
INTERNATIONAL STANDARD



3575

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities

Tôles en acier au carbone galvanisées en continu par immersion à chaud, de qualité commerciale, pour pliage et agrafage ou pour emboutissage

First edition – 1976-10-15

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[ISO 3575:1976](#)

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UDC 669.14-41 : 669.586

Ref. No. ISO 3575-1976 (E)

Descriptors : iron and steel products, metal plates, galvanized materials, steels, carbon steels, zinc coatings, dip coating, cupping, folding, specifications, designation, chemical composition, mechanical properties, tests, mechanical tests, chemical analysis, form tolerances, dimensional tolerances, marking.

Price based on 15 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3575 was drawn up by Technical Committee ISO/TC 17, *Steel*, and was circulated to the Member Bodies in April 1975.

It has been approved by the Member Bodies of the following countries :

Austria	Hungary	South Africa, Rep. of
Belgium	Ireland	Spain
Brazil	Italy	Sweden
Bulgaria	Japan	Switzerland
Canada	Korea, Dem. P. Rep. of	Turkey
Czechoslovakia	Mexico	United Kingdom
Denmark	Netherlands	U.S.A.
Finland	Norway	U.S.S.R.
France	Poland	Yugoslavia
Germany	Romania	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Australia
New Zealand

Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard applies to carbon steel sheet of commercial, lock-forming and drawing qualities coated by a continuous hot-dip zinc coating process. Zinc-coated sheet is suitable for applications where resistance to corrosion is of prime importance and is produced to coating designations as shown in table 2. Under atmospheric conditions the protection afforded by the coating is directly proportional to the mass of the coating per unit area. The mass of coating specified should be compatible with the desired service life, thickness of the base metal and with the forming requirements involved. The coating is expressed as the total coating on both surfaces in grams per square metre. Various types of zinc coating (see 3.2) are available depending on the application.

1.2 Commercial quality zinc-coated sheet (quality 01) is intended for general fabricating purposes where sheet is used in the flat, or for bending or moderate forming. It is produced in the range of thickness 0,25 to 5 mm inclusive after zinc coating, and in widths 600 mm and over in coils and cut lengths.

NOTE — Approximate conversions into inches are given in the annex for information only.

1.3 Lock-forming quality zinc-coated sheet (quality 02) is intended for lock-seaming and other similar applications and has better formability than commercial quality. It is produced in the range of thickness 0,25 to 5 mm inclusive after zinc coating, and in widths 600 mm and over in coils and cut lengths. The coating designation shall not exceed 350.

1.4 Drawing quality zinc-coated sheet (qualities 03, 04 and 05) is intended for drawing or severe forming. It is produced in the range of thickness 0,4 to 5 mm inclusive after zinc coating, and in widths 600 mm and over in coils and cut lengths. Drawing quality sheet 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. The coating designation shall not exceed 275. Drawing qualities are identified as follows :

03 : Drawing quality

04 : Deep drawing quality

05 : Deep drawing quality special killed

1.5 Zinc-coated sheet less than 600 mm wide may be slit from wide sheet and will be considered as sheet.

2 REFERENCES

ISO 82, *Steel — Tensile testing.*

ISO/R 85, *Bend test for steel.*

ISO 86, *Steel — Tensile testing of sheet and strip less than 3 mm and not less than 0,5 mm thick.*

ISO/R 87, *Simple bend testing of steel sheet and strip less than 3 mm thick.*

ISO 1460, *Metallic coatings — Hot-dip galvanized coatings on ferrous materials — Determination of the mass per unit area — Gravimetric method.*

3 DEFINITIONS AND OTHER INFORMATION

3.1 **continuous hot-dip zinc-coated¹⁾ steel sheet** : A product obtained by hot-dip zinc coating cold-reduced sheet coils or hot-rolled descaled sheet coils on a continuous zinc-coating line to produce either zinc-coated coils or zinc-coated cut lengths.

3.2 Types of zinc coating

3.2.1 **spangle coating** : A coating formed as a result of unrestricted growth of zinc crystals during normal solidification. This coating has a metallic lustre and is the type normally furnished for a wide variety of applications.

3.2.2 **minimized spangle coating** : A coating obtained by restricting normal spangle formation during the solidification of the zinc. This product may have some lack of uniformity in surface appearance within a coil or from coil to coil. It is normally furnished in coating designation 350, 275, and 200, in the five quantities listed in table 1 and in the range of thickness 0,5 to 3 mm inclusive.

