



## Annex 4 (informative)

## Continuous hot-dip 55 % aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities

**Introduction** This annex has been prepared based on the second edition of ISO 9364 *Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities* published in 2001 without modifying the technical contents. This annex can not be used to substitute the provisions of the text of this Standard.

## 1 Scope

**1.1** This annex 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 5.0 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 4 attached table 1.

**1.3** Commercial quality aluminium/zinc-coated steel sheet (quality 0.1) 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 annex or, with agreement when ordered, to fabricate an identified part, in which case the mechanical properties of annex 4 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 standards contain provisions which, through reference in this text, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards only the edition of indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply.

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 annex, 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 (Luder's lines) 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

NOTES 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.

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 annex 4 table 1 are used to indicate 55 % aluminium/zinc coating.

**4.2 Coating mass** The coating mass designations are 090, 100, 150, 165, 185 and 200 as listed in annex 4 table 1.

The coating is expressed as the total mass on both surfaces in g/m<sup>2</sup>. 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.

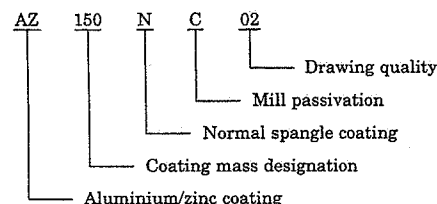
Structural quality grades are indicated by three digits as listed in annex 4 table 2.

**4.6 Complete designation**

**Example 1**

Aluminium killed 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, is designated as follows:

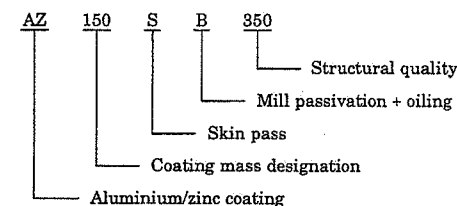
AZ150NC02



**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



**Annex 4 Table 1 Minimum coating mass for equally coated sheet and coil (total mass on both surface)**

Unit: g/m<sup>2</sup>

Coating designation	Triple-spot test average	Single-spot test
AZ090	90	75
AZ100	100	85
AZ150	150	130
AZ165	165	140
AZ185	185	160
AZ200	200	170

**NOTE:** The coating mass in grammes 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.

**Annex 4 Table 2 Mechanical properties of structural-quality steels and coating bend test**

Grade	$R_e$ min.  N/mm <sup>2</sup>	$R_m$ min.  N/mm <sup>2</sup>	A min. <sup>(1)</sup>  %		Coated metal 180° bend mandrel diameter  mm	
			$L_0=50$ mm	$L_0=80$ mm	$e < 3$ mm	$e \geq 3$ mm
220	220	320	20	18	1e	2e
250	250	350	18	16	1e	2e
280	280	390	16	14	2e	3e
320	320	430	14	12	3e	3e
350	320	450	12	10	—	—
550 <sup>(2)</sup>	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  
 $L_0$  = gauge length on test piece  
e = thickness of bend test piece  
1 N/mm<sup>2</sup> = 1 MPa

NOTES 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.  
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.

Notes <sup>(1)</sup> Use either  $L_0 = 50$  mm or  $L_0 = 80$  mm to measure elongation. For material up to and including 0.6 mm in thickness, the elongation values in annex 4 table 4 shall be reduced by 2.  
<sup>(2)</sup> Grade 550 is the unannealed condition and therefore has limited ductility. If the hardness is HRB85 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:

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

**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. chromate) 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 purchaser and the manufacturer.

## 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 annex 4 tables 3 and 4.

## 6.3 Chemical analysis

**6.3.1 Heat analysis** heat analysis of each heat of steel shall be made by the manufacturer to determine compliance with the requirements of annex 4 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.

**Annex 4 Table 3 Chemical composition (heat analysis)**

Unit: %

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 <sup>(1)</sup>	1.15	0.20 <sup>(2)</sup>	0.040

Notes <sup>(1)</sup> Grade 350 may exceed the limits given in annex 4 table 4 or conform to all requirements of annex 4 table 4 and have 0.40 % max. carbon.  
<sup>(2)</sup> Grades 250 and 280 phosphorus: 0.10 % max. Grade 350: phosphorus: 0.20 % max.

