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भारतीय मानक प्रारूप

तप्त-निमज्जी ज़िंक-5 % एल्युमीनियम मिश्रधातु लेपित इस्पात की प्लेटें चादरें एवं पत्तियाँ - विशिष्टि

Draft Indian Standard

HOT-DIP ZINC-5 % ALUMINIUM ALLOY COATED STEEL PLATES, SHEETS AND STRIPS – SPECIFICATION

ICS 77.140.50

Wrought Steel Products Sectional Committee, MTD 04	Last date for receipt of comments: **30 July 2025**

FOREWORD

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

Zinc-5% aluminium coated steels are materials recognized for their effective corrosion resistance and durability. As the demand for reliable and long-lasting materials grows, establishing standards for this coating becomes essential to ensure consistent quality and performance across various applications. This is particularly important in the automotive and construction industries, where material integrity is critical. The zinc-5% aluminium coating standard specifies the technical requirements of zinc-5% aluminium coated steel sheets and strips.

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

HOT-DIP ZINC-5% ALUMINIUM ALLOY COATED STEEL PLATES, SHEETS AND STRIPS — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements for steel sheets, plates and strips, metallic-coated by the continuous hot-dip process, with zinc-5% aluminium (Zn-5% Al) alloy coating. The Zn-5%Al alloy coating usually contains small amounts of elements other than zinc and aluminium that are intended to improve processing and the characteristics of the coated product.

1.2 The product is intended for applications requiring high corrosion resistance, formability and paintability.

1.3 The steel sheet is produced in several quality designations and grades, coating mass, surface treatments and coating finish conditions designed to be compatible with differing application requirements.

2 REFERENCES

The standards listed in Annex A contain provisions, which through references 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 these standards.

3 TERMINOLOGY

For this standard, the definitions given in IS 1956 (Part 4), IS 3531, IS 513 (Part 1 and Part 2), IS 1079, IS 5986, IS 277 and the following definitions shall apply:

3.1 Thickness of Sheet — The thickness of hot-dip zinc-5% aluminium alloy coated carbon steel sheet and strip shall be specified either as the total thickness which is a combination of the base metal and metallic coating or as the thickness of the base metal alone.

The purchaser shall indicate the preferred method of thickness specification at time of enquiry and order. In the absence of such indication, the product shall be supplied with the thickness measured as the combination of base metal and coating.

The requirements for specifying the thickness as base metal alone are described in Annex B.

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

3.3 Product — Hot-dip zinc-5% aluminium alloy coated hot-rolled or cold reduced carbon steel sheet, plate and strip.

3.4 Differential Coating — Coating is deliberately produced to have a different coating mass on each surface.

3.5 Structural — Base-metal quality intended for parts needing guaranteed mechanical properties and where simple forming may be involved.

3.6 Equivalent Coating Thickness — Thickness of coating expressed in µm and is usually calculated using the coating mass applied on both surfaces.

3.7 Regular coating structure — Normal coating structure resulted from unrestricted grain growth during the solidification of the Zn-5%Al coating.

3.8 Minimized coating structure— Fine grain coating structure obtained by a treatment to restrict the formation of the normal coarse grain coating structure formed during the solidification of the Zn-5%Al coating.

3.9 Abbreviation

a) MM — Mischmetal.
b) Zn-5A1 — Zinc-5 % Aluminium.
c) Zn-5Al-Mg — Zinc-5 % Aluminium - 0.1 % Magnesium.
d) Zn-5Al-MM — Zinc-5 % Aluminium - Mischmetal.

4 SUPPLY OF MATERIAL

4.1 The general requirements relating to the supply of zinc-5% aluminium alloy coated steel sheets and strips shall conform to IS 8910.

4.2 Product is manufactured in thicknesses from 0.20 mm to 9 mm inclusive after coating, and in widths of 600 mm and over in coils and cut lengths.

4.3 Product less than 600 mm wide, is slit from a wide coil and further cut into required lengths.

5 DESIGNATIONS

The nomenclature of the grade designation is explained in Annex C.

5.1 Base Metal Grade

Hot dip zinc-5% aluminium alloy coated carbon steel sheet and strip covered by 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 reduced substrate, Table 2 for coated steels with hot-rolled substrate and applicable coating type.

Table 1 Type and Designation for Cold-rolled Substrate

(*Clauses* 5.1)

Sl No.	Type and Designation		Thickness mm
(1)	(2)	(3)	(4)
i)	Mild steel	IZACCR0	0.20 to 3.00
		IZACCR1	0.20 to 3.00
		IZACCR2	0.40 to 3.00
		IZACCR3	0.40 to 3.00
		IZACCR4	0.40 to 3.00
		IZACCR5	0.40 to 3.00
ii)	Structural quality steel	IZAC300S	0.40 to 3.00
		IZAC310S	0.40 to 3.00
		IZAC330S	0.40 to 3.00
		IZAC360S	0.40 to 3.00
		IZAC380S	0.40 to 3.00
		IZAC410S	0.40 to 3.00
		IZAC420S	0.40 to 3.00
		IZAC440S	0.40 to 3.00
		IZAC460S	0.40 to 3.00
		IZAC480S	0.40 to 3.00
		IZAC510S	0.40 to 3.00
		IZAC560S	0.40 to 3.00
		IZAC570S	0.40 to 3.00
iii)	Bake-hardening steel	IZAC270B	0.40 to 2.30
		IZAC290B	0.40 to 2.30
		IZAC320B	0.40 to 2.30
		IZAC340B	0.40 to 2.30
		IZAC360B	0.40 to 2.30
		IZAC400B	0.40 to 2.30
		IZAC440B	0.40 to 2.30
iv)	Interstitial free - high strength	IZAC300P	0.40 to 2.30
		IZAC330P	0.40 to 2.30
		IZAC340P	0.40 to 2.30
		IZAC360P	0.40 to 2.30
		IZAC370P	0.40 to 2.30
		IZAC390P	0.40 to 2.30
		IZAC440P	0.40 to 2.30
v)	C-Mn steel (solid solution strengthening)	IZAC340W	0.40 to 3.00
		IZAC370W	0.40 to 3.00
		IZAC390W	0.40 to 3.00
		IZAC440W	0.40 to 3.00
		IZAC490W	0.60 to 3.00
		IZAC540W	0.60 to 3.00
		IZAC590W	0.60 to 3.00
vi)	High strength low alloy steel	IZAC310LA	0.40 to 3.00
		IZAC320LA	0.40 to 3.00
		IZAC340LA	0.40 to 3.00
		IZAC370LA	0.40 to 3.00
		IZAC410LA	0.40 to 3.00
		IZAC440LA	0.60 to 3.00
		IZAC470LA	0.60 to 3.00

Sl No.	**Type and Designation**		**Thickness** mm
(1)	(2)	(3)	(4)
		IZAC500LA	0.60 to 3.00
		IZAC530LA	0.60 to 3.00
		IZAC620LA	0.60 to 3.00
vii)	Dual phase steel	IZAC450Y	0.40 to 3.00
		IZAC490Y	0.40 to 3.00
		IZAC540Y	0.40 to 3.00
		IZAC590Y	0.40 to 3.00
		IZAC780Y	0.60 to 3.00
		IZAC980Y	0.80 to 3.00
		IZAC980YH	0.80 to 3.00
		IZAC1180Y	0.80 to 3.00
viii)	TRIP steel	IZAC590T	0.40 to 3.00
		IZAC690T	0.60 to 3.00
		IZAC780T	0.70 to 3.00
ix)	Complex phase steel	IZAC600N	0.40 to 3.00
		IZAC780N	0.70 to 3.00
		IZAC980N	0.80 to 3.00
NOTE — Any thickness greater than or less than the mentioned range can also be produced as mutually agreed to between the manufacturer and the purchaser. Acceptance criteria for the range out of the specified product range shall be as agreed upon between the purchaser and the manufacturer.			