3.2.3 **zinc-iron alloy coating** : A coating produced by processing the zinc-coated steel sheet so that the coating formed on the base steel is composed of zinc-iron alloys. This produce is not spangled, is normally dull in appearance, and for some applications may be suitable for immediate painting without further treatment except normal cleaning. Zinc-iron alloy coatings may powder during severe forming.

1) Sometimes referred to as galvanized.

3.2.4 differential coating : A coating having a specified coating mass on one surface, and a significantly lighter coating mass on the other surface.

3.3 Designation

The designation shall consist of the following :

- a) the letter **Z** to indicate a zinc coating, or the letters **ZF** to indicate a zinc-iron alloy coating;
- b) the coating designation given in table 2;
- c) one of the following letters to indicate surface coating condition :
 - N** : normal coating (as produced),
 - S** : normal coating (skin passed),
 - M** : minimized spangle (as produced),
 - E** : minimized spangle (skin passed);
- d) the base metal quality designation given in table 1.

Examples of the complete designation :

Z275N02 and ZF001S04

3.4 skin pass : A light cold-rolling of the zinc-coated steel sheet. If the material is required skin passed, it shall be ordered with an "Extra Smooth" finish. The purposes of skin passing are one or more of the following :

- a) To produce a higher degree of surface smoothness for sheet supplied in coating designations 350, 275, 200, 180, 100 and 001, and to improve appearance or suitability for decorative painting.

This process may adversely affect the ductility of the base metal, particularly with qualities 01 and 02.

Zinc coating defined in 3.2 may be variable in appearance and not suitable for decorative painting.

- b) To minimize temporarily the occurrence of the condition known as stretcher strain (Lüder's lines) or fluting during fabrication of finished parts.

3.5 Strain ageing

Zinc-coated steel sheet (except quality 05, extra smooth quality) tends to strain age, and this may lead to the following :

- a) surface markings from stretcher strain or fluting when the steel is formed;
- b) deterioration in ductility.

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

For skin-passed sheet, reasonable freedom from stretcher strain can be achieved by effective roller levelling immediately prior to fabrication at the purchaser's plant. Freedom from stretcher strain for a period of six months can be achieved by the supply of skin-passed non-ageing steels. Quality 05 shall be specified in such cases where Lüder's lines are not acceptable and where roller levelling is not possible.

3.6 Mill passivating

A chemical treatment is normally applied to zinc coatings to minimize the hazard of wet storage stain (white rust) 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. This treatment is not usually applied to zinc-iron alloyed coatings because it interferes with the adhesion of most paints. The mill will passivate other types of zinc coatings, except extra smooth surface, as a normal procedure.

3.7 Mill phosphating

Zinc-coated steel sheet may be processed chemically at the manufacturer's mill to prepare all types of coatings for painting without further treatment except normal cleaning.

3.8 Oiling

The zinc-coated steel sheet as produced may be oiled to minimize wet storage stain. When the zinc-coated sheet has received a passivating treatment, oiling will minimize further the hazard of wet storage stain.

4 CONDITIONS OF MANUFACTURE

4.1 Steelmaking

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

4.2 Chemical composition

The chemical composition (cast analysis) shall not exceed the values given in table 1.

TABLE 1 – Chemical composition (cast analysis), %

Base metal quality		C max.	Mn max.	P max.	S max.
Designation	Name				
01	Commercial	0,15	0,60	0,05	0,05
02	Lock forming	0,12	0,60	0,04	0,04
03	Drawing	0,12	0,50	0,04	0,04
04	Deep drawing	0,10	0,45	0,03	0,03
05	Deep drawing special killed	0,08	0,45	0,03	0,03

4.3 Chemical analysis

4.3.1 Cast analysis

A cast analysis of each cast of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus, and sulphur. On request, this analysis shall be reported to the purchaser or his representative.

4.3.2 Verification analysis

A verification analysis may be made by the purchaser to verify the specified chemical composition of the semi-finished or finished steel and shall take into consideration any normal heterogeneity. Non-killed steels (such as rimmed or capped) are not technologically suited to verification analysis, except for copper analysis when copper-bearing steel is specified. For killed steels, or when copper-bearing steel is specified, the sampling method and deviation limits shall be agreed upon between the interested parties at the time of ordering.

