall not exceed 0.006 percent.
2 The nitrogen content of the steel shall not exceed 0.009 percent for Si Killed. For Al killed or aluminium-silicon killed, the nitrogen content shall not exceed 0.012 percent. This shall be ensured by occasional checking.
3 Other elements like Cr, Mo, Ni, which are not specified in the above table shall not exceed 1.00 percent when added either individually or in combination.
4 Restricted chemical compositions may be mutually agreed upon between the purchaser and the manufacturer
5 Unless otherwise agreed upon**,** when the steel is Al killed, the total Al content shall not be less than 0.02 percent.

8.2 Product Analysis

Permissible variation in the case of product analysis, after stripping of coating, from the limits specified in Table 7A, Table 7B shall be as given in Table 8.

Table 8 Tolerances on Product Requirements (For Cold-Rolled and Hot-Rolled Substrate)
(*Clause* 8.2)

Sl No.	Element	Specified Chemical Composition Limit, Percent, *Max*	Variation Over specified Limit, Percent, *Max*
(1)	(2)	(3)	(4)
i)	Carbon	≤0.150	0.02
		> 0.150	0.03
ii)	Manganese	≤0.6	0.03
		>0.60 to ≤1.150	0.04
		≥1.150	0.05
iii)	Sulphur	≤ 0.050	0.005
iv)	Phosphorus	≤0.050	0.005
		> 0.050	0.01
v)	Silicon	≤0.600	0.03
		> 0.600	0.06
vi)	Micro Alloying elements	—	As agreed

9 COATING PROPERTIES

9.1 Coating Mass

The coating mass expressed in grams per square meter given for one side shall conform to the requirements specified in Table 3. The maximum coating mass may be agreed upon between the purchaser and the manufacturer. Differentially coated products can be mutually agreed upon between the purchaser and manufacturer.

9.2 Sampling

One sample is to be drawn from each mother coil or a lot of 50T or less processed under the identical conditions of a single ladle, hot and cold rolling conditions, thickness, width, coating and process conditions at an electrolytic coating line.

9.3 Coating Mass Test

9.3.1 The coating mass of the product should be tested by taking a sample piece from each mother coil approximately 300 mm in length from each coil, and cutting three test specimens, one from the mid-width position and one from each side, not closer than 50 mm to the side edge. The minimum area of the each of three specimens should be 1200 mm^2.

9.3.2 The coating mass is the triple-spot test result which shall be the average coating mass found on the three specimens taken in accordance with **9.3.1**. However, the minimum of three coating values should comply with the single-spot test requirements of the coating designation. For narrow strips, which have been slit from a wide coil, only a single-spot test is applicable and should comply with the minimum requirement of the coating designation.

9.3.3 The coating mass shall be determined by the X-ray fluorescence method (*see* IS 12860) or by weight loss (Gravimetric) method (*see* **B-1**) by employing any suitable method for masking the second surface as agreed upon between the manufacturer and the purchaser. In the case of differential coating, the coating mass of the product is to be tested by the X-ray fluorescence method only.

9.3.4 If required by the purchaser, the thickness of the coating can be calculated from the coating weight (mass) by using the following relationships:

a) 1.00 g/m^2 coating mass = 0.137 micrometer coating thickness; and
b) 1.00 micrometer coating thickness = 7.32 g/m^2 coating mass.

9.4 Coating Composition

Coating composition shall be Zn-Ni alloy containing Ni mass fraction of 9% to 16 % and remaining zinc. Reference method to determine the Zn-Ni coating mass and the Zn-Ni coating composition is given in Annex B.

9.5 Coating Adhesion

9.5.1 The coating shall be free from peeling, extensive powdering, chipping, flaking or any other damages during normal handling and storage conditions.

9.5.2 If mutually agreed upon, coating adherence may be tested by heating the test pieces at (220 ± 10)°C for 30 min and then immediately quenched in water at 15°C to 25°C. There shall be no peeling or blistering.

9.5.3 Coating adhesion may also be tested as per other suitable test methods such as burnishing test, bend test specified in ISO 2819.

9.6 Chipping at Low Temperature

Criteria for chipping at low temperature shall be subject to agreement between the purchaser and the manufacturer.

9.7 Corrosion resistance for coating

If required by the purchaser, the corrosion resistance of the coating may be tested by Neutral Salt Spray test (NSS) as per IS 5528. The acceptance criteria shall be agreed upon between the purchaser and the manufacturer.

10 SURFACE TREATMENT AND FINISH

10.1 Mill Passivation

If required, the Zn-Ni electrodeposited surface may be subjected to a chemical treatment in order to minimize the hazard of wet storage staining (white rust) and blackening during shipment and storage. However, the inhibiting characteristics of the treatment are limited and, if the material becomes wet during shipment or storage, the material should be used immediately or dried.

10.2 Mill Phosphating

If agreed upon between purchaser and the manufacturer, the manufacturer may apply phosphate treatments to electrolytic Zn-Ni alloy coated steel sheets and strips.

10.3 Oiling

If agreed upon between the purchaser and the manufacturer, the electrolytic Zn-Ni alloy coated steel sheets and strips, as produced, may be oiled to prevent marring and scratching of the soft surface during handling or shipping and to minimize wet storage stains.

> NOTE — When electrolytic Zn-Ni alloy coated steel sheets and strips has received a passivating treatment, oiling will further minimize the hazard of wet storage stain.

10.4 Thin Organic Film (or Sealing)

If agreed upon between purchaser and the manufacturer, the electrolytic Zn-Ni alloy coated steel sheets and strips, as produced, may be coated with a thin organic film coating to offer additional corrosion protection and, depending on its nature, increase the protection against fingerprints. It may improve the sliding characteristics during forming operations and can be used as a priming coat for subsequent painting.

10.5 Any other surface treatments may be done as agreed upon between the purchaser and the manufacturer.

11 MECHANICAL PROPERTIES

11.1 Sampling

11.1.1 Specimen for mechanical properties shall be drawn from each mother coil or a lot of 50T or less processed under the identical conditions of a single ladle, hot and cold rolling conditions, thickness, width, coating, and process conditions at electrolytic Zn-Ni coating line.

