INTERNATIONAL STANDARD

ISO 9364

Second edition
2001-11-15

Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities

Tôles en acier revêtues en continu par immersion à chaud d'une couche d'alliage aluminium-zinc de qualité commerciale, pour emboutissage ou destinées à la construction

Reference number
ISO 9364:2001(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9364 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 12, *Continuous mill flat rolled products*.

This second edition cancels and replaces the first edition (ISO 9364:1991), which has been technically revised.

Annex A forms a normative part of this International Standard.

Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities

1 Scope

1.1 This International Standard specifies the characteristics of steel of commercial, drawing and structural qualities coated by a continuous hot-dip aluminium/zinc alloy coating process. The aluminium/zinc alloy composition by mass is nominally 55 % aluminium, 1,6 % silicon and the balance zinc. The product is intended for applications where the corrosion characteristics of aluminium coupled with those of zinc are desired.

1.2 Aluminium/zinc-coated steel sheet is produced in thicknesses up to 5 mm after coating, and in widths of 600 mm and over in coils and cut lengths. Aluminium/zinc-coated steel sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

NOTE Values of total theoretical thickness for coating mass are given in annex A.

1.3 Commercial quality aluminium/zinc-coated steel sheet (quality 01) is intended for general fabricating purposes where sheet is used in the flat, or for bending or moderate forming.

1.4 Drawing quality aluminium/zinc-coated steel sheet (qualities 02 and 03) are intended for drawing or severe forming. It is furnished to all the requirements of this International Standard or, with agreement when ordered, to fabricate an identified part, in which case the mechanical properties of Table 3 do not apply.

Drawing qualities are identified as follows:

02: Drawing quality

03: Deep drawing quality

1.5 Structural quality aluminium/zinc-coated steel sheet is produced in six grades as defined by a minimum yield stress.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2178:1982, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 3497:2000, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
continuous hot-dip aluminium/zinc coated steel sheet
product obtained by hot-dip coating steel sheet coils on a continuous aluminium/zinc coating line to produce either coated coils or cut lengths

3.2
types of aluminium/zinc coatings

3.2.1
normal spangle coating
coating formed as a result of unrestricted growth of aluminium/zinc crystals during normal solidification

3.2.2
smooth finish
smooth coating produced by skin-passing the coated material in order to achieve an improved surface condition as compared with the normal as-coated product

NOTE End-use applications may require negotiations between the supplier and consumer in order to establish specific surface requirements.

3.3
skin pass
a light cold rolling of the product

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

a) to minimize the appearance of coil breaks, stretcher strains and fluting;

b) to control the shape;

c) to obtain the required surface finish.

3.4
aluminum killed
deoxidized with aluminum sufficient to prevent the evolution of gas during solidification

3.5
resquared
attempt to approach a true 90° angle at the shear cut

NOTE 1 This normally applies to steel sheet for which tighter than standard width, length, camber or out-of-square tolerances are required and which typically necessitates an additional shearing operation after the sheet has been cut to length from a coil.

NOTE 2 “Resquared” is referred to as “restricted” in some areas of the world.

4 Designations

4.1 General

The designation system includes the coating mass designation, coating condition, surface treatment, quality and grade of steel.

The letters AZ in Table 1 are used to indicate 55 % aluminium/zinc coating.

4.2 Coating mass

The coating mass designations are 90,100, 150, 165, 185 and 200 as listed in Table 1.

The coating is expressed as the total mass on both surfaces in g/m^2. The coating mass specified shall be compatible with the desired service life, the thickness of the base metal and the forming requirements involved.

4.3 Coating type

The type of coating is designated as:

N normal spangle coating (as coated);

S skin-passed for improved surface (smoother) condition.

4.4 Surface treatment

The surface treatment is designated as:

A oiling;

B mill passivation plus oiling;

C mill passivation;

D no surface treatment.

4.5 Base metal quality

This is designated as:

01 commercial quality;

02 drawing quality;

03 deep drawing quality.

Structural quality grades are indicated by three digits as listed in Table 2.