4.4 Zinc-coating mass

The mass of coating shall conform to the requirements presented in table 2 for the specific coating designation. The mass of coating is the total amount of zinc on both surfaces of the sheet, expressed in grams per square metre (g/m²) of sheet. The coating mass of differentially coated material shall be agreed on between the interested parties. If a maximum coating mass is required, the manufacturer shall be notified at the time of ordering. Methods of checking that the material complies with this International Standard are given in 7.2 and clause 8.

4.5 Weldability

The product is suitable for welding if appropriate welding methods and procedures are used with special attention to the heavier coatings. Zinc-iron alloyed coatings (ZF) are usually more suitable than other coatings (Z) for resistance welding.

4.6 Painting

Hot-dip zinc-coated steel sheet is a suitable base for paint but the first treatment may be different from those used on mild steel. Pre-treatment primers, chemical conversion coatings (chromate, phosphate or oxide type) and some paint specially formulated for direct application to zinc surfaces, are all appropriate first treatments for hot-dip zinc-coated sheet. In drawing up a painting schedule, consideration shall be given as to whether the hot-dip zinc-coated sheet shall be ordered passivated or not passivated.

4.7 Application

It is desirable that zinc-coated steel sheet be identified for fabrication by name of part or by the intended application. Zinc-coated steel sheet of drawing qualities (03, 04 and 05) may be produced to make an identified part within a properly established breakage allowance which shall be agreed upon previously between the interested parties. In this case, part name, details of fabrication, and special requirements such as freedom from stretcher strain or from fluting shall be specified and the mechanical properties in table 3 do not apply.

4.8 Mechanical properties

Except when ordered to an identified part as explained in 4.7, at the time that the steel is made available for shipment, the mechanical properties shall be as stated in table 3 when they are determined on test pieces obtained according to the requirements of 6.1. Prolonged storing of the sheet can cause a change in mechanical properties (increase in hardness and a decrease in elongation), leading to a decrease in drawability. To minimize this effect, quality 05 shall be specified.

5 DIMENSIONAL TOLERANCES

Dimensional tolerances applicable to zinc-coated steel sheet shall be as given in tables 5 to 14 inclusive.

6 SAMPLING

6.1 Mechanical tests

6.1.1 Tensile test

One representative sample for the tensile test required in table 3 shall be taken from each lot of sheet for shipment. A lot consists of 50 tonnes or less of sheet of the same quality rolled to the same thickness and condition.

6.1.2 Bend test

One representative sample for the bend test (only applicable to qualities 01 and 02) shall be taken from each lot of sheet for shipment. A lot consists of all sheet of the same quality rolled to the same thickness and condition.

6.2 Coating tests

6.2.1 Mass of coating

The manufacturer shall make such tests and measurements as he deems necessary to ensure that the material produced complies with the values in table 2. The purchaser may verify the mass of coating by use of the following sampling method :

Three specimens shall be cut, one from the mid-width position, and one from each side not closer than 25 mm to the side edge. The minimum specimen area shall be 2 000 mm².

6.2.2 Bend test (applicable only to qualities Z 01 and Z 02)

One representative sample shall be taken from each lot of sheet for shipment. The test pieces shall be taken for the coated bend test, not closer than 25 mm from the side edge. The minimum test piece width shall be 50 mm.

7 TEST METHODS

7.1 Mechanical tests

7.1.1 Tensile test (base metal)

The tensile test shall be carried out in accordance with ISO 82 and ISO 86. Transverse or longitudinal test pieces shall be taken mid-way between the centre and edge of the sheet as rolled. Since the tensile test is for determination of properties of the base metal, ends of test pieces shall be stripped of the coating to measure base metal thickness for calculation of cross-sectional area.

7.1.2 Bend test (base metal) (applicable only to qualities 01 and 02)

The transverse bend test piece, stripped of coating in a suitably inhibited acid, shall withstand being bent through 180° in the direction shown in figure 1, around the inside diameter as shown in table 3, without cracking on the outside of the bent portion. The bend test is to be performed at ambient temperature and as described in ISO/R 85 and ISO/R 87.