**Annex 4 Table 4 Limits on additional chemical elements<sup>(1)</sup>**

Unit: %

Element max.	Heat analysis	Product analysis
Cu <sup>(2)</sup>	0.20	0.23
Ni <sup>(2)</sup>	0.20	0.23
Cr <sup>(2), (3)</sup>	0.15	0.19
Mo <sup>(2), (2)</sup>	0.06	0.07
Nb <sup>(4)</sup>	0.008	0.018
V <sup>(4)</sup>	0.008	0.018
Ti <sup>(4)</sup>	0.008	0.018

Notes <sup>(1)</sup> 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 %".  
<sup>(2)</sup> 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.  
<sup>(3)</sup> 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.  
<sup>(4)</sup> Heat analysis greater than 0.008 % may be supplied after agreement between the purchaser and the manufacturer.

**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 annex 4 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 grammes per square metre (g/m<sup>2</sup>) of sheet. Methods of checking that the material complies with this annex 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 annex 4 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 annex 4 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, annex 4 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 annex 4 table 2 when they are determined on test pieces obtained in accordance with the requirements of 8.1.

**7 Dimensional tolerances** Dimensional tolerances shall be in accordance with annex 4 tables 6 to 17. The thickness is the total of the base metal and the coating.

Annex 4 Table 5 Mechanical properties

Base metal quality		$R_e$ max. <sup>(1)</sup>	$R_m$ max. <sup>(2)</sup>	A min. <sup>(3)</sup> %		
Name	Designation	N/mm <sup>2</sup> <sup>(4)</sup>	N/mm <sup>2</sup>	$L_0=50$ mm	$L_0=80$ mm	$L_0=5.65 \sqrt{S_0}$ <sup>(5)</sup>
Commercial	01	—	—	—	—	—
Drawing	02	300 <sup>(6)</sup>	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

 $L_0$  = gauge length on test piece $S_0$  = original cross-sectional area of gauge length

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

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

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.

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.

Notes <sup>(1)</sup> The yield values apply to 0.2 % proof stress if the yield point is not pronounced, otherwise to the lower yield point ( $R_{eL}$ ).

<sup>(2)</sup> Minimum tensile strength for drawing qualities would normally be expected to be 260 N/mm<sup>2</sup>. All tensile strength values determined to the nearest 10 N/mm<sup>2</sup>.

<sup>(3)</sup> For material  $\leq 0.6$  mm in thickness, the elongation values in the table shall be reduced by 2.

<sup>(4)</sup> 1 N/mm<sup>2</sup> = 1 MPa.

<sup>(5)</sup> May be used for material  $> 3$  mm in thickness.

<sup>(6)</sup> This value applies to skin-passed products only.

Annex 4 Table 6 Normal thickness tolerances for commercial and drawing quality coils and cut lengths

Unit: mm

Specified width	Thickness tolerances <sup>(1)</sup> for specified thicknesses <sup>(2)</sup>										
	≤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 0.01 mm will be subtracted from the values in these tables.

Notes <sup>(1)</sup> 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.

<sup>(2)</sup> Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

Annex 4 Table 7 Normal thickness tolerances for structural-quality coils and cut lengths

Unit: mm

Specified width	Thickness tolerances <sup>(1)</sup> for specified thicknesses <sup>(2)</sup>										
	≤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 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.

Notes <sup>(1)</sup> 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<sup>2</sup> 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.

<sup>(2)</sup> Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

**Annex 4 Table 8 Restricted thickness tolerances for commercial, drawing and structural quality coils and cut lengths (Hot-rolled substrate)**

Unit: mm

Specified width	Thickness tolerances <sup>(1)</sup> for specified thicknesses <sup>(2)</sup>				
	≤ 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

Notes <sup>(1)</sup> 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  $R_e = 360 \text{ N/mm}^2$  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.