4.6 Complete designation

EXAMPLE 1

Steel sheet with a coating of 55 % aluminium/zinc of mass 150, of normal spangle quality, that has undergone mill passivation and is of drawing quality, aluminium killed is designated as follows:

AZ150NC02

EXAMPLE 2

Steel sheet with a coating of 55 % aluminium/zinc of mass 150, in the skin-passed condition, that has undergone mill passivation plus oiling and is of structural quality grade is designated as follows:

AZ150SB350

Table 1 — Coating mass test limits for aluminium/zinc-coated steel sheet

Coating designation	Triple-spot test total both sides min. g/m^2	Single-spot test, total both sides min. g/m^2
AZ090	90	75
AZ100	100	85
AZ150	150	130
AZ165	165	140
AZ185	185	160
AZ200	200	170

NOTE The coating mass in grams per square metre refers to the total coating on both surfaces. Because of the many variables and changing conditions that are characteristic of continuous hot-dip coating, the coating mass is not always evenly divided between the two surfaces of a sheet, neither is the coating evenly distributed from edge to edge. However, it can normally be expected that no less than 40 % of the single-spot test limit will be found on either surface.

Table 2 — Mechanical properties of structural-quality steels and coating bend test

Grade	R_e min. N/mm^2	R_m min. N/mm^2	A min.[a] %		Coated metal 180° bend mandrel diameter mm	
			L_o = 50 mm	L_o = 80 mm	$e < 3$	$e \geqslant 3$
220	220	320	20	18	1 e	2 e
250	250	350	18	16	1 e	2 e
280	280	390	16	14	2 e	3 e
320	320	430	14	12	3 e	3 e
350	350	450	12	10	—	—
550[b]	550	560	—	—	—	—

R_e = yield stress – can be either R_{eL} or R_{eH} but not both

R_{eL} = lower yield stress

R_{eH} = higher yield stress

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

e = thickness of bend test piece

1 N/mm^2 = 1 MPa

NOTE 1 R_{eL} can be measured by 0,5 % total elongation proof stress (proof stress under load) or by 0,2 % offset when a definite yield phenomenon is not present.

NOTE 2 In determining the base metal mechanical properties, base metal thickness should be measured after stripping the coating from the end of the specimen contacting the grips of the tensile-testing machine before testing.

[a] Use either L_o = 50 mm or L_o = 80 mm to measure elongation. For material up to and including 0,6 mm in thickness, the elongation values in the table shall be reduced by 2.

[b] Grade 550 is the unannealed condition and therefore has limited ductility. If the hardness is HRB 85 or higher, no tensile test is required.

5 Manufacturing processes

5.1 Strain ageing

Aluminium/zinc coated steel sheet tends to strain age, and this may lead to the following:

a) surface marking from stretcher strain (Luder's lines) or fluting when the steel is formed;

b) a deterioration in ductility.

Because of these factors, it is essential that the period between final processing at the mill and fabrication be kept to a minimum. Rotation of stock, by using the oldest material first, is important. Reasonable freedom from stretcher strain can be achieved by effective roller levelling immediately prior to fabrication at the purchaser's plant.

5.2 Mill passivation

A chemical treatment may be applied to aluminium/zinc-coated steel sheet to minimize the hazard of wet storage stain during shipment and storage. However, the inhibiting characteristics of the treatment are limited and if a shipment is received wet, the material shall be used immediately or dried.

5.3 Painting

Hot-dip aluminium/zinc-coated steel sheet is a suitable base for paint but the first treatment may be different from those used on mild steel. Pretreatment primers, chemical conversion coatings (chromate, phosphate or oxide type) and some paints specially formulated for direct application to zinc surfaces are all appropriate first treatments for hot-dip zinc/aluminium-coated sheet. In a painting schedule, it should be considered whether the product should be ordered with or without chemical passivation. Surfaces with certain passivation treatments (e.g. chromated) are not suitable for phosphating or the application of a pretreatment (etch) primer.

5.4 Oiling

Oiling of the as-produced aluminium/zinc-coated steel sheet prevents marring and scratching of the soft surface during handling or shipping and helps to minimize the hazard of wet storage stains (known as black rust on this type of product). For these reasons, the purchaser is advised to consider specifying the aluminium/zinc-coated steel in the oiled condition, provided this is compatible with his processing system.