Table 2 Type and Designation for Hot-rolled Substrate
(*Clauses* 5.1)

Sl No.	**Type and Designation**		**Thickness** mm
(1)	(2)	(3)	(4)
i)	Commercial quality steel	IZAHHR1	1.60 to 9.00
ii)	Drawing quality steel	IZAHHR2	1.60 to 9.00
		IZAHHR3	1.60 to 9.00
		IZAHHR4	1.60 to 9.00
iii)	Structural quality steel	IZAH290S	1.60 to 9.00
		IZAH330S	1.60 to 9.00
		IZAH360S	1.60 to 9.00
		IZAH410S	1.60 to 9.00
		IZAH430S	1.60 to 9.00
		IZAH450S	1.60 to 9.00
		IZAH490S	1.60 to 9.00
		IZAH540S	1.60 to 9.00
		IZAH570S	1.60 to 9.00
iv)	High strength low alloy high yield ratio steel	IZAH320LA	1.60 to 9.00
		IZAH360LA	1.60 to 9.00
		IZAH390LA	1.60 to 9.00
		IZAH410LA	1.60 to 9.00
		IZAH430LA	1.60 to 9.00
		IZAH450LA	1.60 to 9.00
		IZAH480LA	1.60 to 9.00
		IZAH500LA	1.60 to 9.00
		IZAH550LA	2.00 to 9.00
		IZAH600LA	2.00 to 9.00
		IZAH650LA	2.00 to 9.00
		IZAH700LA	2.00 to 9.00
		IZAH750LA	2.00 to 9.00
v)	High strength structural steel	IZAH440R	1.60 to 9.00
		IZAH490R	1.60 to 9.00
		IZAH540R	2.00 to 9.00
		IZAH590R	2.00 to 9.00
		IZAH780R	2.00 to 9.00
vi)	High hole expansion ratio steel	IZAH440FB	1.60 to 9.00
NOTE — Any thickness greater than or less than the mentioned range can also be produced as mutually agreed to between the manufacturer and the purchaser. Acceptance criteria for the range out of the specified product range shall be as agreed upon between the purchaser and the manufacturer.			

5.2 Coating Class

Coating class is designated as ZAXXX

where, ZA stands for Zinc-5%Aluminium alloy coated and XXX stands for coating mass in g/m^2.

The differentially coated steel class including single side coated steel shall be designated as ZAXXX/ ZAYYY

where, XXX stands for coating mass in g/m^2 of top surface of sheet/outer surface of strip; and
YYY stands for coating mass in g/m^2 of bottom surface of sheet/inner surface of strip

NOTE — The product shall be coated on at least one surface; therefore, the combination. ZA000/ ZA000 shall not be specified.

5.3 Coating Type

5.3.1 This standard covers two coating types based on chemical composition of coating:

Type I—Zinc-5 % aluminium-mischmetal (Zn-5Al-MM)
Type II—Zinc-5 % aluminium-0.1 % magnesium (Zn-5Al-Mg) as per Table 4.

5.3.2 Each coating type is classified into two coating structures, as follows:

Class A—Minimized coating structure
Class B—Regular coating structure

The coating designations shall be as per Table 5.

5.4 Coating Composition

The coating composition of the Type I—Zinc-5 % aluminium-mischmetal (Zn-5Al-MM) coating should be as per Table 3 and the coating composition of Type II—Zinc-5 % aluminium-0.1 % magnesium (Zn-5Al-Mg) coating should be as per Table 4.

NOTE — The ingots of zinc, aluminium and magnesium used for the preparation of molten bath for hot dipping should conform to any of the grades specified in IS 209, IS 2590 and IS 6694 respectively. In case of zinc-5 % aluminium alloyed ingot, its properties and chemical composition may be as agreed upon between the manufacturer and the customer.

Table 3 Zn-5Al-MM Alloy Ingot Chemical Requirements Type I [A,B,C,D]
(Clause 5.3 and 5.4)

Sl. No.	Element	Composition, *Percent*
(1)	(2)	(3)
i)	Aluminium [E]	4.2-6.2
ii)	Cerium + lanthanum (total)	0.03-0.10
iii)	Iron	0.075 *Max*
iv)	Silicon	0.015 *Max*
v)	Lead[F]	0.005 *Max*
vi)	Cadmium[F]	0.005 *Max*
vii)	Tin [F]	0.002 *Max*
viii)	Others[G], each	0.02 *Max*
ix)	Others[G], total	0.04 *Max*
x)	Zinc	Remainder

A - By agreement between purchaser and supplier, analysis may be required, and limits established for elements or compounds not specified in the table of chemical composition.
B - Zn-5Al-MM alloy ingot for hot-dip coatings may contain antimony, copper, and magnesium in amounts of up to 0.002 percent, 0.1 percent, and 0.05 percent, respectively. No detrimental effects on alloy performance have ever been noted due to the presence of these elements up to these concentrations and, therefore, analyses are not required for these elements.
C - Magnesium may be specified by the buyer up to 0.1 percent maximum.
D - Zirconium and titanium may each be specified by the buyer up to 0.02 percent maximum.
E - Aluminium may be specified by the buyer up to 12 percent maximum.
F - Lead and cadmium, and to a lesser extent tin and antimony, are known to cause intergranular corrosion in zinc-aluminium alloys. For this reason, it is important to maintain the levels of these elements below the limits specified.
G - Except antimony, copper, magnesium, zirconium, and titanium.

Table 4 Zn-5Al Alloy Ingot Chemical Requirements Type II [A]
(Clause 5.3 and 5.4)

Sl. No.	Element	Composition, *Percent*
i)	Aluminium	4.5-6.2
ii)	Magnesium	0.06-0.15
iii)	Others, total [B]	0.01 *Max*
iv)	Zinc[C]	Remainder [C]

A- By agreement between the purchaser and the supplier, analysis may be required and limits established for elements not specified in Table 4.
B- Except iron.
C- For information only. Quantitative determination of the element is not required.

Table 5 Weight [Mass] of Coating Requirements [A,B,C]
(Clause 5.3 and 8.1)

Sl. No.	Coating Designation	Triple-spot Test g/m^2	Single-spot Test g/m^2
i)	ZA001	3	3
ii)	ZA45	45	35
iii)	ZA60	60	50
iv)	ZA90	90	75
v)	ZA135	135	113
vi)	ZA180	180	150
vii)	ZA225	225	195
viii)	ZA275	275	235
ix)	ZA350	350	300
x)	ZA450	450	385
xi)	ZA600	600	510
xii)	ZA700	700	595

A - The coating designation number is the term by which the minimum triple spot, total both sides coating weight [mass] is specified. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating lines, the zinc-5 % aluminium alloy coating is not always evenly divided between the two surfaces of a coated sheet; nor is it always evenly distributed from edge to edge. However, minimum single spot coating weight [mass] on any one side is normally not less than 40 % of the single-spot total both sides requirement.

B - As it is an established fact that the atmospheric corrosion resistance of zinc-5 % aluminium alloy-coated sheet products is a function of coating thickness (weight [mass]), the selection of thinner (lighter) coating designations will result in reduced corrosion performance of the Zn-5Al coating. For example, the heavier zinc-5 % aluminium alloy coatings perform adequately in bold atmospheric exposure, whereas the lighter coatings are often further coated with paint or a similar barrier coating for increased corrosion resistance. Because of this relationship, material carrying the statement "meets IS XXXXX requirements" should also specify the particular coating type and designation.

C - The corrosion performance of Type I Zn-5Al-MM coated sheet products is nonlinear as the corrosion rate decreases with time, due to the formation of a characteristic passivation layer.

NOTE — Single- spot test≅0.85×Triple-spot test.

5.5 Surface Finish

The surface finish of the product shall be as given in Table 6.

Table 6 Surface Finish Requirement
(*Clause* 5.5)

Sl No.	Surface Finish Designation	
	Type	Description
(1)	(2)	(3)
i)	N	As coated finish, no skin pass
ii)	S	smooth finish with skin pass

NOTE — For a smooth finish with skin pass, different kinds of surface finishes with varied ranges of roughness values can be mutually agreed upon between the purchaser and the manufacturer. Roughness check shall be carried out in accordance with the IS 18432 (Part 3) .

5.6 Surface Treatment

The surface treatment for the product shall be as given in Table 7.

Table 7 Surface Treatment and Oiling Requirement

(*Clause* 5.6 and 9)

Sl No.	Surface Treatment 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 the manufacturer, in addition to the above-mentioned treatment or stand-alone, other surface treatments can also be applied.		

6 MANUFACTURE

6.1 Unless otherwise agreed upon between the manufacturer and the purchaser, the processes used in making the steel and in subsequent manufacturing of product are left to discretion of the manufacturer. However, the purchaser may be informed of the steelmaking process.