11.1.2 For hot-rolled substrate, one tensile test shall be taken from each cast. Where strips of more than one thickness are rolled from the same cast, additional tensile test shall be carried out as follows:

In case of strips (less than 5 mm),

a) One sample shall be tested for strips of thickness less than 2.0 mm;
b) One sample shall be tested for strips of thickness greater than 2.00 mm and less than 3.20 mm; and
c) One sample shall be tested for strips of thickness greater than 3.20 mm.

11.2 Tensile Test

11.2.1 *Tensile Test Specimen*

Tensile test values apply to the direction and type of specimen mentioned in Table 9A and Table 9B for cold-rolled substrate and Table 9C for hot-rolled substrate. Strips having a width of 250 mm and below shall be tested longitudinally.

11.2.2 *Testing*

Tensile test to be conducted as IS 1608 (Part 1) at room temperature and Tensile properties such as Yield Strength, Tensile Strength and % Elongation shall meet the requirements specified in Tables 9A, Tables 9B and Tables 9C. The yield strength value applies to 0.2 % of proof stress if yield stress is not clearly defined, otherwise the value applies to lower yield stress or upper yield stress based on mutual agreement between purchaser and manufacturer.

11.2.3 When specified by the purchaser, the tensile test can be omitted.

11.3 Plastic Strain Ratio (r bar/r-90)

11.3.1 The plastic strain ratio, an index of drawability (r-avg/r-90), shall apply to a thickness between 0.50 mm to 2.00 mm. For thicknesses more than 1.00 mm, the r- avg/r-90 value is reduced by 0.10 and if required, for the thickness more than 2.0 mm, the r- avg/r-90 value is reduced by 0.20.

11.3.2 The plastic strain ratio shall be checked in accordance with IS 11999 and results shall conform to as given in Table 9A and Table 9B.

11.3.3 When specified by the purchaser, the Plastic strain ratio test can be omitted.

11.4 Tensile Strain Hardening Exponent (n value/n-90)

11.4.1 The tensile strain hardening is an index of the stretchability (n-value/n-90), which shall be applicable to a thickness between 0.50 mm and 2.00 mm. If required, for a thickness of more than 2.00 mm, the n-value/n-90 is reduced by 0.02.

11.4.2 The tensile strain hardening component shall be checked in accordance with IS 15756 and results shall conform to as given in Table 9A and Table 9B.

11.4.3 When specified by the purchaser, the tensile strain hardening exponent test can be omitted.

11.5 Bake Hardening Index (BH)

11.5.1 Bake hardening index shall be tested as per Annex C and the minimum BH value shall as be given in Table 9A and Table 9B.

11.6 Hardness Test

11.6.1 If specified by the purchaser, the hardness test shall be out in accordance with IS 1586 for Rockwell Hardness or as per IS 1501 for Vickers Hardness. The evaluation criteria shall be subject to mutual agreement between the purchaser and the manufacturer.

11.7 Ageing period

The values mentioned against the different mechanical properties' requirements are applicable for the periods mentioned in Table 10 from the date, the product is available for the shipment at manufacturer's end.

11.8 Thickness for calculating tensile properties and bake hardening properties shall be either one of the following:

a) Actual measured thickness after removing the coating layer;
b) Result after subtracting the coating thickness on each side specified in Table 3 from the actual measured thickness including the coating layers; or
c) Results after subtracting the equivalent coating thickness of the actual measured coating mass from the measured thickness including the coating layers. Refer to Annex D for calculating coating thickness based on coating mass.

Table 9A Mechanical Properties (For Cold Rolled Substrate)

(*Clauses* 11.3, 11.4, 11.5 *and* 11.6)

Sl No.	Type and Designation		Tensile Strength, N/mm² *Min*	Yield point or proof stress N/mm²			% Elongation Type 3 specimen as per IS 1608 (Part 1)								Amount of Bake Hardening N/mm²	Testing Direction	Mean plastic strain ratio r-Avg , *Min*	Strain Hardening Component, n *Min*,
				Specified Thickness t, mm			Specified Thickness t, mm											
				0.4 ≤ t 0.8	0.8 ≤ t <1.0	1.0 ≤ t <3.0	0.4 ≤ t <0.6	0.6 ≤ t <0.8	0.8 ≤ t <1.0	1.0 ≤ t <1.2	1.2 ≤ t <1.6	1.6 ≤ t <2.0	2≤ t <2.5	2.5 ≤ t ≤3.0				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
i)	Mild Steel Sheet	IZNCCR0[1]	270	--	--	--	--	--	--	--	--	--	--	--				
		IZNCCR1	270	145-265	135-255	125-245	35-44	36-45	37–46	38 –47	39 – 48	40 – 51	41 – 53	42 - 55	--	Rolling	--	--
		IZNCCR2	270	135 –225	125 –215	115 - 205	38-47	39-48	40-49	41-50	42-51	43-53	44-55	45-57	--	Rolling	1.0	0.15
		IZNCCR3	270	130 –205	120 –195	110 - 185	40-48	41-49	42-50	43-51	44-52	45-54	46-56	47-58	--	Rolling	1.2	0.18
		IZNCCR4	270	120 -185	110 - 175	100-165	42-50	43-51	44-52	45-53	46-54	47-56	48-58	--	--	Rolling	1.4	0.2
		IZNCCR5	260	110-175	100-165	90-155	44-52	45-53	46-54	47-55	48-56	49-58	50-60	--	--	Rolling	1.6	0.22
ii)	Bake-hardening steel	IZNC270B	270	135 - 225	125 - 215	115 - 205	38-48	39-49	40-50	41-51	42-52	43 *Min*			30 *Min*	Rolling	1.3	0.18
		IZNC340B	340	195 - 295	185 - 285	175 - 275	33 - 43	34 - 44	35 - 45	36 - 46	37 - 47	38 *Min*			30 *Min*	Transverse	1.1	0.15
iii)	Interstitial Free- High Strength Steel	IZNC340P	340	165 - 255	155-245	145-235	33-43	34-44	35-45	36-46	37-47	38 *Min*			--	Transverse	1.3	0.2
		IZNC370P	370	175-265	165-255	155-245	31-41	32-42	33-43	34-44	35-45	36 *Min*			--	Transverse	1.2	0.18
		IZNC390P	390	205-305	195-295	185-285	29-40	30-41	31-42	32-43	33-44	34 *Min*			--	Transverse	1.2	0.16