5.5 Coating line butt welds

These may be permitted if agreed upon between the manufacturer and purchaser.

6 Conditions of manufacture

6.1 Steelmaking

The processes used in making the steel and in manufacturing aluminium/zinc-coated sheet are left to the discretion of the manufacturer. When requested, the purchaser shall be informed of the steelmaking process being used.

6.2 Chemical composition of the steel

The chemical composition (heat analysis) shall be in accordance with the values given in Tables 3 and 4.

6.3 Chemical analysis

6.3.1 Heat analysis

A heat analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements of Tables 3 and 4. When requested, this analysis shall be reported to the purchaser or his representative.

6.3.2 Product analysis

A product analysis may be made by the purchaser to verify the specified analysis of the product and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to product analysis. For killed steels, the sampling method and deviation limits shall be agreed upon between manufacturer and purchaser at the time of ordering.

Table 3 — Chemical composition (heat analysis) %

Base Metal Quality		C	Mn	P	S
Name	Designation	max.	max.	max.	max.
Commercial	01	0,10	0,60	0,030	0,035
Drawing	02 and 03	0,06	0,50	0,020	0,025
Structural	220 to 550	0,25[a]	1,15	0,20[b]	0,040

[a] Grade 350 may exceed the limits given in Table 4 or conform to all requirements of Table 4 and have 0,40 % max. carbon.

[b] Grades 250 and 280 phosphorus: 0,10 % max. Grade 350: phosphorus: 0,20 % max.

Table 4 — Limits on additional chemical elements[a]

Element max. %	Heat analysis	Product analysis
Cu[b]	0,20	0,23
Ni[b]	0,20	0,23
Cr[b, c]	0,15	0,19
Mo[b, c]	0,06	0,07
Nb[d]	0,008	0,018
V[d]	0,008	0,018
Ti[d]	0,008	0,018

[a] Each of the elements listed in this table shall be included in the report of the heat analysis. When the amount of copper, nickel, chromium or molybdenum present is less than 0,02 %, the analysis may be reported as "< 0,02 %".

[b] The sum of copper, nickel, chromium and molybdenum shall not exceed 0,50 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[c] The sum of chromium and molybdenum shall not exceed 0,16 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining elements will apply.

[d] Heat analysis greater than 0,008 % may be supplied after agreement between producer and consumer.

6.4 Steel substrate

Unless otherwise agreed between interested parties, the rolling condition of the sheets to be coated (cold rolled sheet or hot-rolled sheet) is at the discretion of the manufacturer.

6.5 Coating mass

The coating mass shall conform to the requirements presented in Table 1 for the specified coating designation. The coating mass is the total amount of the aluminium/zinc alloy, including both sides of the sheet, expressed in grams per square metre (g/m^2) of sheet. Methods of checking that the material complies with this International Standard are given in 8.2.1 and 9.2.2 to 9.2.4.

6.6 Weldability

The product is suitable for welding if appropriate welding conditions are selected with special attention paid to the heavier coatings. If appropriate welding conditions are selected, the product is suitable for spot welding and roller seam welding, as well as fusion welding.

When the carbon content increases above 0,15 %, spot welding becomes increasingly difficult. Because the heat of welding might have a significant effect on lowering the strength of grade 550, this grade is not recommended for welding.

6.7 Application

It is desirable that the specified product be identified for fabrication by name of the part or by intended application, which shall be compatible with the grade and coating designation specified. Proper identification of the part may include visual examination, prints or description, or a combination of these.

Drawing qualities (02 and 03) may be produced to make an identified part according to a performance criteria or within a properly established breakage allowance, which shall be previously agreed upon between the interested parties. In these cases, the part name, the details of fabrication and special requirements (such as freedom from stretcher strain or fluting) shall be specified and the mechanical properties in Table 5 do not apply.

6.8 Mechanical properties

6.8.1 Drawing qualities

Except when ordered according to an identified part as explained in 6.7, at the time that the steel is made available for shipment, the mechanical properties shall be as stated in Table 5 when they are determined on test pieces obtained in accordance with requirements of 8.1.