6.2 For the hot-dip coating process, hot-rolled or cold-rolled substrates shall be used. The hot-rolled strip shall be pickled first before the hot-dip coating process.

6.3 The strip is dipped in a suitable bath of molten metal alloy of zinc-5 % aluminium at a temperature suitable to produce a complete and uniform adherent coating.

7 CHEMICAL COMPOSITION

7.1 Ladle Analysis

The ladle analysis of the base metal of steel sheet and strip shall be as per the requirements given in Table 8A and Table 8B for cold-rolled substrate and hot-rolled substrate respectively when carried out either by the method specified in the relevant parts of IS 228 or any other established 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.

Table 8A Chemical Composition Requirements for Cold-Rolled Substrate

(*Clauses* 7.1 *and* 7.2)

Sl No.	**Type and Designation**		**Constituent,** Percent, *Max*			
			C	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Mild steel	IZACCR0	0.20	2.00	0.12	0.035
		IZACCR1	0.18	1.20	0.12	0.035
		IZACCR2	0.10	0.50	0.04	0.030
		IZACCR3	0.08	0.45	0.03	0.030
		IZACCR4	0.06	0.45	0.03	0.030
		IZACCR5	0.02	0.25	0.03	0.020
ii)	Structural quality steel	IZAC300S	0.25	1.60	0.10	0.040
		IZAC310S	0.25	1.60	0.10	0.040
		IZAC330S	0.25	1.60	0.10	0.040
		IZAC360S	0.25	1.60	0.10	0.040
		IZAC380S	0.25	1.60	0.10	0.040
		IZAC410S	0.25	1.60	0.10	0.040
		IZAC420S	0.25	1.60	0.10	0.040
		IZAC440S	0.25	1.60	0.10	0.040
		IZAC460S	0.25	1.60	0.10	0.040
		IZAC480S	0.25	1.60	0.10	0.040
		IZAC510S	0.25	1.60	0.10	0.040
		IZAC560S	0.25	1.60	0.10	0.040
		IZAC570S	0.25	1.60	0.10	0.040
iii)	Bake-hardening steel	IZAC270B	0.01	0.80	0.10	0.020
		IZAC290B	0.01	0.80	0.10	0.020
		IZAC320B	0.01	0.80	0.10	0.020
		IZAC340B	0.01	1.20	0.10	0.020

Sl No.	**Type and Designation**		**Constituent,** Percent, *Max*			
			C	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		IZAC360B	0.01	1.40	0.10	0.020
		IZAC400B	0.01	1.60	0.10	0.020
		IZAC440B	0.01	1.60	0.10	0.020
iv)	Interstitial free- high strength	IZAC300P	0.01	0.80	0.10	0.020
		IZAC330P	0.01	0.80	0.10	0.020
		IZAC340P	0.01	0.80	0.10	0.020
		IZAC360P	0.01	1.00	0.10	0.020
		IZAC370P	0.01	1.20	0.10	0.020
		IZAC390P	0.01	1.40	0.10	0.020
		IZAC440P	0.01	1.60	0.10	0.020
v)	C-Mn steel (solid solution strengthening)	IZAC340W	0.12	0.90	0.03	0.030
		IZAC370W	0.15	1.30	0.03	0.030
		IZAC390W	0.20	1.50	0.03	0.030
		IZAC440W	0.20	1.70	0.03	0.030
		IZAC490W	0.20	2.00	0.03	0.030
		IZAC540W	0.20	2.50	0.03	0.030
		IZAC590W	0.25	2.50	0.03	0.030
vi)	High strength low alloy Steel	IZAC310LA	0.10	1.00	0.07	0.025
		IZAC320LA	0.10	1.00	0.07	0.025
		IZAC340LA	0.10	1.20	0.07	0.025
		IZAC370LA	0.12	1.40	0.07	0.025
		IZAC410LA	0.12	1.50	0.07	0.025
		IZAC440LA	0.12	1.60	0.07	0.025
		IZAC470LA	0.14	1.60	0.07	0.025
		IZAC500LA	0.14	1.80	0.07	0.025
		IZAC530LA	0.14	1.80	0.07	0.025

Sl No.	**Type and Designation**		**Constituent,** Percent, *Max*			
			C	Mn	P	S
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		IZAC620LA	0.16	2.50	0.07	0.025
vii)	Dual phase steel	IZAC450Y	0.15	2.00	0.10	0.020
		IZAC490Y	0.15	2.00	0.10	0.020
		IZAC540Y	0.15	2.20	0.10	0.020
		IZAC590Y	0.15	2.50	0.10	0.020
		IZAC780Y	0.18	2.50	0.10	0.020
		IZAC980Y	0.25	3.50	0.10	0.020
		IZAC980YH	0.25	3.50	0.10	0.020
		IZAC1180Y	0.30	3.50	0.10	0.020
viii)	TRIP steel	IZAC590T	0.30	2.20	0.10	0.015
		IZAC690T	0.35	2.50	0.10	0.015
		IZAC780T	0.35	2.50	0.10	0.015
ix)	Complex phase steel	IZAC600N	0.18	2.20	0.10	0.015
		IZAC780N	0.18	3.00	0.10	0.015
		IZAC980N	0.20	3.50	0.10	0.015

NOTES

1 The above specified grades can also be supplied with the addition of micro-alloying elements like boron, titanium, niobium and vanadium either individually or in combination. However, boron addition shall be restricted to 0.006 percent maximum.

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

3 The elements (for example Cr, Mo, Ni etc) not mentioned in the above table can be added up to 1 percent max either individually or in combination.

4 Restricted chemical composition may be mutually agreed to between the purchaser and the supplier.

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

Table 8B Chemical Composition Requirements for Hot-rolled Substrate
(*Clauses* 7.1 *and* 7.2)

Sl No.	**Type and Designation**		**Constituent,** Percent**,** *Max*					
			C	Mn	P	S	Si	Micro Alloying
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Commercial quality steel[1]	IZAHHR1	0.15	0.60	0.05	0.035	–	–
ii)	Drawing quality steel[1]	IZAHHR2	0.10	0.45	0.04	0.035	–	–
		IZAHHR3	0.08	0.40	0.35	0.030	–	–
		IZAHHR4	0.08	0.35	0.30	0.030	–	–
iii)	Structural quality steel	IZAH290S	0.12	0.60	0.04	0.040	0.50	0.15
		IZAH330S	0.15	0.80	0.04	0.040	0.50	0.15
		IZAH360S	0.17	1.20	0.04	0.040	0.50	0.15
		IZAH410S	0.20	1.40	0.04	0.040	0.50	0.15
		IZAH430S	0.25	1.70	0.05	0.035	0.50	0.15
		IZAH450S	0.25	1.70	0.05	0.035	0.50	0.15
		IZAH490S	0.25	1.70	0.05	0.035	0.50	0.15
		IZAH540S	0.25	1.70	0.05	0.035	0.50	0.15
		IZAH570S	0.25	1.70	0.05	0.035	0.50	0.15
iv)	High strength low alloy High yield ratio steel	IZAH320LA	0.12	1.20	0.02	0.025	–	0.22
		IZAH360LA	0.12	1.20	0.02	0.025	–	0.22
		IZAH390LA	0.12	1.30	0.02	0.025	–	0.22
		IZAH410LA	0.12	1.40	0.02	0.025	–	0.22
		IZAH430LA	0.12	1.50	0.02	0.025	–	0.22
		IZAH450LA	0.12	1.50	0.02	0.025	–	0.22
		IZAH480LA	0.12	1.50	0.015	0.025	–	0.22
		IZAH500LA	0.12	1.60	0.015	0.025	–	0.22
		IZAH550LA	0.12	1.70	0.015	0.025	–	0.22
		IZAH600LA	0.12	1.80	0.015	0.025	–	0.22
		IZAH650LA	0.12	1.90	0.015	0.025	–	0.22
		IZAH700LA	0.12	2.00	0.015	0.025	–	0.22

		IZAH750LA	0.12	2.10	0.015	0.025	–	0.22
v)	High strength structural steel	IZAH440R	0.20	1.50	0.02	0.030	–	0.20
		IZAH490R	0.20	1.60	0.02	0.030	–	0.20
		IZAH540R	0.20	1.70	0.02	0.030	–	0.20
		IZAH590R	0.20	1.80	0.02	0.030	–	0.20
		IZAH780R	0.20	2.00	0.02	0.030	–	0.25
vi)	High hole expansion ratio steel	IZAH440FB	0.16	1.60	–	–	–	0.20

NOTES

1 The above specified grades can also be supplied with the addition of micro-alloying elements like boron, titanium, niobium and vanadium either individually or in combination. However, boron addition shall be restricted to 0.006 percent maximum.