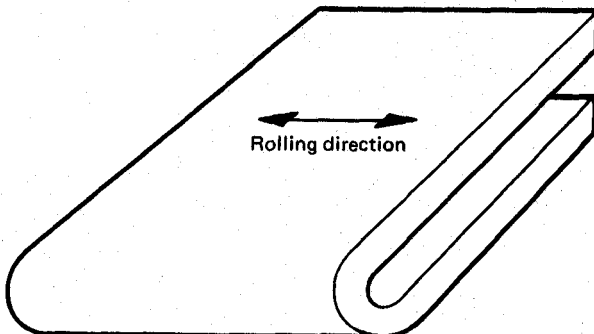


FIGURE 1 — Transverse bend test piece (after bending)

7.2 Coating tests

7.2.1 Triple spot test

The triple spot test result shall be the average coating mass found on the three specimens taken according to 6.2.1. The test is normally carried out by stamping out a known area of sheet and calculating the coating mass from the loss in mass after removing the zinc in suitably inhibited acid. ISO 1460 may be used as a reference method.

7.2.2 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.

7.2.3 Bend test (coating) [applied only to zinc coatings (Z)]

Bend test pieces taken after coating (before additional processing) shall withstand being bent through 180° in either direction without flaking of the coating on the outside of the bend. The radius of the bend is determined by the number of pieces of the same thickness (or mandrel equivalent) as shown in table 4. Flaking of coating within 7 mm from the edge of the test piece shall not be cause for rejection.

8 RETESTS

If a test does not give the required results, two more tests shall be carried out at random on the same lot. Should either of these tests fail to meet the specified requirements the material shall be considered not to comply with the requirements of this International Standard.

9 WORKMANSHIP

The zinc-coated steel sheet in cut lengths shall be free from amounts of laminations, surface flaws and other imperfections that are detrimental to subsequent appropriate processing. Processing for shipment in coils does not afford the manufacturer the opportunity to observe readily or to remove defective portions as can be carried out on the cut length product.

10 INSPECTION AND ACCEPTANCE

10.1 While not usually required for products covered by this International Standard, when the purchaser specifies that inspection and tests for acceptance be observed prior to shipment from the manufacturer's works, the manufacturer shall afford the purchaser's inspector all reasonable facilities to determine that the steel is being furnished in accordance with this International Standard.

10.2 Steel that is reported to be defective after arrival at the user's works shall be set aside, properly and correctly identified and adequately protected. The supplier shall be notified in order that he may properly investigate.

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11 COIL SIZE

When zinc-coated steel sheet is ordered in coils, a minimum or range of acceptable inside diameter (I.D.) shall be specified. In addition, the maximum outside diameter (O.D.) and maximum acceptable coil mass shall be specified.

12 MARKING

Unless otherwise stated, the following minimum requirements for identifying the steel shall be legibly stenciled on the top of each lift or shown on a tag attached to each coil or shipping unit :

- a) the manufacturer's name or identifying brand;
 - b) the number of this International Standard;
 - c) the quality designation;
 - d) the order number;
 - e) the product dimensions;
 - f) the lot number;
 - g) the mass.
- b) the name and designation of the material (for example, hot-dip zinc-coated sheet Z275N02) (see 1.2, 1.3, 1.4 and 3.3 and tables 1 and 2);
 - c) the dimensions of the product (the thickness includes the coating) in the sequence, thickness, width, length and mass, and the quantity required;
 - d) the application (name of part) if possible (see 4.7);
 - e) for drawing qualities 03, 04 and 05, whether ordered to mechanical properties (see 4.8) or to fabricate an identified part (see 4.7);
 - f) whether oiled or not (see 3.8);
 - g) whether mill passivated or not (see 3.6);
 - h) whether mill phosphated or not (see 3.7);
 - i) extra smooth, if required (see 3.4);
 - j) the coil size requirements (see clause 11);
 - k) the report of the cast analysis, if required (see 4.3.1);
 - l) inspection and tests for acceptance prior to shipment from the manufacturer's works, if required (see clause 10).

13 INFORMATION TO BE SUPPLIED BY THE PURCHASER

To specify adequately the requirements under this International Standard, inquiries and orders shall include the following information :

- a) the number of this International Standard;

NOTE — A typical ordering description is as follows :

International Standard ISO 3575, hot-dip zinc-coated sheet Z275N02, 0,46 X 1 200 X 2 400 mm, 20 000 kg, to fabricate drawn shells, part # 7 201, mill passivation and oiled, maximum lift 4 000 kg.