NOTE Prolonged storage of the sheet may cause a change in the mechanical properties (increase in hardness and decrease in elongation) leading to adverse effect on formability. See note 1, Table 5.

6.8.2 Structural qualities

At the time that the steel is made available for shipment, the mechanical properties shall be as stated in Table 2 when they are determined on test pieces obtained in accordance with the requirements of clause 8.1.

7 Dimensional tolerances

7.1 Dimensional tolerances shall be in accordance with Tables 6 to 17. The thickness is the total of the base metal and the coating.

7.2 Restricted tolerances are given in Tables 8, 9 and 16.

Table 5 — Mechanical properties

Base Metal Quality		R_e max.[a]	R_m max.[b]	A min[c] %		
Name	**Designation**	N/mm [b,d]	N/mm^2	L_o = 50 mm	L_o = 80 mm	$L_o = 5{,}65\sqrt{S_o}$ [e]
Commercial	01	—	—	—	—	—
Drawing	02	300[f]	430	24	23	22
Deep drawing	03	260	410	26	25	24

R_e = yield stress

R_m = tensile strength

A = percentage elongation after fracture

L_o = gauge length on test piece

S_o = original cross-sectional area of gauge length

NOTE 1 Time periods that may be applied for values stated in this table:

Quality	**Time period**
Commercial	—
Drawing	8 days
Deep drawing	1 month

NOTE 2 For products produced according to performance criteria, the typical mechanical properties presented here are non-mandatory. They are intended solely to provide the purchaser with as much information as possible to make an intelligent ordering decision. Values outside these ranges are to be expected. The purchaser may negotiate with the supplier if a specific range, or a more restrictive range, is required for the application.

NOTE 3 These typical mechanical properties apply to the full range of steel sheet thicknesses. The yield tends to increase and some of the formability aspects tend to decrease as the sheet thickness decreases.

[a] The yield values apply to 0,2 % proof stress if the yield point is not pronounced, otherwise to the lower yield point (R_{eL}).

[b] Minimum tensile strength for drawing qualities would normally be expected to be 260 N/mm^2. All tensile strength values determined to the nearest 10 N/mm^2.

[c] For material $\leqslant$ 0,6 mm in thickness, the elongation values in the table shall be reduced by 2.

[d] 1 N/mm^2 = 1 MPa.

[e] May be used for material $\geqslant$ 3 mm in thickness.

[f] This value applies to skin-passed products only.

Table 6 — Normal thickness tolerances for commercial and drawing quality coils and cut lengths

Values in millimetres

Specified width	Thickness tolerances[a] for specified thicknesses[b]										
	⩽ 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**
600 ⩽ 1 200	± 0,05	± 0,06	± 0,08	± 0,09	± 0,10	± 0,12	± 0,18	± 0,19	± 0,21	± 0,23	± 0,25
> 1 200 ⩽ 1 500	± 0,06	± 0,07	± 0,09	± 0,10	± 0,11	± 0,13	± 0,20	± 0,22	± 0,23	± 0,25	± 0,27
> 1 500 ⩽ 1 800	—	± 0,09	± 0,10	± 0,11	± 0,13	± 0,15	± 0,22	± 0,24	± 0,25	± 0,27	± 0,29

NOTE Given the difference in tolerances and physical properties of hot-rolled and cold-rolled sheet products, the user and supplier may negotiate a specific type of substrate.

Where thickness tolerance is based on base metal thickness the value of 0,01mm will be subtracted from the values in these tables.

[a] The 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.

[b] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 7 — Normal Thickness tolerances for structural-quality coils and cut lengths

Values in millimetres

Specified width	Thickness tolerances[a] for specified thickness[b]										
	⩽ 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**
600 ⩽ 1 200	± 0,06	± 0,07	± 0,09	± 0,10	± 0,11	± 0,13	± 0,18	± 0,19	± 0,21	± 0,23	± 0,25
> 1 200 ⩽ 1 500	± 0,07	± 0,08	± 0,10	± 0,11	± 0,12	± 0,14	± 0,20	± 0,22	± 0,23	± 0,25	± 0,27
> 1 500 ⩽ 1 800	—	± 0,10	± 0,11	± 0,12	± 0,14	± 0,16	± 0,22	± 0,24	± 0,25	± 0,27	± 0,29

NOTE 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.