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

3 The elements (for example Cr, Mo, Ni etc) not mentioned in the above table can be added up to 1 percent max either individually or in combination.

4 Restricted chemical composition may be mutually agreed to between the purchaser and the supplier.

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

7.2 Product Analysis

Permissible variation in the case of product analysis, after stripping of coating, from the limits specified in Table 8A, Table 8B shall be as given in Table 9.

Table 9 Permissible Variation for Product Analysis

(*Clause* 7.2)

Sl No.	Element	Specified Chemical Composition Limit	Permissible Variation Over the Specified Limit
		Percent, *Max*	Percent, *Max*
(1)	(2)	(3)	(4)
i)	Carbon	≤ 0.150	0.02
		> 0.150	0.03
ii)	Manganese	≤ 0.6	0.03
		> 0.60, ≤ 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 Alloy	≤ 0.300	Subject to negotiation

NOTE — When analyzing the product using spark spectroscopy, it is essential to ensure that thin sheets or strips do not burn out during the process

8 COATING PROPERTIES

8.1 Coating Mass

The coating mass expressed in grams per square metre given for both surfaces shall conform to the requirements specified in Table 5. 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.

8.2 Coating Mass Test

8.2.1 The coating mass of the product shall be tested by taking a sample piece from each mother coil approximately 300 mm in length by the as-coated width 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 each of the three specimens shall be 1200 mm^2.

8.2.2 The triple spot coating mass is the average coating mass of the three specimens taken in

accordance with **8.2.1**. However, the minimum of three coating values should comply with the single spot test requirements of the coating designation. For narrow width strips, which have been slit from a wide hot dip zinc-5 % aluminium alloy-coated coil, only a single spot test is applicable and should comply with the minimum requirement of the coating designation.

8.2.3 The coating mass shall be determined by the X-ray fluorescence method as per IS 12860 or by gravimetric method as per IS 6745. For measuring coating on a single surface by gravimetric method, a suitable method shall be employed to mask the second surface as agreed upon between the manufacturer and the purchaser.

8.2.4 The equivalent coating thickness may be calculated as per Annex B.

8.3 Adherence Test

8.3.1 Zinc-5 % aluminium alloy-coated steel sheet shall be capable of being bent in any direction, in accordance with the mandrel diameter requirements of Table 10, without flaking of the coating on the outside of the bend. Unless otherwise specified, the test piece shall be taken in parallel to the rolling direction of the base metal. Flaking of the coating within 7 mm from the edge shall not be a cause for rejection. Stricter conditions can also be agreed upon between the purchaser and manufacturer.

8.3.2 For adhesion test, one sample 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 a hot dip galvanizing line.

8.3.3 In addition to the bend test specified above, any other coating adherence/powdering test may also be carried out as per applicable international or established test methods as agreed upon between the purchaser and the manufacturer and the evaluation criteria may also be agreed upon.

8.4 Corrosion Resistance for Coating

If agreed upon at the time of enquiry and order, the corrosion resistance of the coating may be tested as per IS 5528 or any other established method. The test conditions for the corrosion resistance test and evaluation criteria may be agreed upon between the purchaser and the manufacturer.

Table 10 Coating Adherence Test
(*Clause* 8.3.1)

Sl No.	**Type**	**Grade Designation/ Strength**	**Bending Angle**	**Diameter of Mandrel for Bending**, mm					
				t < 1.6 mm for cold-rolled substrate 1.60 mm ≤ t < 3.00 mm for hot-rolled substrate			t ≥ 1.6 mm for cold-rolled substrate t ≥ 3.00 mm		
				up to ZA275	ZA300 to ZA350	ZA450 and Above	Up to ZA 275	ZA300 to ZA350	ZA450 and Above
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Mild steel	IZACCR1	180°	1 *t*	–	–	1 *t*	–	–
		IZACCR2, IZACCR3, IZACCR4, IZACCR5	180°	Close	–	–	Close	–	–
ii)	Structural quality steel (cold-rolled substrate)	Tensile strength ≤ 310 MPa	180°	1 *t*	1 *t*	2 *t*	1 *t*	2 *t*	2 *t*
		310 MPa < Tensile strength ≤ 400 MPa	180°	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
		400 MPa < Tensile strength ≤ 500 MPa	180°	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*
		Tensile strength > 500 MPa	180°	*	*	*	*	*	*
iii)	High strength low alloy steel (cold-rolled substrate)	Tensile strength ≤ 500 MPa	180°	1 *t*	1 *t*	1 *t*	1 *t*	1 *t*	1 *t*
		Tensile strength >500 MPa	180°	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
iv)	Commercial quality steel	IZAHHR1	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
v)	Drawing quality steel	IZAHHR2	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
		IZAHHR3	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
		IZAHHR4	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
vi)	Structural quality steel	IZAH290S	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
		IZAH330S	180°	1 *t*	2 *t*	2 *t*	2 *t*	2 *t*	2 *t*
		IZAH360S	180°	1 *t*	1 *t*	2 *t*	2 *t*	2 *t*	3 *t*

Sl No.	**Type**	**Grade Designation/ Strength**	**Bending Angle**	**Diameter of Mandrel for Bending**, mm					
				$t < 1.6$ mm for cold-rolled substrate 1.60 mm $\leq t < 3.00$ mm for hot-rolled substrate			$t \geq 1.6$ mm for cold-rolled substrate $t \geq 3.00$ mm		
				up to ZA275	ZA300 to ZA350	ZA450 and Above	Up to ZA 275	ZA300 to ZA350	ZA450 and Above
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		IZAH410S	180°	2 *t*	2 *t*	2 *t*	3 *t*	3 *t*	3 *t*
		IZAH430S	180°	2 *t*	2 *t*	2 *t*	3 *t*	3 *t*	3 *t*
		IZAH450S	180°	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*
		IZAH490S	180°	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*
		IZAH540S	180°	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*
		IZAH570S	180°	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*	3 *t*

* These grades are generally not subjected to coating adherence test. If specified, test may be carried out as agreed upon between the purchaser and manufacturer.

NOTES

1 (–) → May be applied based on the mutual agreement between the purchaser and manufacturer.

2 *t* → Nominal thickness of the product.

3 For the remaining grades of hot-rolled substrate and cold-rolled substrate, coating adherence test to be carried out as per the mutual agreement between purchaser and manufacturer and acceptance criteria shall also be agreed upon.

9 SURFACE TREATMENT

9.1 Mill Passivation

If agreed upon at the time of enquiry and order, a chemical treatment may be applied to zinc-5 % aluminium alloy-coated steel sheets and strips to minimize the hazard of wet storage staining (white rust). However, the inhibiting characteristics of the treatment are limited and, if a shipment is received wet, the material shall be used immediately or dried.

9.2 Mill Phosphating

If agreed upon at the time of enquiry and order, the manufacturer shall apply phosphate treatments to zinc-5 % aluminium alloy-coated steel sheets to prepare the surface for painting without further treatment except normal cleaning.

9.3 Oiling

If agreed upon at the time of enquiry and order, the zinc-5 % aluminium alloy-coated steel strip as produced shall be oiled to prevent marring and scratching of the soft surface during handling or shipping and to minimize wet storage stains.

9.4 Thin Organic Film (or Sealing)

If agreed upon at the time of enquiry and order, zinc-5 % aluminium alloy-coated steel sheet as produced shall 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 may be used as a priming coat for subsequent painting based on the mutual agreement between the purchaser and manufacturer.

9.5 As agreed upon between the purchaser and the manufacturer, other applicable and suitable kinds of surface treatments may be applied.

10 MECHANICAL PROPERTIES

10.1 Tensile Test

10.1.1 *Test Frequency*

10.1.1.1 For cold-rolled substrate 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 a hot-dip metallic coating line.

10.1.1.2 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, one additional tensile test shall be made from the material - In the case of strips (for thickness less than 5 mm) — One sample shall be tested for thickness less than 2.00 mm, one sample shall be tested for thickness greater than

2.00 mm and less than 3.20 mm and one sample shall be tested for thickness greater than 3.20 mm.