Sl No.	Type and Designation		Tensile Strength, N/mm² *Min*	Yield point or proof stress N/mm²			% Elongation Type 3 specimen as per IS 1608 (Part 1)								Amount of Bake Hardening N/mm²	Testing Direction	Mean plastic strain ratio r-Avg , *Min*	Strain Hardening Component, n *Min*,
				Specified Thickness t, mm			Specified Thickness t, mm											
				0.4 ≤ t 0.8	0.8 ≤ t <1.0	1.0 ≤ t <3.0	0.4 ≤ t <0.6	0.6 ≤ t <0.8	0.8 ≤ t <1.0	1.0 ≤ t <1.2	1.2 ≤ t <1.6	1.6 ≤ t <2.0	2≤ t <2.5	2.5 ≤ t ≤3.0				
		IZNC440P	440	245-355	235-345	225-335	26 - 37	27 - 38	28 - 39	29 - 40	30 - 41	31 *Min*			--	Transverse	1.1	0.15
iv)	CMn steel	IZNC340W	340	205 - 305	195-295	185-285	31-41	32-42	33-43	34-44	35-45	38 *Min*			--	Transverse	--	--
		IZNC370W	370	205-305	195-295	185-285	28-38	29-39	30-40	31-41	32-42	33 *Min*			--	Transverse	--	--
		IZNC390W	390	245-355	235-345	225-355	27-38	28-39	29-40	30-41	31-42	32 *Min*			--	Transverse	--	--
		IZNC440W	440	285-390	275-380	265-370	24-36	25-37	26-38	27-39	28-40	29 *Min*			--	Transverse	--	--
v)	High Strength Low Alloy	IZNC590LA	590	430-580	420-570	410-560	--	15-30	15-30	16-31	16-31	16 *Min*			--	Transverse	--	--

NOTES

1 Tensile properties are non-mandatory for IZNCCR0.
2 1 N/mm² = 1 MPa.
3 Stricter mechanical properties requirements may be agreed to between the manufacturer and the purchaser, before placing the order.
4 Mechanical properties apply only to annealed followed by skin-passed products.
5 The values of yield stress are the 0.2 percent proof stress for products that do not represent a marked yield point and the lower yield stress for the others.
6 (--) → Not required. Where deemed required, purchaser and manufacturer can agree up on testing with mutually agreed criteria for evaluation.
7 All tensile strength values are determined to the nearest 10 MPa.
8 Based on the mutual agreement between purchaser and manufacturer, different testing directions can be applied while conducting tensile tests. For such cases, mechanical properties requirement will be based on the mutual agreement and those agreed values should be reasonably close to the values mentioned in Table 9A.
9 Based on mutual agreement, hardness check can be applied.

Table 9B Mechanical Properties (For Cold Rolled Substrate)
(*Clauses* 11.3, 11.4, 11.5 *and* 11.6)

Sl No.	**Type and Designation**		**Tensile Strength,** N/mm^2 *Min*	**Yield point or proof stress** N/mm^2			**%Elongation,** *Min*			**Testing Direction**	**Amount of Bake Hardening BH,** N/mm^2 *Min*	**Plastic strain Ratio**	**Strain Hardening Exponent**
				Thickness, t mm			**Test Piece Type 2 of IS 1608 (Part 1)** Thickness, **t** mm						
				≤ 0.5	**0.50 < t ≤ 0.7**	**t > 0.70**	**≤ 0.5**	**0.50 < t ≤ 0.7**	**t > 0.70**			**r90,** *Min*	**n90 ,** *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
i)	Bake-hardening steel	IZNC290B	290	180-280	180-260	180-240	30	32	34	Transverse	30	1.7	0.16
		IZNC320B	320	220-320	220-300	220-280	28	30	32	Transverse	30	1.2	0.15
		IZNC360B	360	260-370	260-350	260-330	24	26	28	Transverse	30	--	--
		IZNC400B	400	300-400	300-380	300-360	22	24	26	Transverse	30	--	--
		IZNC440B	440	340-440	340-420	340-400	20	22	24	Transverse	30	--	--
ii)	Interstitial Free - High	IZNC300P	300	160-260	160-240	160-220	33	35	37	Transverse	--	1.9	0.2
		IZNC330P	330	180-280	180-260	180-240	30	32	34	Transverse	--	1.7	0.18
iii)	High Strength Low Alloy	IZNC310LA	310	210-330	210-310	210-290	22	24	26	Transverse	--	--	--
		IZNC320LA	320	240-360	240-340	240-320	20	22	24	Transverse	--	--	--
		IZNC340LA	340	260-380	260-360	260-340	20	22	24	Transverse	--	--	--
		IZNC370LA	370	300-420	300-400	300-380	19	21	23	Transverse	--	--	--
		IZNC410LA	410	340-460	340-440	340-420	16	18	20	Transverse	--	--	--
		IZNC440LA	440	--	380-460	380-440	--	15	17	Transverse	--	--	--
		IZNC470LA	470	--	420-540	420-520	--	14	16	Transverse	--	--	--

NOTES
1 Tensile properties are non-mandatory for IZNCCR0.
2 1 N/mm^2 = 1 MPa.
3 Stricter mechanical properties requirements may be agreed to between the manufacturer and the purchaser, before placing the order.
4 Mechanical properties apply only to annealed followed by skin-passed products.
5 The values of yield stress are the 0.2 pe cent proof stress for products that do not represent a marked yield point and the lower yield stress for the others.
6 (--) → Not required. Where deemed required, purchaser and manufacturer can agree up on testing with mutually agreed criteria for evaluation.
7 All tensile strength values are determined to the nearest 10 MPa.
8 Based on the mutual agreement between purchaser and manufacturer, different testing directions can be applied while conducting tensile tests. For such cases, mechanical properties requirement will be based on the mutual agreement and those agreed values should be reasonably close to the values mentioned in Table 9B.
9 Based on mutual agreement, hardness check can be applied.