TABLE 2 – Mass of coating (total both sides)¹⁾

Type of coating	Coating designation	Minimum check limit	
		Triple spot test g/m ² (of sheet)	Single spot test g/m ² (of sheet)
Zinc (Z)	700	700	595
	600	600	510
	450	450	385
	350	350	300
	275	275	235
	200	200	170
	180	180	150
	100	100	85
	001	No minimum ²⁾	No minimum ²⁾
Zinc-iron alloy (ZF)	180	180	150
	100	100	85
	001	No minimum	No minimum

1) Because of the many variables and changing conditions that are characteristic of continuous zinc coating, the mass of coating is not always evenly divided between the two surfaces of a zinc-coated sheet; neither is the zinc coating evenly distributed from edge to edge. However, it can normally be expected that not less than 40 % of the single-spot check limit will be found on either surface.

2) "No minimum" means that there are no established minimum check limits for triple and single spot tests.

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TABLE 3 – Mechanical properties¹⁾ (see 4.8)

Base metal quality		R_m max. ²⁾ N/mm ²	A min. % ³⁾ 76			Base metal 180° bend mandrel diameter	
Designation	Name		$L_o = 50$ mm	$L_o = 80$ mm	$L_o = 5,65\sqrt{S_o}$ ⁵⁾	$e < 3$	$e \geq 3$
01	Commercial	—	—	—	—	1 a	2 a
02	Lock-forming	—	—	—	—	0 (flat on itself)	1 a
03	Drawing	430	24	23	22	—	—
04	Deep drawing	410	26	25	24	—	—
05	Deep drawing special killed	410	29	28	27	—	—

1) 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

e = thickness of steel sheet, in millimetres

a = thickness of bend test piece

1 N/mm² = 1 MPa

2) Minimum tensile strength for qualities 03, 04 and 05 would normally be expected to be 260 N/mm². All tensile strength values are determined to the nearest 10 N/mm².

3) For material up to and including 0,6 mm in thickness, the elongation values in the table shall be reduced by 2.

4) All qualities are available with a minimized spangle zinc coating.

5) May be used for material over 3 mm thickness.

TABLE 4 – Coating bend test requirements

Zinc (Z) coating designations	180° bend mandrel diameter								
	$e < 1,6$			$1,6 < e < 3,0$			$e \geq 3,0$		
	Commercial quality	Lock- forming quality	Drawing qualities	Commercial quality	Lock- forming quality	Drawing qualities	Commercial quality	Lock- forming quality	Drawing qualities
700	3a	—	—	3a	—	—	4a	—	—
600	2a	—	—	2a	—	—	3a	—	—
450	2a	—	—	2a	—	—	2a	—	—
350	1a	0	—	2a	0	—	2a	1a	—
275	1a	0	0	1a	0	0	2a	1a	0
200	1a	0	0	1a	0	0	2a	1a	0
180	1a	0	0	1a	0	0	2a	1a	0
100	1a	0	0	1a	0	0	2a	1a	0
001	1a	0	0	1a	0	0	2a	1a	0

a = thickness of bend test mandrel
 e = thickness of steel sheet, in millimetres
 0 = flat on itself

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TABLE 5 – Thickness tolerances for coils and cut lengths

Values in millimetres

Specified widths	Thickness tolerances ¹⁾ , over and under, for specified thicknesses										
	0,25 up to and including 0,4	over 0,4 up to and including 0,6	over 0,6 up to and including 0,8	over 0,8 up to and including 1,0	over 1,0 up to and including 1,2	over 1,2 up to and including 1,6	over 1,6 up to and including 2,0	over 2,0 up to and including 2,5	over 2,5 up to and including 3,0	over 3,0 up to and including 4,0	over 4,0 up to and including 5,0
600 up to and including 1 200	0,08	0,09	0,10	0,11	0,13	0,15	0,19	0,21	0,22	0,24	0,28
Over 1 200 up to and including 1500	0,09	0,10	0,11	0,12	0,14	0,16	0,21	0,23	0,24	0,26	0,29
Over 1 500 up to and including 1 800	—	0,11	0,12	0,14	0,15	0,18	0,23	0,25	0,26	0,28	0,30

1) Thickness is measured at any point on the sheet not less than 40 mm from a side edge.