10.1.2 *Tensile Test Specimen*

Tensile test values apply to the direction and type of specimen mentioned in Table 11A and Table 11B. Strips having a width of 250 mm and below shall be tested longitudinally.

10.1.3 *Testing*

Tensile test to be conducted as per IS 1608 (Part 1) at room temperature and tensile properties that is, yield strength, tensile strength and percent elongation shall meet the requirements specified in Table 11A and Table 11B. The yield strength value applies to lower yield stress or upper yield stress based on mutual agreement between the purchaser and the manufacturer. When there is no specific agreement, the yield strength value applies to lower yield stress. When a definite yield phenomenon is not observed, the yield strength value applies to 0.2 percent proof stress.

10.2 Plastic Strain Ratio (r-bar/r-td)

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

10.2.2 The plastic strain ratio shall be checked in accordance with IS 11999 and results shall conform to as given in Table 11A.

10.2.3 When specified by the purchaser, the plastic strain ratio requirement can be omitted.

10.3 Tensile Strain Hardening Exponent (n-value/n-td)

10.3.1 The tensile strain hardening is an index of the stretchability (n-value/n-td), 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-td is reduced by 0.02.

10.3.2 The tensile strain hardening component shall be checked in accordance with IS 15756 and results shall conform to as given in Table 11A.

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

10.4 Bake Hardening Index (BH)

Bake hardening index shall be as given in Table 11A when tested as per Annex D.

Table 11A Mechanical Property Requirement (for Cold-rolled Substrate)

(*Clauses* 10.1.2, 10.1.3, 10.2.2, 10.3.2,10.4 *and Annex* D)

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2 *Min*	**Yield Point or Proof Stress** N/mm^2			**% Elongation**, *Min* **[Test Piece Type 2 of** IS 1608 (Part 1)**]**			**Testing Direction**	**Bake Hardening Index (BH)** N/mm^2, *Min*	**Plastic Strain Ratio**		**Strain Hardening Exponent**	
				Thickness, *t* mm			Thickness, *t* mm								
				≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70	≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70			r-td, *Min*	r-bar, *Min*	n-td, *Min*	n-value, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
i)	Mild steel[b]	IZACCR0	–	–	–	–	–	–	–	–	–	–	–	–	–
		IZACCR1[b]	270	–	–	–	–	–	22	–	–	–	–	–	–
		IZACCR2	270	140 to 300	140 to 280	140 to 260	26	28	30	Transverse	–	–	–	–	–
		IZACCR3	270	120 to 260	120 to 240	120 to 220	30	32	34	Transverse	–	1.6[a]	1.4[a]	0.18[a]	0.16[a]
		IZACCR4	260	120 to 220	120 to 200	120 to 180	33	35	37	Transverse	–	1.7[a]	1.4[a]	0.2[a]	0.18[a]
		IZACCR5	260	120 to 210	120 to 190	120 to 170	35	37	39	Transverse	–	1.9[a]	1.6[a]	0.21[a]	0.2[a]
ii)	Structural quality steel	IZAC300S	300	220 *Min*			16	18	20	Longitudinal	–	–	–	–	–
		IZAC310S	310	230 *Min*			16	18	20	Longitudinal	–	–	–	–	–
		IZAC330S	330	250 *Min*			15	17	19	Longitudinal	–	–	–	–	–
		IZAC360S	360	280 *Min*			14	16	18	Longitudinal	–	–	–	–	–
		IZAC380S	380	280 *Min*			13	15	17	Longitudinal	–	–	–	–	–
		IZAC410S	410	335 *Min*			12	14	16	Longitudinal	–	–	–	–	–
		IZAC420S	420	350 *Min*			12	14	16	Longitudinal	–	–	–	–	–
		IZAC440S	440	365 *Min*			11	13	15	Longitudinal	–	–	–	–	–
		IZAC460S	460	390 *Min*			11	13	15	Longitudinal	–	–	–	–	–
		IZAC480S	480	420 *Min*			10	12	14	Longitudinal	–	–	–	–	–
		IZAC510S	510	450 *Min*			10	12	14	Longitudinal	–	–	–	–	–

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2 *Min*	**Yield Point or Proof Stress** N/mm^2			**% Elongation**, *Min* **[Test Piece Type 2 of** IS 1608 (Part 1)**]**			**Testing Direction**	**Bake Hardening Index (BH)** N/mm^2, *Min*	**Plastic Strain Ratio**		**Strain Hardening Exponent**	
				Thickness, *t* mm			Thickness, *t* mm								
				≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70	≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70			r-td, *Min*	r-bar, *Min*	n-td, *Min*	n-value, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
		IZAC560S	560	550 *Min*			–	–	–	Longitudinal	–	–	–	–	–
		IZAC570S	570	550 *Min*			–	–	–	Longitudinal	–	–	–	–	–
iii)	Bake-hardening steel	IZAC270B	270	160 to 260	160 to 240	160 to 220	34	36	38	Longitudinal	30	–	1.3	–	0.18
		IZAC290B	290	180 to 280	180 to 260	180 to 240	30	32	34	Transverse	30	1.7	–	0.16	–
		IZAC320B	320	220 to 320	220 to 300	220 to 280	28	30	32	Transverse	30	1.2	–	0.15	–
		IZAC340B	340	220 to 330	220 to 310	220 to 290	28	30	32	Transverse	30	–	1	–	0.15
		IZAC360B	360	260 to 370	260 to 350	260 to 330	24	26	28	Transverse	30	–	–	–	–
		IZAC400B	400	300 to 400	300 to 380	300 to 360	22	24	26	Transverse	30	–	–	–	–
		IZAC440B	440	340 to 440	340 to 420	340 to 400	20	22	24	Transverse	30	–	–	–	–
iv)	Interstitial free-high strength	IZAC300P	300	160 to 260	160 to 240	160 to 220	33	35	37	Transverse	–	1.9	–	0.2	–
		IZAC330P	330	180 to 280	180 to 260	180 to 240	30	32	34	Transverse	–	1.7	–	0.18	--
		IZAC340P	340	180 to 290	180 to 270	180 to 250	28	30	32	Transverse	–	–	1.3	–	0.2
		IZAC360P	360	220 to 330	220 to 310	220 to 290	28	30	32	Transverse	–	1.5	–	0.17	–
		IZAC370P	370	260 to 370	260 to 350	260 to 330	26	28	30	Transverse	–	1.2	–	0.15	–
		IZAC390P	390	280 to 400	280 to 380	280 to 360	23	25	27	Transverse	–	1.3	–	0.15	–
		IZAC440P	440	280 to 420	280 to 400	280 to 380	22	24	26	Transverse	–	–	1.1	–	0.15
v)	C-Mn steel (solid solution strengthening)	IZAC340W	340	220 to 340	220 to 320	220 to 300	29	31	33	Transverse	–	–	–	–	–
		IZAC370W	370	240 to 360	240 to 340	240 to 320	26	28	30	Transverse	–	–	–	–	–
		IZAC390W	390	260 to 390	260 to 370	260 to 350	25	27	29	Transverse	–	–	–	–	–
		IZAC440W	440	280 to 410	280 to 390	280 to 370	22	24	26	Transverse	–	–	–	–	–
		IZAC490W	490	–	310 to 420	310 to 400	–	20	22	Transverse	–	–	–	–	–
		IZAC540W	540	–	330 to 460	330 to 440	–	17	19	Transverse	–	–	–	–	–
		IZAC590W	590	–	350 to 470	350 to 460	–	14	16	Transverse	–	–	–	–	–
vi)	High	IZAC310LA	310	210 to 330	210 to 310	210 to 290	22	24	26	Transverse	–	–	–	–	–