Table 9C Mechanical Properties (Hot Rolled Substrate)

(*Clause* 11.3, 11.4, 11.5 *and* 11.6)

Sl No.	Type and Designation		Tensile Strength N/mm^2 *Min*	Yield point or proof stress N/mm^2, *Min*			% Elongation, *Min* Type 3 specimen as per IS 1608 (Part 1)			Testing Direction
				Specified Thickness t mm			Specified Thickness t mm			
				t <2.0	2.0 ≤ t <3.2	3.2 ≤ t	t <2.0	2.0 ≤ t <3.2	3.2 ≤ t	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	Mild Steel Sheet	IZNHHR1	270	--	--	--	--	--	--	--
		IZNHHR2	270	170 *Min*	170 *Min*	170 *Min*	26	26	31	Rolling
		IZNHHR3	270	170 *Min*	170 *Min*	165 *Min*	29	29	34	Rolling
		IZNHHR4	270	165 *Min*	155 *Min*	145 *Min*	32	32	37	Rolling
ii)	Commercial Type Steel Sheet (Solid Solution strengthening)	IZNH310W	310	195 *Min*	185 *Min*	175 *Min*	35	36	37	Rolling
		IZNH370W	370	225 *Min*	215 *Min*	205 *Min*	32	33	34	Rolling
		IZNH400W	400	245-375	235-365	225-355	30	31	33	Rolling
		IZNH440W	440	285-410	275-400	265-390	27	28	31	Rolling
iii)	High Strength Low Alloy	IZNH490R	490	375-500	365-490	355-480	22	23	24	Transverse
		IZNH540R	540	430-570	420-560	410-550	19	20	21	Transverse
		IZNH590R	590	480-630	460-620	450-610	17	17	19	Transverse

NOTES

1 Tensile properties are non-mandatory for IZNCCR0.
2 1 N/mm^2 = 1 MPa.
3 Stricter mechanical properties requirements may be agreed to between the manufacturer and the purchaser, before placing the order.
4 Mechanical properties apply only to annealed followed by skin-passed products.
5 The values of yield stress are the 0.2 percent proof stress for products that do not represent a marked yield point and the lower yield stress for the others.
6 (--) → Not required. Where deemed required, purchaser and manufacturer can agree up on testing with mutually agreed criteria for evaluation.
7 All tensile strength values are determined to the nearest 10 MPa.
8 Based on the mutual agreement between purchaser and manufacturer, different testing directions can be applied while conducting tensile tests. For such cases, mechanical properties requirement will be based on the mutual agreement and those agreed values should be reasonably close to the values mentioned in Table 9C.
9 Based on mutual agreement, hardness check can be applied.

Table 10 Ageing Period Requirement
(*Clause* 11.7)

Sl No.	Type and Designation (For Cold rolled Substrate)		Applicable Non Ageing Period
(1)	(2)	(3)	(4)
i)	Mild Steel	IZNCCR3	6 Months
		IZNCCR4	6 Months
		IZNCCR5	6 Months
ii)	Bake-hardening type steel	IZNC270B	3 Months
		IZNC290B	3 Months
		IZNC320B	3 Months
		IZNC340B	3 Months
		IZNC360B	3 Months
		IZNC400B	3 Months
		IZNC440B	3 Months
iii)	Interstitial Free - High Strength	IZNC300P	6 Months
		IZNC330P	6 Months
		IZNC340P	6 Months
		IZNC370P	6 Months
		IZNC390P	6 Months
		IZNC440P	6 Months

NOTES
1 Applicable non ageing period is applicable only for the Type and designation mentioned in Table 10. For the remaining type and designations, based on mutual agreement, non-ageing period can be applied.
2 Based on mutual agreement, stricter test conditions can be applied

12 DIMENSIONS, SHAPE AND TOLERANCES

12.1 Coil Inner Diameter

Unless otherwise agreed, the internal diameter of coils shall be 508 mm (±10 mm).

12.2 Tolerances on Thickness shall be as per Table 11A and Table 11B for cold-rolled and hot-rolled substrate respectively.

Table 11A Thickness Tolerance (Cold-Rolled Substrate)

(*Clause* 12.2)

Sl No.	**Specified Width**	**<0.4**	**>0.4 ≤0.6**	**>0.6 ≤0.8**	**>0.8 ≤1.0**	**>1.0 ≤1.2**	**>1.2 ≤1.6**	**>1.6 ≤2.0**	**>2.0 ≤2.5**	**>2.5 ≤3.0**	**>3.0 ≤4.0**	**>4.0 ≤5.0**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	600 < 1 200	±0.04	±0.05	±0.06	±0.08	±0.09	±0.10	±0.12	±0.15	±0.16	±0.18	±0.19
ii)	>1200<1500	±0.05	±0.06	±0.06	±0.08	±0.09	±0.11	±0.13	±0.15	±0.17	±0.19	±0.21
iii)	>1500<1800	—	±0.07	±0.07	±0.09	±0.11	±0.13	±0.15	±0.17	±0.20	±0.22	±0.23

NOTES

1 Dimensions and tolerances are in mm.
2 Thickness tolerances for sheets in coil form are same as for sheets supplied in cut lengths but, in cases where welds are present, the tolerances shall be double those given over a length of 15 m in the vicinity of the weld.
3 Given the difference in tolerances and physical properties of hot-rolled and cold-rolled sheet products, the user and the supplier may negotiate a specific type of substrate. The relationship between the coating mass, in grams per square meter, and the thickness, in micrometers, can be retrieved from the respective standards.
4 For specified strength levels of R_e = 360 MPa and greater, tolerances are increased by 10 %, applying normal rounding-off procedures.
5 Thickness is measured at any point on the sheet not less than 25 mm from a side edge.
6 The Specified thickness range captions apply as a specific value.
7 The tolerances provided in this table are based on normal thickness (tolerance over and under). For ordered thicknesses other than nominal, the total tolerance is twice the tabled value and may be distributed as agreed upon between the buyer and seller.
8 Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer.