Where thickness tolerance is based on base metal thickness the value of 0,01 mm will be subtracted from the values in these tables.

[a] Thickness tolerances for sheet in coil form are the 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. For specified strength levels of R_e = 360 N/mm^2 and greater increase the thickness tolerances by 10 %, by applying normal rounding off procedures. Tolerances for grade 550 shall be as agreed upon between the purchaser and the manufacturer.

[b] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 8 — Restricted thickness tolerances for commercial, drawing and structural quality coils and cut lengths — Hot rolled substrate

Values in millimetres

Specified width	Thickness tolerances[a] for specified thicknesses[b]				
	⩽ 2,0	> 2,0 ⩽ 2,5	> 2,5 ⩽ 3,0	> 3,0 ⩽ 4,0	> 4,0 ⩽ 5,0
600 ⩽ 1 200	± 0,14	± 0,15	± 0,16	± 0,18	± 0,20
> 1 200 ⩽ 1 500	± 0,15	± 0,16	± 0,18	± 0,19	± 0,22
> 1 500 ⩽ 1 800	± 0,15	± 0,18	± 0,20	± 0,22	± 0,23

[a] Thickness tolerances for sheet in coil form are the 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. For specified strength levels of R_e = 360 N/mm^2 and greater tolerances are increased by 10 %, applying normal rounding off procedures. Tolerances for grade 550 shall be as agreed upon between the purchaser and the manufacturer.

[b] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

NOTE Where thickness tolerance is based on base metal thickness the value of 0,01 mm will be subtracted from the values in these tables.

Table 9 — Restricted thickness tolerances for commercial, drawing and structural quality coils and cut lengths — Cold-rolled substrate

Values in millimetres

Specified width	Thickness tolerances[a] for specified thickness[b]									
	⩽ 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
600 ⩽ 1 200	± 0,035	± 0,045	± 0,05	± 0,055	± 0,065	± 0,08	± 0,09	± 0,11	± 0,12	± 0,13
> 1 200 ⩽ 1 500	± 0,045	± 0,055	± 0,06	± 0,07	± 0,08	± 0,09	± 0,10	± 0,12	± 0,13	± 0,14
> 1 500 ⩽ 1 800	—	± 0,06	± 0,07	± 0,07	± 0,08	± 0,09	± 0,10	± 0,12	± 0,13	± 0,14

NOTE Where thickness tolerance is based on base metal thickness the value of 0,01 mm will be subtracted from the values in these tables.

[a] Thickness tolerances for sheet in coil form are the 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. For specified strength levels of R_e = 360 N/mm^2 and greater increase the thickness tolerances by 10 %, by applying normal rounding off procedures. Tolerances for grade 550 shall be as agreed upon between the purchaser and the manufacturer.

[b] Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Table 10 — Width tolerances for coils and cut lengths, not resquared

Values in millimetres

Specified width	Tolerance
⩽ 1 500	$^{+7}_{0}$
> 1 500 ⩽ 1 800	$^{+10}_{0}$

NOTE For resquared material more restrictive tolerances are subject to negotiation.

Table 11 — Length tolerances for cut lengths, not resquared

Values in millimetres

Specified length	Tolerance
$\leqslant$ 3 000	$^{+20}_{0}$
$>$ 3 000 $\leqslant$ 6 000	$^{+30}_{0}$
$>$ 6 000	+ 0,5 % $\times$ length 0
NOTE For resquared material more restrictive tolerances are subject to negotiation.	

Table 12 — Camber tolerances for coils and cut lengths, not resquared

Form	Camber tolerance
Coils	20 mm in any 5 000 mm length
Cut lengths	0,4 % $\times$ length
NOTE 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 Fgure 1.	
NOTE 2 For resquared material more restrictive tolerances are subject to negotiation.	

Table 13 — Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1 % $\times$ 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 Figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.	