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2 *Min*	**Yield Point or Proof Stress** N/mm^2			**% Elongation**, *Min* **[Test Piece Type 2 of** IS 1608 (Part 1)**]**			**Testing Direction**	**Bake Hardening Index (BH)** N/mm^2, *Min*	**Plastic Strain Ratio**		**Strain Hardening Exponent**	
				Thickness, *t* mm			Thickness, *t* mm								
				≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70	≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70			r-td, *Min*	r-bar, *Min*	n-td, *Min*	n-value, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	strength low alloy steel	IZAC320LA	320	240 to 360	240 to 340	240 to 320	20	22	24	Transverse	–	–	–	–	–
		IZAC340LA	340	260 to 380	260 to 360	260 to 340	20	22	24	Transverse	–	–	–	–	–
		IZAC370LA	370	300 to 420	300 to 400	300 to 380	19	21	23	Transverse	–	–	–	–	–
		IZAC410LA	410	340 to 460	340 to 440	340 to 420	16	18	20	Transverse	–	–	–	–	–
		IZAC440LA	440	–	380 to 460	380 to 440	–	15	17	Transverse	–	–	–	–	–
		IZAC470LA	470	–	420 to 540	420 to 520	–	14	16	Transverse	–	–	–	–	–
		IZAC500LA	500	–	460 to 600	460 to 580	–	10	12	Transverse	–	–	–	–	–
		IZAC530LA	530	–	500 to 640	500 to 620	–	8	10	Transverse	–	–	–	–	–
		IZAC620LA	620	–	550 *Min*	550 *Min*	–	7	9	Transverse	–	–	–	–	–
vii)	Dual phase steel	IZAC450Y	450	260 to 380	260 to 360	260 to 340	23	25	27	Transverse	–	–	–	–	–
		IZAC490Y	490	290 to 420	290 to 400	290 to 380	20	22	24	Transverse	–	–	–	–	–
		IZAC540Y	540	310 to 450	310 to 430	310 to 410	18	20	22	Transverse	–	–	–	–	–
		IZAC590Y	590	330 to 470	330 to 450	330 to 430	16	18	20	Transverse	–	–	–	–	–
		IZAC780Y	780	–	440 to 570	440 to 550	–	12	14	Transverse	–	–	–	–	–
		IZAC980Y	980	–	–	590 to 740	–	–	10	Transverse	–	–	–	–	–
		IZAC980YH	980	–	–	700 to 850	–	–	8	Transverse	–	–	–	–	–
		IZAC1180Y	1180	–	–	740 to 1 000	–	–	7	Transverse	–	–	–	–	–
viii)	TRIP steel	IZAC590T	590	360 to 550	360 to 530	360 to 510	22	24	26	Transverse	–	–	–	–	–
		IZAC690T	690	–	380 to 550	380 to 530	–	19	21	Transverse	–	–	–	–	–
		IZAC780T	780	–	–	410 to 560	–	–	16	Transverse	–	–	–	–	–

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2 *Min*	**Yield Point or Proof Stress** N/mm^2			**% Elongation**, *Min* **[Test Piece Type 2 of** IS 1608 (Part 1)**]**			**Testing Direction**	**Bake Hardening Index (BH)** N/mm^2, *Min*	**Plastic Strain Ratio**		**Strain Hardening Exponent**	
				Thickness, *t* mm			Thickness, *t* mm								
				≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70	≤ 0.5	0.5 < *t* ≤ 0.7	*T* > 0.70			r-td, *Min*	r-bar, *Min*	n-td, *Min*	n-value, *Min*
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
ix)	Complex phase steel	IZAC600N	600	350 to 570	350 to 550	350 to 530	10	12	14	Transverse	–	–	–	–	–
		IZAC780N	780	–	–	500 to 710	–	–	9	Transverse	–	–	–	–	–
		IZAC980N	980	–	–	690 to 910	–	–	6	Transverse	–	–	–	–	–

a It is required to report only one value against the plastic strain ratio (either r-bar or r-td) and strain hardening exponent (n-value or n-td).

b If agreed upon between the purchaser and the supplier, tensile requirements may be omitted.

NOTES

1 1 N/mm^2 = 1 MPa.

2 Stricter mechanical properties' requirements may be agreed upon between the manufacturer and the purchaser, before placing the order.

3 Mechanical properties apply only to annealed followed by skin-passed products.

4 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.

5 (–) → Not required. Where deemed required, the purchaser and the manufacturer can agree up on testing with mutually agreed criteria for evaluation.

6 Based on the mutual agreement between purchaser and manufacturer, different testing directions and test specimen types can be applied while conducting tensile tests. For such cases, mechanical properties requirements will be based on the mutual agreement and those agreed values should be reasonably close to the values mentioned in Table 11A.

7 IZACCR0 is a cold-rolled full hard grade. Based on mutual agreement, a hardness check can be applied.

8 td – Tensile test direction.

Table 11B Mechanical Property Requirement (for Hot-rolled Substrate)

(*Clauses* 10.1.2 *and* 10.1.3)

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2	**Yield Point or Proof Stress** N/mm^2 *Min*	**Elongation**, Percent, *Min*				**Testing Direction**
					$t \leq 3.0$ mm		$t > 3.0$ mm		
					Test Piece Type 2 of IS 1608 (Part 1)	Test Piece Type 3 of IS 1608 (Part 1)	Gauge Length $L_0 = 5.65\sqrt{S_0}$	Gauge Length $L_0 = 50$ mm	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Commercial quality steel	IZAHHR1	440 *Max*	–	23	24	28	29	Transverse
ii)	Drawing quality steel	IZAHHR2	420 *Max*	–	25	26	30	31	Transverse
		IZAHHR3	400 *Max*	–	28	29	33	34	Transverse
		IZAHHR4	380 *Max*	–	31	32	36	37	Transverse
iii)	Structural quality steel	IZAH290S	290 *Min*	165 *Min*	22	–	30	–	Transverse
		IZAH330S	330 *Min*	205 *Min*	20	–	28	–	Transverse
		IZAH360S	360 *Min*	235 *Min*	19	–	26	–	Transverse
		IZAH410S	410 *Min*	255 *Min*	17	–	23	–	Transverse
		IZAH430S	430 *Min*	320 *Min*	12	–	21	14	Transverse
		IZAH450S	450 *Min*	350 *Min*	10	–	20	12	Transverse
		IZAH490S	490 *Min*	355 *Min*	10	–	20	–	Transverse
		IZAH540S	540 *Min*	380 *Min*	10	–	17	12	Transverse
		IZAH570S	570 *Min*	450 *Min*	–	–	–	–	Transverse
iv)	High strength low alloy high yield ratio steel	IZAH320LA	320 to 420	255 *Min*	25	–	27	–	Transverse
		IZAH360LA	360 to 460	300 *Min*	23	–	25	–	Transverse
		IZAH390LA	390 to 510	315 *Min*	20	–	24	–	Transverse
		IZAH410LA	410 to 520	340 *Min*	20	–	23	–	Transverse
		IZAH430LA	430 to 550	355 *Min*	19	–	23	–	Transverse
		IZAH450LA	450 to 570	380 *Min*	18	–	21	–	Transverse
		IZAH480LA	480 to 620	420 *Min*	16	–	19	–	Transverse
		IZAH500LA	500 to 670	450 *Min*	14	–	18	–	Transverse
		IZAH550LA	550 to 700	500 *Min*	12	–	14	–	Transverse
		IZAH600LA	600 to 760	550 *Min*	12	–	14	–	Transverse
		IZAH650LA	650 to 820	600 *Min*	11	–	13	–	Transverse

Sl No.	**Type and Designation**		**Tensile Strength** N/mm^2	**Yield Point or Proof Stress** N/mm^2 *Min*	**Elongation**, Percent, *Min*				**Testing Direction**
					$t \leq 3.0$ mm		$t > 3.0$ mm		
					Test Piece Type 2 of IS 1608 (Part 1)	Test Piece Type 3 of IS 1608 (Part 1)	Gauge Length $L_0 = 5.65\sqrt{S_0}$	Gauge Length $L_0 = 50$ mm	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		IZAH700LA	700 to 880	650 *Min*	10	–	12	–	Transverse
		IZAH750LA	750 to 950	700 *Min*	10	–	11	–	Transverse
v)	High strength structural steel	IZAH440R	440	305 *Min*	–	26	–	28	Transverse
		IZAH490R	490	355 *Min*	–	22	–	24	Transverse
		IZAH540R	540	410 *Min*	–	19	–	21	Transverse
		IZAH590R	590	450 *Min*	–	17	–	19	Transverse
		IZAH780R	780	675 *Min*	–	14	–	15	Transverse
vi)	High hole expansion ratio steel	IZAH440FB	440	265 *Min*	–	28	–	33	Longitudinal

NOTES

1 1 N/mm^2 = 1 MPa.

2 Stricter mechanical properties requirements may be agreed upon between the manufacturer and the purchaser, before placing the order.

3 Mechanical properties apply only to annealed followed by skin-passed products.

4 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.