Table 11B Thickness Tolerance (Hot-Rolled Substrate)

(*Clause* 12.2)

Sl No.	**Specified Width**	**≤2.0**	**>2.0 ≤2.5**	**>2.5 ≤3.0**	**>3.0 ≤4.0**	**> 4.0 ≤ 5.0**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	600 < 1 200	±0.14	±0.15	±0.16	±0.18	±0.20
ii)	> 1 200 < 1 500	±0.15	±0.16	±0.18	±0.19	±0.22
iii)	> 1 500 < 1 800	±0.15	±0.18	±0.20	±0.22	±0.23

NOTES

1 Dimensions and tolerances are in mm.
2 Thickness tolerances for sheet in coil form are the same as for sheet supplied in cut lengths but, in cases where welds are present, the tolerances shall be double those given over a length of 15 m in the vicinity of the weld.
3 Given the difference in tolerances and physical properties of hot-rolled and cold-rolled sheet products, the user and the supplier may negotiate a specific type of substrate. The relationship between the coating mass, in grams per square meter, and the thickness, in micrometers, can be retrieved from the respective standards.
4 For specified strength levels of R_e = 360 MPa and greater, tolerances are increased by 10 %, applying normal rounding-off procedures.
5 Thickness is measured at any point on the sheet not less than 25 mm from a side edge.
6 The Specified thickness range captions apply as a specific value.
7 The tolerances provided in this table are based on normal thickness (tolerance over and under). For ordered thicknesses other than nominal, the total tolerance is twice the tabled value and may be distributed as agreed upon between the buyer and seller.
8 Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer.

12.3 Tolerances on width shall be as per Table 12 for hot-rolled and cold-rolled substrate. For untrimmed/hot rolled mill edges, width tolerances shall be +20/-0 mm and for edges that are trimmed before cold rolling, width tolerances shall be +7/-0 mm.

Table 12 Width Tolerance (Hot-Rolled and Cold Rolled Substrate)
(*Clause* 12.3)

Sl No.	Specified Width	Tolerance
(1)	(2)	(3)
i)	<1 500	7 mm,0 mm
ii)	> 1 500 < 1 800	10 mm,0 mm
NOTES **1** Dimensions and tolerances are in mm. **2** For ordered length other than nominal, the total tolerance is the tabled value and may be distributed as agreed upon between the buyer and seller. **3** Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer.		

12.4 Tolerances on length shall be as per Table 13 for hot-rolled and cold-rolled substrate.

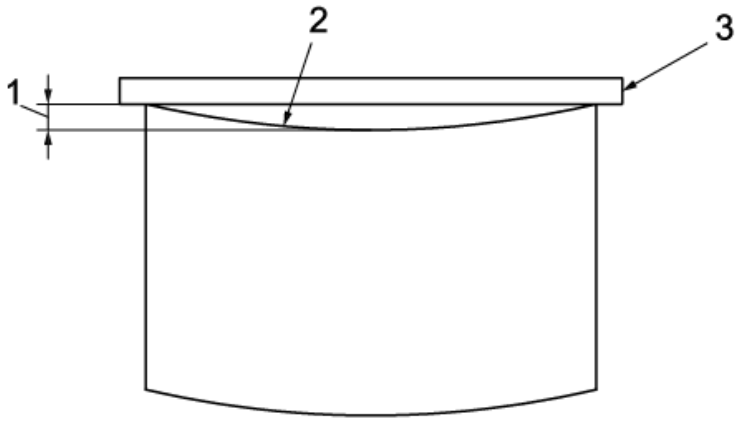
Table 13 Length Tolerance (Hot Rolled and Cold Rolled Substrate)
(*Clause* 12.4)

Sl No.	Specified Length	Tolerance
(1)	(2)	(3)
i)	≤ 3 000	+ 20 mm, 0 mm
ii)	>3 000 ≤ 6 000	+ 30 mm, 0 mm
iii)	>6 000	+ 0.5 %x length mm
NOTES **1** Dimensions and tolerances are in mm. **2** For ordered length other than nominal, the total tolerance is the tabled value and may be distributed as agreed upon between the buyer and seller. **3** Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer.		

12.5 Tolerances on camber shall be as per Table 14 for hot-rolled and cold-rolled substrate.

Table 14 Camber Tolerance (Hot-Rolled and Cold-Rolled Substrate)
(*Clause* 12.5)

Sl No.	Form	Camber tolerance
(1)	(2)	(3)
i)	Coils	20 mm in any 5000 mm length
ii)	Cut lengths	0.4 % × length
NOTES **1** 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 as shown in Fig 1. **2** Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer		



Key
1 edge camber
2 side edge (concave side)
3 straight edge

Figure 1 — Measurement of camber

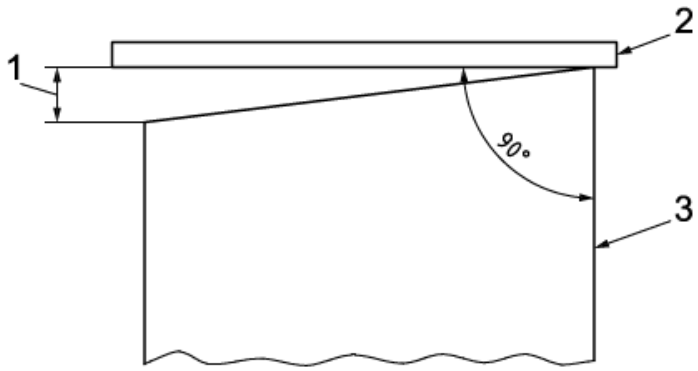
12.6 Tolerances on Out- of -Squareness shall be as per Table 15 and Table 16.