Table 14 — Out-of square tolerances for resquared material

Values in millimetres

Specified length	Specified width	Out-of square tolerance
⩽ 3 000	⩽ 1 200	$^{+2}_{0}$
	> 1 200	$^{+3}_{0}$
> 3 000	All widths	$^{+3}_{0}$

NOTE 1 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 Figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

NOTE 2 When measuring material ordered to resquared tolerances, consideration may have to be given to extreme variations in temperature.

Table 15 — Standard flatness tolerances for commercial and drawing quality in cut lengths[a]

Values in millimetres

Specified thickness	Specified width	Flatness tolerance
⩽ 0,7	⩽ 1200	15
	> 1 200 ⩽ 1 500	18
	> 1 500	22
> 0,7 ⩽ 1,2	⩽ 1200	12
	> 1 200 ⩽ 1 500	15
	> 1 500	19
> 1,2	⩽ 1 200	10
	> 1 200 ⩽ 1 500	12
	> 1 500	17

NOTE 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 Figure 3.

[a] This table also applies to sheet cut to length from coils by the customer when agreed-upon flattening procedures are performed. For specified strength levels of R_{eL} = 360 N/mm^2 and greater increase the flatness tolerances by 25 %. These tolerances are only applicable to sheet ⩽ 5 000 mm length when the thickness is 5 mm or less. Tolerances for sheet exceeding 5 000 mm in length shall be subject to agreement.

Table 16 — Restricted flatness tolerances for commercial and drawing quality in cut lengths[a]

Values in millimetres

Specified thickness	Specified width	Specified length	Flatness tolerance
⩽ 2	⩽ 1 200	⩽ 2 500	9
	> 1 200	> 2 500	15
> 2 ⩽ 5	⩽ 1 200	⩽ 2 500	8
	> 1 200	> 2 500	13

NOTE 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 Figure 3.

[a] Tolerances for sheet > 5 000 mm in length shall be subject to agreement.

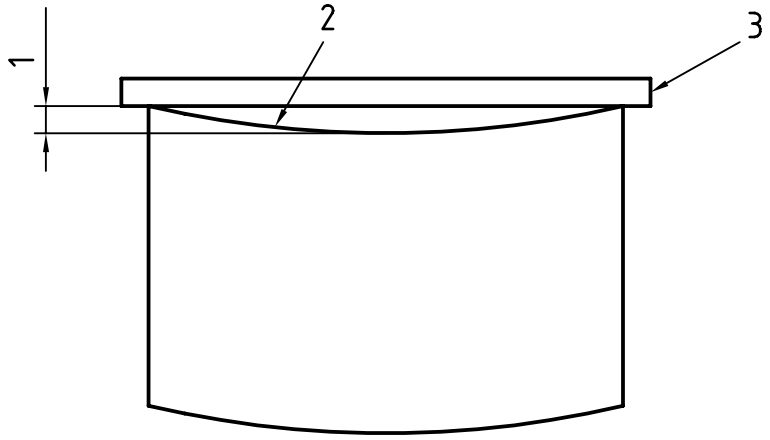
Table 17 — Standard flatness tolerances for structural quality cut lengths[a]

Value in millimetres

Specified thickness	Specified width	Flatness tolerance
⩽ 0,7	⩽ 1 200	23
	> 1 200 ⩽ 1 500	27
	> 1 500	33
> 0,7 ⩽ 1,2	⩽ 1 200	18
	> 1 200 ⩽ 1 500	23
	> 1 500	29
> 1,2	⩽ 1 200	15
	> 1 200 ⩽ 1 500	18
	> 1 500	26

NOTE 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 Figure 3.