5 (–) → Not required. Where deemed required, the purchaser and the manufacturer can agree up on testing with mutually agreed criteria for evaluation.

6 Minimum tensile strength for IZAHHR1, IZAHHR2, IZAHHR3 and IZAHHR4 would normally be expected to be 270 MPa. Where minimum tensile strength is required, the value of 270 MPa may be specified. All tensile strength values are determined to the nearest 10 MPa.

7 Based on the mutual agreement between the 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 11B.

8 For Grade IZAH440FB, minimum hole expansion (HER) required shall be 70 percent. The test shall be conducted in accordance with IS 17414.

10.5 Bend Test

a) Unless otherwise agreed upon mutually, bend test shall be carried out in accordance with IS 1599 for the cold-rolled substrate.
b) The angle of bend and the internal diameter for the different grades of material shall be as given in Table 12.
c) The axis of the bend shall be perpendicular to the direction of rolling. The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks.
d) When specified by the purchaser, the bend test can be omitted.
e) The bend test is applicable to fully annealed steel products only.

Table 12 Requirements for Bend Test for Cold-rolled Substrate
(*Clause* 10.5)

Sl No.	**Minimum Tensile Strength** MPa	**Bend Angle**	**Bend Radius** (*t* = Thickness of Sheet)
(1)	(2)	(3)	(4)
i)	340	180°	Close
ii)	370	180°	Close
iii)	390	180°	Close
iv)	440	180°	Close
v)	490	180°	Close
vi)	540	180°	0.5 *t*
vii)	590	180°	1 *t*
viii)	780	180°	3 *t*
ix)	900	180°	4 *t*
x)	980	180°	4 *t*
xi)	1 100	180°	4 *t*

NOTES

1 For grades, where a minimum tensile requirement is not mentioned in the above table, the nearest minimum tensile strength value can be applied.

2 Based on mutual agreement, stricter test conditions can be applied.

10.6 Hardness Test

If specified by the purchaser, the hardness test shall be carried out in accordance with IS 1586 (Part 1) for Rockwell hardness and as per IS 1501 (Part 1) for Vickers hardness. The evaluation criteria shall be subject to mutual agreement between the purchaser and the manufacturer.

10.7 Ageing Period

The values mentioned against the requirements for different mechanical properties are applicable for the periods mentioned in Table 13 from the date, product is available for the shipment at manufacturer's end.

Table 13 Ageing Period Requirement for Cold-rolled Substrate
(*Clause* 10.7)

Sl No.	Type and Designation		Applicable Non-Ageing Period
(1)	(2)	(3)	(4)
i)	Mild steel	IZACCR2	8 Days
		IZACCR3	1 Month
		IZACCR4	6 Months
		IZACCR5	6 Months
ii)	Bake-hardening steel	IZAC270B	3 Months
		IZAC290B	3 Months
		IZAC320B	3 Months
		IZAC340B	3 Months
		IZAC360B	3 Months
		IZAC400B	3 Months
		IZAC440B	3 Months
iii)	Interstitial free-high strength	IZAC300P	6 Months
		IZAC330P	6 Months
		IZAC340P	6 Months
		IZAC360P	6 Months
		IZAC370P	6 Months
		IZAC390P	6 Months
		IZAC440P	6 Months

NOTES
1 Applicable non-ageing period is applicable only for the type and designation mentioned in Table 13. 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.

10.8 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 5 from the actual measured thickness including the coating layers;
c) Results after subtracting the equivalent coating thickness of the actual measured coating mass from the measured thickness including the coating layers; and
d) Refer to Annex B for calculating coating thickness based on coating mass.

11 DIMENSIONS, SHAPE AND TOLERANCES

11.1 Coil Inner Diameter

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

11.2 Tolerances

Tolerances on dimensions (thickness, width, length), shape (flatness, waviness), camber, and out-of- squareness shall be as per IS/ISO 16163.

11.3 Plates, sheets and strips may be supplied either with mill or trimmed edges. 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. For edges trimmed after cold rolling, annealing and coating, width tolerances shall be as per IS/ISO 16163.

11.4 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.

12 RETEST

12.1 When any portion of the test results does not meet the specified requirements, two additional sets of test samples from the same lot must be retested for the relevant specific test criteria to determine the overall acceptability of the lot.

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

12.3 On any tensile test, if any part of the fracture is outside the gauge length scribed before the test, the test shall be discarded and a retest carried out.

13 STRAIN AGEING

13.1 Zinc - 5% Aluminium 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.

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

13.3 The details given above are for information and the purchaser may adopt the same at their discretion.

14 SURFACE APPEARANCE

14.1 The steel sheet, plate 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.

14.2 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 the manufacturer for treating such cases.

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

14.4 For zinc - 5% aluminium alloy-coated steel sheets and strips, defects that are inherent like dull surface, random black spots, presence of visible airflow patterns, surface darkening, orange peel, flow marks should not be a reason for rejection if it meets the end application and requirements. The acceptance level of these defects may be as per mutual agreements between the purchaser and the manufacturer.

14.5 The required surface quality of the zinc - 5% aluminium alloy-coated steel sheets and strips shall be as follows and to be fixed during placing of the order.

a) *As Coated Surface (AC)* — Imperfections such as pimples, marks, scratches, pits, variation in surface appearance, dark spots, strip marks and slight passivation marks are permissible. Stretch levelling marks may appear.

b) Improved Surface (B) — With this surface quality, small imperfections such as stretch levelling marks, skin pass marks, run-off marks, slight passivation stains are permissible.

c) Best Quality Surface (I) — The controlled surface shall make it possible to apply a uniform high class paint finish. The other surface shall at least have the characteristics of surface quality of the improved surface.

15 PACKING

Zinc - 5% aluminium alloy-coated steel sheets and strips should be suitably packed to avoid transit/handling/storage damage and as per the agreement between the purchaser and the manufacturer.

16 MARKING

16.1 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) Manufacturer’s name or trade-mark;
b) Material identification/coil number/packet number/batch number etc;
c) Product dimensions;
d) Number of sheets or mass;
e) Designation of zinc - 5% aluminium alloy-coated hot-rolled and cold reduced carbon steel sheet/strip;
f) Date of manufacture.

16.2 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.

17 STORAGE AND TRANSPORTATION

17.1 Moisture, in particular condensation between the sheets, laps of the coil or other adjacent parts made of hot dip-coated flat products, can lead to the formation of corrosion products. The possible types of temporary surface protection are given in **9**. As a precaution, the products should be transported and stored dry and protected from moisture.

17.2 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 209 : 2024	Refined Zinc - Specification (*fifth revision*)
IS 228 (in various parts)	Methods for chemical analysis of steels
IS 277 : 2018	Galvanized steel strips and sheets (plain and corrugated) - Specification (*seventh revision*)
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 1 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): 2020/ ISO 6507-1 : 2018	Metallic materials — Vickers hardness test: Part 1 Test method (*fifth revision*)
IS 1586 (Part 1) : 2018/ ISO 6508-1 : 2016	Metallic materials — Rockwell hardness test: Part 1 Test method (*fifth revision*)
IS 1599:2023/ ISO 7438 : 2020	Metallic Materials — Bend Test (*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 2590 : 1987	Specification for primary aluminium ingots for remelting for general engineering purposes (*second revision*)
IS 2629 : 1985	Recommended practice for hot-dip galvanizing of iron and steel (*first revision*)
IS 3531 : 1997	Glossary of terms relating to corrosion of metals (*second revision*)
IS 5528:202/ 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 6694:1999	Magnesium ingots - Specification (*second revision*)

IS 6745 : 1972	Methods for determination of mass of zinc coating on zinc coated iron and steel articles
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
IS 15756 : 2022/ ISO 10275 : 2020	Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent (*first revision*)
IS/ISO 16163 : 2012	Continuously hot-dipped coated steel sheet products — Dimensional and shape tolerances (*first revision*)
IS 17414 : 2020/ ISO 16630 : 2017	Metallic materials — Sheet and strip — Hole expanding test

ANNEX B
(*Clauses* 3.1, 8.2.4 *and* 10.8)

ORDERS REQUIRING BASE-METAL THICKNESS

B-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. 1.

Thickness tolerance tables apply to the product thickness.