Table 15 Out-of-Squareness for cut lengths, not re-squared
(*Clause* 12.6)

Sl No.	Dimensions	Out-of-square Tolerance
(1)	(2)	(3)
i)	All thicknesses and all sizes	0.7 % × width
NOTE — 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 as shown in Fig 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet. When measuring material ordered to re-squared tolerances, consideration may have to be given to extreme variations in temperature.		

Table 16 Out-of-Squareness for cut lengths, re-squared
(*Clause* 12.6)

Sl No.	Specified Length	Specified Width	Out-of-square Tolerance
(1)	(2)	(3)	(4)
i)	< 3 000	< 1200	+1 mm, 0 mm
		> 1200	+2 mm, 0 mm
ii)	> 3 000	All widths	+2 mm, 0 mm
NOTE — 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 as shown in Fig 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet. When measuring material ordered to re-squared tolerances, consideration may have to be given to extreme variations in temperature.			



Key
1 out-of-square
2 straight edge
3 side edge

Figure 2 — Measurement of out-of-square

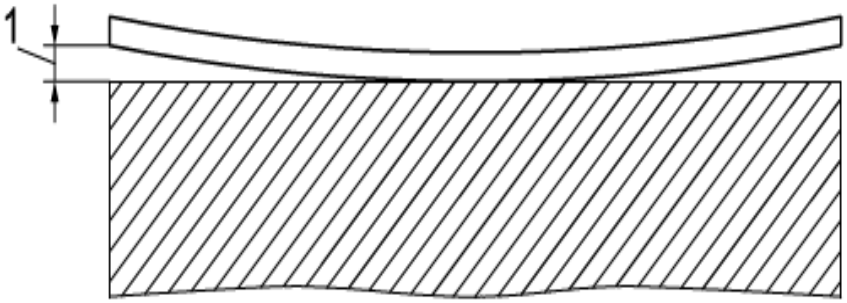
12.7 Tolerances on flatness shall be as per Table 17.

Table 17 Flatness Tolerances
(*Clause* 12.7)

Sl No.	Specified Thickness	Specified Width	Specified Strength Level - Yield Point or Proof Stress N/mm²		
			< 220 N/mm²	**> 220 ≤ 340** N/mm²	**> 340** N/mm²
(1)	(2)	(3)	(4)	(5)	(6)
i)	<0.7	≤ 1 200	14	17	20
		> 1 200 ≤ 1 500	17	20	23
		> 1 500	21	24	29
ii)	>0.7 ≤1.2	≤ 1 200	12	15	18
		> 1 200 ≤ 1 500	14	17	21
		> 1 500	19	22	27
iii)	> 1.2 ≤2.0	≤ 1 200	12	12	18
		> 1 200 ≤ 1 500	14	15	21
		> 1 500	19	21	27
iv)	>2.0 ≤5.0	≤ 1 200	16	16	20
		> 1 200 ≤ 1 500	20	20	30
		> 1 500	25	25	40

NOTES

1 Dimensions and tolerances are in mm.
2 1 N/mm² = 1 MPa
3 This table also applies to sheet cut to length from coils by the customer when agreed-upon flattening procedures are performed.
4 Maximum deviation from a flat horizontal surface: with the sheet lying under its own weight 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 as shown in Fig 3.
5 Restrictive tolerances can be applied based on the mutual agreement between the purchaser and the manufacturer.



Key
1 maximum deviation from flatness

Figure 3 — Measurement of flatness

12.8 For hot-rolled substrate-coated steel sheet and strip with untrimmed or mill edges, thickness shall be measured at any point not less than 40 mm from a side edge.

13 RETEST

13.1 If a sample is found non-conforming in any requirement, two additional samples from the same lot shall be re-tested for that specific requirement. If both re-test samples are found conforming, the lot may be accepted.

13.2 If any of the re-test samples fail to meet the test requirements, the lot represented by the sample shall be deemed as not conforming to this standard.

13.3 During a tensile test, if the fracture occurs outside the middle half of the gauge length marked before the test, and if the measured values are out of the specification limit, the sample shall be discarded, and a new sample shall be tested.

14 STRAIN AGEING

14.1 Electrolytic Zn-Ni alloy coated steel sheets and strips tend to strain age and this may lead to following:

a) Surface marking from stretcher strains or fluting when the steel is formed, and;
b) Deterioration in ductility.

14.2 Freedom from stretcher strain for a period of 6 months from the date of manufacture can be achieved by the supply of skin-passed non-ageing steel.

14.3 The details given above are for information and the manufacturer may adopt the same at his discretion.

15 SURFACE APPEARANCE

15.1 The steel sheet in cut lengths shall be free from laminations, surface flaws and other imperfections that are detrimental to the final product's practical application or subsequent appropriate processing.

15.2 However, it is difficult to inspect the overall coils for defects and removing defects in strips is not as easy as the removal of defects in sheets. There can be a mutual agreement between the purchaser and manufacturer for treating such cases.

15.3 Unless otherwise specified, surface defects shall be applied to one side. For sheets, it generally referred to the top side of the packing and for strips, the outer side is referred to as the applicable side.

15.4 The acceptance level of these defects will be as per mutual agreements between purchaser and manufacturer.

16 Packing

Electrolytic Zn-Ni alloy coated steel sheets and strips should be suitably packed to avoid any transit/handling/storage damage and as per the agreement between the purchaser and the manufacturer.

17 Marking

17.1 The following shall be legibly and indelibly marked on the top of each coil or package of sheets or shown on a tag attached to each coil or packet:

a) IS No. of this standard;
b) Manufacturer's name or trademark;
c) Material identification/coil number/packet number/batch number, etc.;
d) Product dimensions;
e) Number of sheets or mass;
f) Designation of Electrolytic Zn-Ni alloy coated steel sheets and strips; and,
g) Date of manufacture.

17.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

19 STORAGE AND TRANSPORTATION

19.1 As a precaution, the products should be transported and stored dry and protected from moisture.

19.2 During transportation, dark spots may appear on the surfaces as a result of friction. Generally, they only impair the appearance. Friction is reduced by oiling the products. Additionally, secure packing, transporting the coils laid flat and avoiding local pressure points, reduce the risk of dark spots.