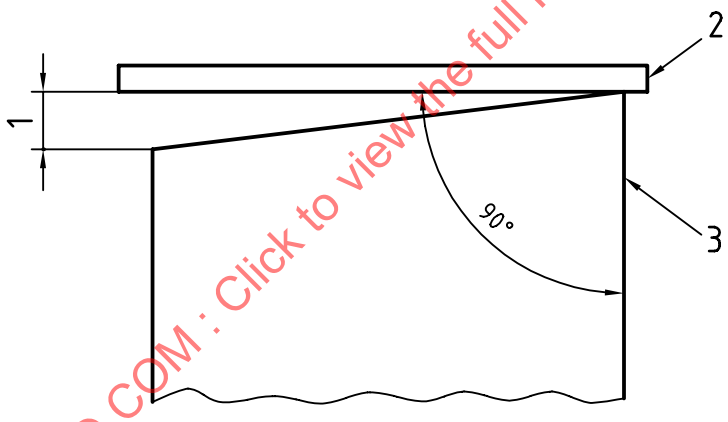
[a] This table also applies to sheet cut to length from coils by the customer when agreed upon flattening procedures are performed. For specified strength levels of R_{eL} = 360 N/mm^2 and greater increase the flatness tolerances by 25 %. These tolerances are only applicable to sheet ⩽ 5 000 mm length when the thickness is 5 mm or less. Tolerances for sheet > 5 000 mm in length shall be subject to agreement. This table does not apply to full hard sheet (grade 550).



Key

1 Edge camber
2 Side edge (concave side)
3 Straightedge

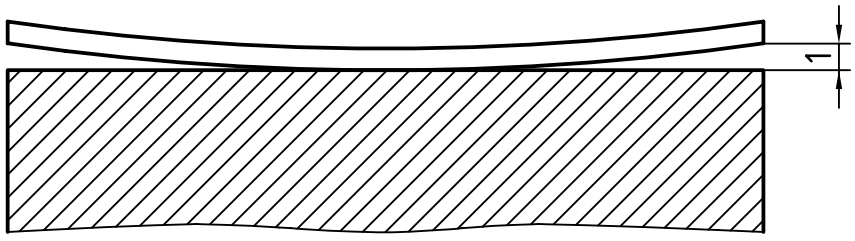
Figure 1 — Measurement of camber



Key

1 Out-of-square
2 Straightedge
3 Side edge

Figure 2 — Measurement of out-of-square



Key

1 Maximum deviation from flatness

Figure 3 — Measurement of flatness

8 Sampling

8.1 Sampling for mechanical tests – Tensile test

One representative sample for the tensile test required in Table 2 or Table 5 shall be taken from each lot of steel for shipment. A lot consists of 50 tonnes or less of sheet of the same grade rolled to the same thickness and condition.

8.2 Sampling for coating tests

8.2.1 Mass of coating

Test specimens for coils and cut lengths coated in coils shall be taken from a sample piece approximately 300 mm in length ony the as-coated width. The purchaser, in order to verify the mass of coating, shall use the following sampling method: three specimens shall be cut, one from the mid-width position and one from each side, no closer than 25 mm from the side edge. The minimum specimen area shall be 2 000 mm^2.

8.2.2 Coated bend test

One representative sample shall be taken from each lot of sheet for shipment, except that bend tests are not required for structural grades 350 and 550. The specimens for the coated bend test shall be taken no closer than 25 mm from the side edge. The minimum width shall be 50 mm.

9 Test methods

9.1 Tensile test (base metal/structural grades)

The tensile test shall be carried out in accordance with ISO 6892. Longitudinal test pieces shall be taken mid-way between the centre and edge of the sheet as-rolled. Since the tensile test is for the determination of properties of the base metal, ends of test pieces shall be stripped off the coating to measure base metal thickness for calculation of cross-sectional area.

9.2 Coating tests (mass and bend)

9.2.1 General

The manufacturer shall make such tests and measurements as he deems necessary to ensure that the material produced complies with the values given in Table 1.

9.2.2 Triple-spot test

The triple-spot test result shall be the average coating mass found on the three specimens taken according to 8.2.1.

NOTE The method given in ISO 1460 may be used as a reference method.

9.2.3 Single-spot test

The single-spot test result shall be the minimum coating mass found on any one of the three specimens used for the triple-spot test. Material which has been slit from wide coil shall be subject to a single-spot test only.

9.2.4 Estimated coating thickness and coating mass

Coating mass is determined by converting coating thickness measurements made with magnetic gauges (see ISO 2178) or by X-ray spectrometry (see ISO 3497). These test methods may be used as a basis for acceptance, but rejection shall be governed by the coating mass tests described in 9.2.2 and 9.2.3.