TABLE 6 – Width tolerances for coils and cut lengths, not required

Values in millimetres

Specified widths	Tolerance
Up to and including 1 500	+ 7 0
Over 1 500 up to and including 1 800	+ 10 0

TABLE 7 – Length tolerances for cut lengths, not required

Values in millimetres

Specified lengths	Tolerance
Up to and including 3 000	+ 20 0
Over 3 000 up to and including 6 000	+ 30 0
Over 6 000	+ 0,5 % 0

TABLE 8 – Camber tolerances for coils and cut lengths, not required

Form	Camber tolerance
Coils	20 mm in any 5 000 mm length
Cut lengths	0,4 % × length

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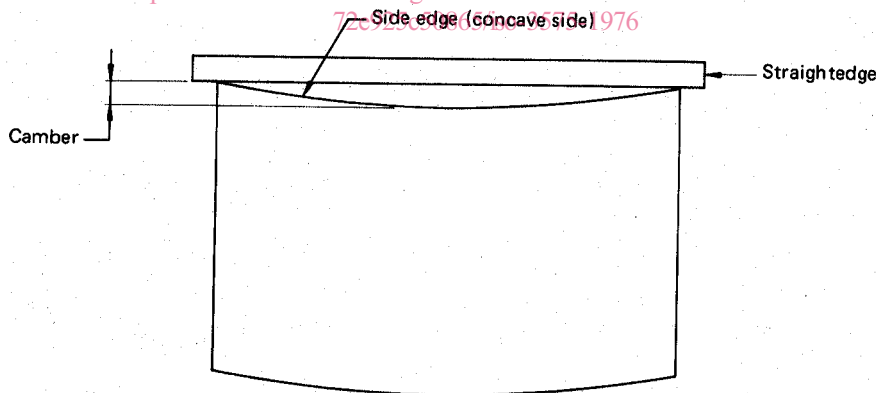


FIGURE 2 – Measurement of camber

Camber is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straightedge.

TABLE 9 – Out-of-square tolerance for cut lengths, not resquared

Dimensions	Out-of-square tolerance
All thicknesses and all sizes	1,0 % X width

TABLE 10 – Out-of-square¹⁾ tolerances for resquared sheet²⁾

Values in millimetres

Specified lengths	Specified widths	Out-of-square tolerance
Up to and including 3 000	Up to and including 1 200	+ 2 0
	Over 1 200	+ 3 0
Over 3 000	All widths	+ 3 0

1) See figure 3.

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

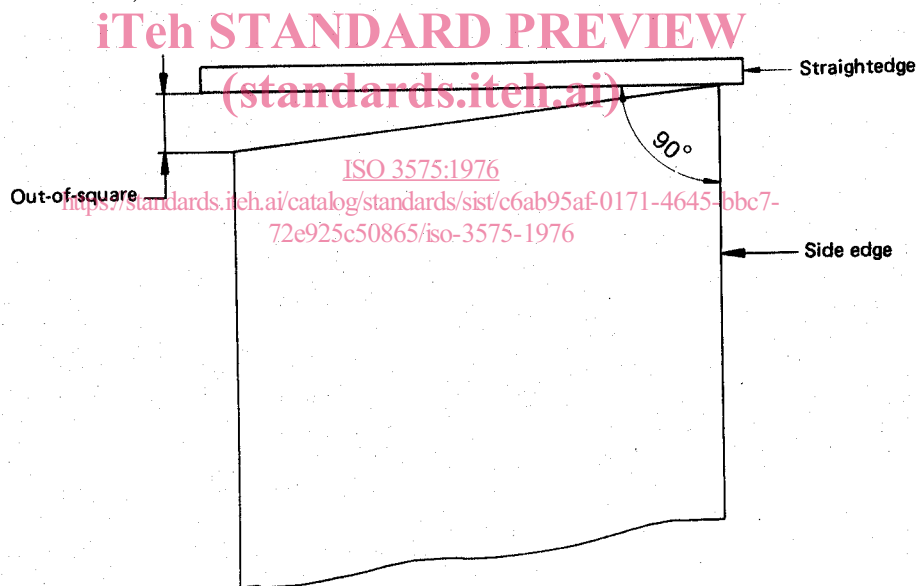


FIGURE 3 – Measurement of out-of-square

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, the measurement being taken as shown in figure 3. It can also be measured as one half the difference between the diagonals of the cut length sheet.