ANNEX A
(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	Title
IS 228 (various parts)	Method for chemical analysis of steel
IS 513 (Part 1) : 2016	Cold reduced carbon steel sheet and strip : Part 1 Cold forming and drawing purpose (*sixth revision*)
IS 513 (Part 2) : 2016	Cold reduced carbon steel sheet and strip : Part 2 High tensile and multi-phase steel (*sixth revision*)
IS 1079 : 2017	Hot rolled carbon steel sheet, plate and strip - Specification (*seventh revision*)
IS 1501 (Part 1):2025/ ISO 6507-1 : 2023	Metallic Materials — Vickers Hardness Test Part 1 Test Method (*sixth revision*)
IS 1586 (Part 1) : 2018/ ISO 6508-1 : 2016	Metallic Materials —Rockwell Hardness Test Part 1 Test Method (*fifth revision*)
IS 1608 (Part 1) : 2022/ISO 6892-1 : 2019	Metallic materials — Tensile testing : Part 1 Method of test at room temperature (*fifth revision*)
IS 1956 (Part 4) : 2013	Glossary of terms relating to iron and steel : Part 4 Flat products (*second revision*)
IS 3531:2024/ ISO 8044 : 2020	Corrosion of Metals and Alloys —Vocabulary (*third revision*)
IS 3554 : 2017	Glossary of terms relating to electroplating (*first revision*)
IS 5528:2024/ ISO 9227 : 2022	Corrosion Tests in Artificial Atmospheres — Salt Spray Tests (*second revision*)
IS 5986 : 2017	Hot rolled steel sheet, plate and strip for forming and flanging purposes - Specification (*fourth revision*)
IS 8910 : 2022 / ISO 404 : 2013	Steel and Steel Products — General Technical Delivery Requirements (*second revision*)
IS 11999:2022/ ISO 10113:2020	Metallic Materials — Sheet and Strip — Determination of Plastic Strain Ratio (*second revision*)
IS 12860 : 1989	Metallic coating thickness by X-Ray fluorescence technique method — Determination
IS 18432 (Part 3):2023 / ISO 21920-3:2021	Geometrical Product Specifications (GPS) — Surface Texture — Profile Part 3 Specification Operators
ISO 2819 : 2017	Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion

ANNEX B
(*Informative)*
(*Clause* 9.3.5)

REFERENCE METHOD FOR DETERMINATION OF THE ZINC-NICKEL COATING MASS AND THE ZINC-NICKEL COATING COMPOSITION

B-1 Determination of the Zinc-Nickel Coating Mass

B-1.1 Principle

The sample shall be at least 5000 mm^2 in area. This can be achieved usually by a disc of at least 80 mm in diameter. The actual area is A (mm^2) The loss of mass in grams when dissolved, multiplied by an area related factor F1, will represent the Zn-Ni mass in grams per square metre on each surface of the product. For single side determinations the non-dissolved side must be protected suitably against the attack of the HCl.

B-1.2 Reagents

a) Inhibited hydrochloric acid (HCl, ρ_{20} = 1.19 g/ cm^3) which is diluted with distilled water (1:1);
b) Nitric acid (HNO_3) ρ_{20} = 1.40 g/ cm^3)

B-1.3 Apparatus

Analytical balance, measuring accuracy: 0.001 g.

B-1.4 Procedure

a) The sample with the area A is cleaned and weighed (W1);
b) The coating is removed using the HCl (1:1); the progress of the removal is visually controlled;
c) The sample is wiped and rinsed with distilled water;
d) The sample is dried and re-weighed (W2);
e) 2 to 3 drops of HNO_3 are added to the hydrochloric acid solution which is then heated up until boiling; and
f) After short boiling the solution is cooled down to ambient temperature.

B-1.5 Evaluation

Coating weight (g/m^2) $W = (W1-W2) \cdot F1$

$$\mathbf{F1} = \frac{1\,000\,000}{A}$$

B-2 Determination of the Zinc-Nickel Coating Composition

For the determination of the Zn-Ni coating composition in principle three methods are possible, depending on the lab-facilities and the skill of lab-people. The Nickel concentration is measured by ICP or FAAS. Instead of these spectrometry methods, the gravimetric can be used.

B-2.1 Measurement of nickel-concentration by ICP or FAAS

a) The solution, obtained by B.1.4 f), is transferred into a measuring flask and filled up with distilled water to the volume V (ml)

$$\mathbf{F2} = \frac{1000}{V}$$

b) The nickel-concentration (mg/l) is determined with ICP or FAAS using suitable standard solutions

Evaluation:

$$\frac{Ni\ (\mathrm{mg/l}) \cdot F1}{W \cdot F2 \cdot 10} = \%\ \mathrm{Nickel}$$

B-2.2 Determination of Nickel by the Gravimetric Method

B-2.2.1 Reagents

a) Tartaric acid (500 g/l);
b) Dimethylglyoxime ($C4H8N2O_2$ 1 % ethanol solution);
c) Ammonia (NH_4OH, ρ_{20} = 0.91 g/ cm^3).

B- 2.2.2 Apparatus

a) analytical balance, measuring accuracy: 0.001g;
b) filter crucible Duran 4;
c) vacuum filtering device.

B- 2.2.3 Procedure

The hydrochloric acid solution (*see* B-1.4f) is filled up to 250 ml with distilled water and 20 ml each of tartaric acid and dimethylglyoxime are added.

Then ammonia is added while stirring until the solution is slightly alkaline. A red, bulky deposit of Diacetyldioxime ($NiC_8\ H_{14}\ N_4\ O_4$) is precipitated. Then the solution is heated up to about 60°C and kept at this temperature for about 1h. Then the deposit is filtered using the filter crucible weighed in advance. The deposit is cleaned by distilled warm water. The filter crucible is dried at 120°C/2h to weight constancy. After cooling down to ambient temperature the filter crucible is reweighed.

The difference between the two weighing M (g) is calculated.