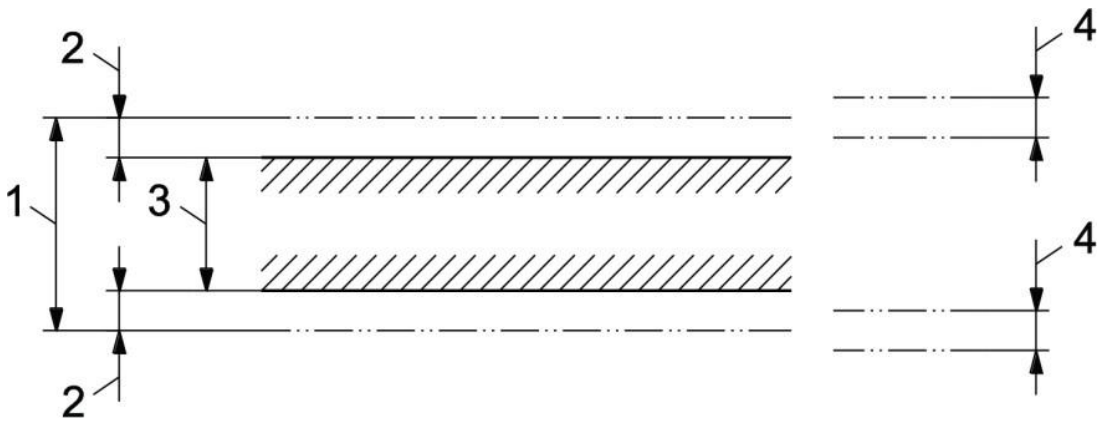


FIG.1 CALCULATION OF THE PRODUCT THICKNESS

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

The equivalent coating thickness may be calculated from coating mass, for example, as follows:

$$t_z = m_z/2d$$

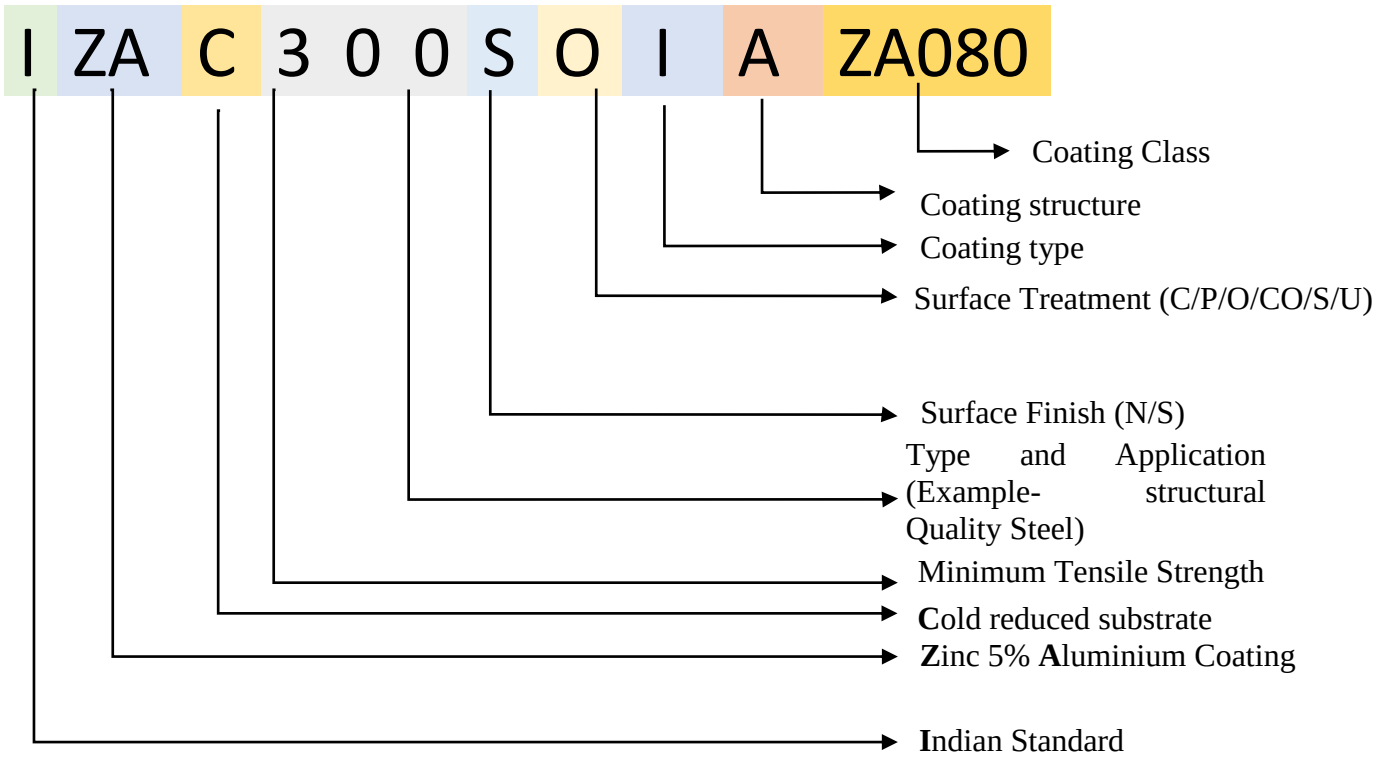
where

t_z = equivalent coating thickness (μm);
m_z = coating mass on both surfaces (g/m^2); and
d = coating density (g/cm^3).

NOTE — The approximate coating density for Zinc-5% Aluminium alloy may be taken as 6.6 g/cm^3.

ANNEX C
(*Clause* 5)

NOMENCLATURE

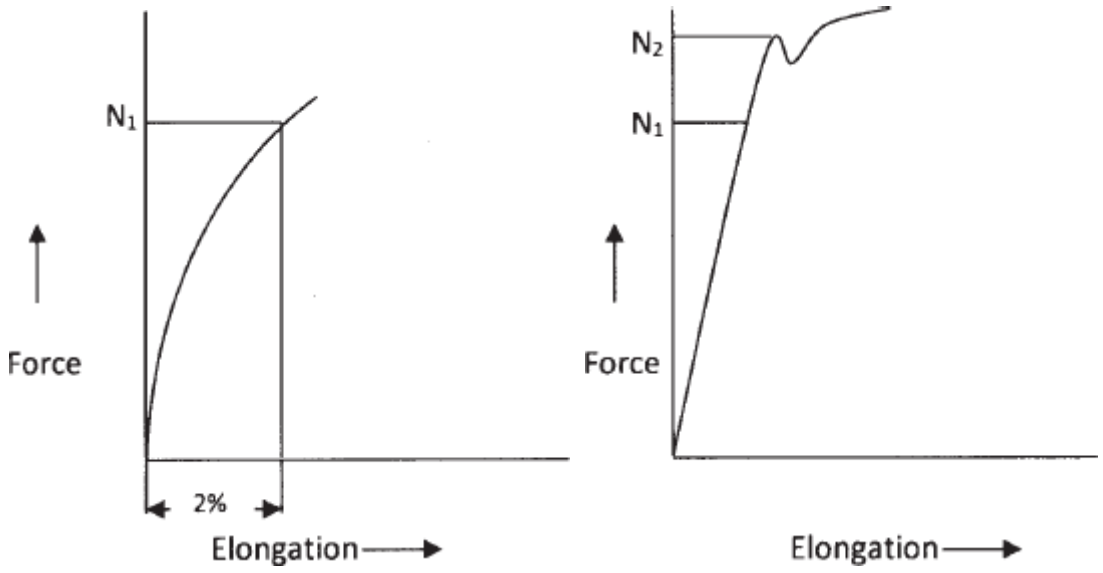


ANNEX D
(*Clause* 10.4)

C-1 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:

a) Test specimens shall be collected from annealed skin-passed material in the direction mentioned as per Table 11A and . Tensile specimen to be prepared as per IS 1608 (Part 1);
b) The parallel portion area of the test piece shall be noted be as A_0;
c) The test specimen shall be strained to two percent tensile elongation. The corresponding force shall be noted as N_1;
d) The specimen shall be unloaded from the tensile tester and heat treated for 20 min at a temperature of 170 °C;
e) 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 N_2;
f) The BH value calculation shall be obtained as $BH = (N_2 – N_1)/A_0$; and
g) BH value calculation is schematically represented in below Fig. 2.



Preliminary strain loading After baking process – heat treatment

FIG. 2 SCHEMATIC REPRESENTATION of BH VALUES