Evaluation:

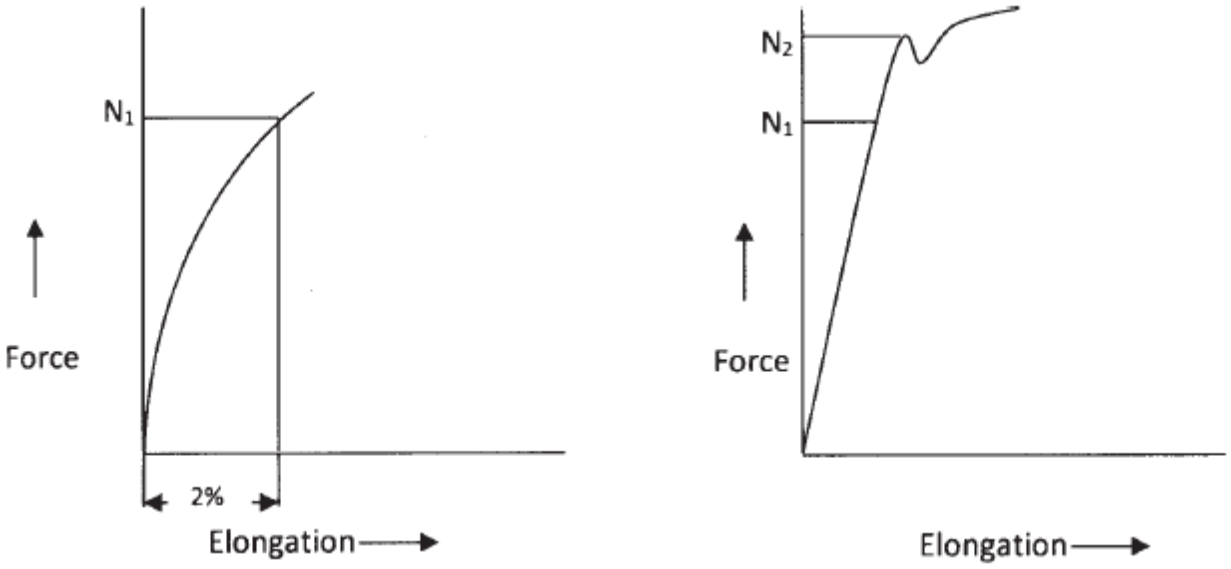
$$\frac{\mathrm{M\ (g)} \cdot 20.32}{(\mathrm{W1} - \mathrm{W2})\ (\mathrm{g})} = \%\mathrm{Nickel}$$

ANNEX C
(*Clause* 11.5)

BAKE HARDENING TEST

The bake hardening index (BH) is the increase in the yield point that is found in the bake hardening test carried out. Bake hardening of steel is achieved during the paint baking treatment. The test procedure for the determination of bake hardening index is as follows:

1. Test specimens shall be collected from annealed, skin-passed material in the direction mentioned as per Table 9A. Tensile specimen to be prepared as per IS 1608 (Part 1)
2. The parallel portion area of the test piece shall be noted be as A_0.
3. The test specimen shall be strained to 2 percent tensile elongation. The corresponding force shall be noted as N_1.
4. The specimen shall be unloaded from tensile tester and heat treated for 20 min at a temperature of 170^0C
5. After the heat treatment, the test specimen shall be subjected to tensile testing again. The sharp yield point is expected to appear along with the yield drop phenomenon. The force corresponding to the upper yield point shall be noted as N2.
6. The BH value calculation shall be obtained as $BH = (N_2 – N_1)/A_0$.
7. BH Value calculation is schematically represented in below Fig. 4.



Preliminary Strain Loading After Baking Process – Heat Treatment

FIG. 4 SCHEMATIC REPRESENTATION of BH VALUES

ANNEX D

(*Clause* 11.8)

ORDERS REQUIRING BASE-METAL THICKNESS

D-1 The Average Thickness of the Coating Calculation

When specified by the purchaser, the ordered thickness shall be the base-metal thickness. In these cases, the product thickness shall be calculated as the base-metal thickness + the equivalent coating thickness for each surface, as indicated in Fig. 5.

Thickness tolerance tables apply to the product thickness.

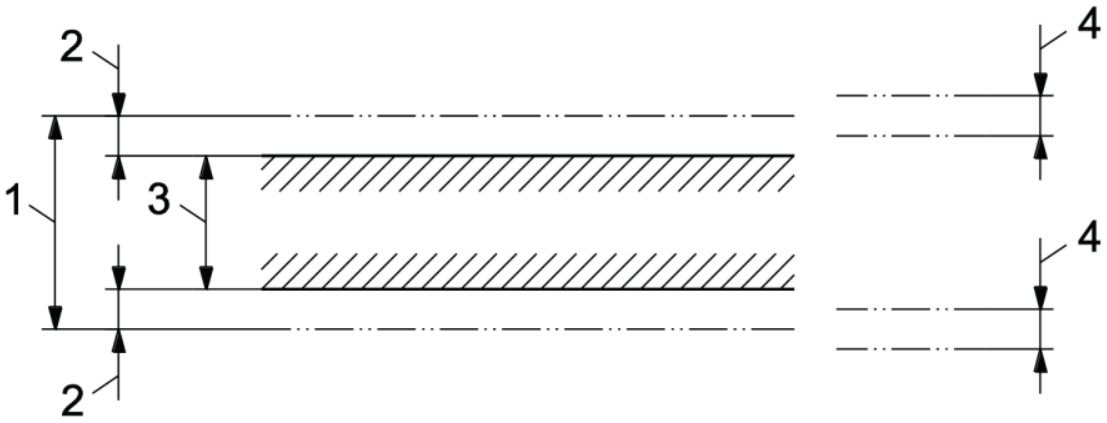


FIG. 5 CALCULATION OF THE PRODUCT THICKNESS

Key
1 product thickness
2 equivalent coating thickness
3 base-metal thickness
4 thickness tolerance

For calculating, equivalent coating thickness following empirical relations can be used.

a) 1.00 g/m^2 coating mass = 0.137 micrometer coating thickness; and
b) 1.00 micrometer coating thickness = 7.32 g/m^2 coating mass.