<sup>(2)</sup> 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.

**Annex 4 Table 9 Restricted thickness tolerances for commercial, drawing and structural quality coils and cut lengths (Cold-rolled substrate)**

Unit: mm

Specified width	Thickness tolerances <sup>(1)</sup> for specified thicknesses <sup>(2)</sup>									
	≤ 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.

Notes <sup>(1)</sup> 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  $R_e = 360 \text{ N/mm}^2$  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.

<sup>(2)</sup> Thickness is measured at any point on the sheet not less than 25 mm from a side edge.

**Annex 4 Table 10 Width tolerances for coils and cut lengths (not resquared)**

Unit: mm

Specified width	Tolerance
≤ 1 500	±7 0
> 1 500 ≤ 1 800	±10 0

NOTE: For resquared material more restrictive tolerances are agreed by the purchaser and the manufacturer.

**Annex 4 Table 11 Length tolerances for cut lengths (not resquared)**

Unit: mm

Specified length	Tolerance
≤ 3 000	±20 0
> 3 000 ≤ 6 000	±30 0
> 6 000	+0.5 % × length 0

NOTE: For resquared material more restrictive tolerances are agreed by the purchaser and the manufacturer.

**Annex 4 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 % × length

NOTES 1 Camber is the greatest deviation of a side edge from a straight lie, the measurement being taken on the concave side with a straight edge as shown in annex 4 figure 1.

2 For resquared material more restrictive tolerances are agreed by the purchaser and the manufacturer.

**Annex 4 Table 13 Out-of-square tolerance for cut lengths (not resquared)**

Dimensions	Out-of-square tolerance
All thickness and all sizes	1.0 % × 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 annex 4 figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.



**Annex 4 Table 14 Out-of-square tolerances (resquared material)**

Unit: mm

Specified length	Specified width	Out-of-square tolerance
$\leq 3\ 000$	$\leq 1\ 200$	+2 0
	$> 1\ 200$	+3 0
$> 3\ 000$	All widths	+3 0

NOTES 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 annex 4 figure 2. It can also be measured as one-half the difference between the diagonals of the cut length sheet.

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

**Annex 4 Table 15 Standard flatness tolerances for commercial and drawing quality in cut lengths<sup>(1)</sup>**

Unit: mm

Specified thickness	Specified width	Flatness tolerance
$\leq 0.7$	$\leq 1\ 200$	15 max.
	$> 1\ 200 \leq 1\ 500$	18 max.
	$> 1\ 500$	22 max.
$> 0.7 \leq 1.2$	$\leq 1\ 200$	12 max.
	$> 1\ 200 \leq 1\ 500$	15 max.
	$> 1\ 500$	19 max.
$> 1.2$	$\leq 1\ 200$	10 max.
	$> 1\ 200 \leq 1\ 500$	12 max.
	$> 1\ 500$	17 max.

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 annex 4 figure 3.

Note <sup>(1)</sup> 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  $R_{eL} = 360\text{ N/mm}^2$  and greater increase the flatness tolerances by 25 %. These tolerances are only applicable to sheet  $\leq 5\ 000\text{ mm}$  length when the thickness is 5 mm or less. Tolerances for sheet exceeding 5 000 mm in length shall be agreed by the purchaser and the manufacturer.

**Annex 4 Table 16 Restricted flatness tolerances for commercial and drawing quality in cut lengths<sup>(1)</sup>**

Unit: mm

Specified thickness	Specified width	Specified length	Flatness tolerance
$\leq 2$	$\leq 1\ 200$	$\leq 2\ 500$	9 max.
	$> 1\ 200$	$> 2\ 500$	15 max.
$> 2 \leq 5$	$\leq 1\ 200$	$\leq 2\ 500$	8 max.
	$> 1\ 200$	$> 2\ 500$	13 max.

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 annex 4 figure 3.

Note <sup>(1)</sup> Tolerances for sheet  $> 5\ 000\text{ mm}$  in length shall be agreed by the purchaser and the manufacturer.

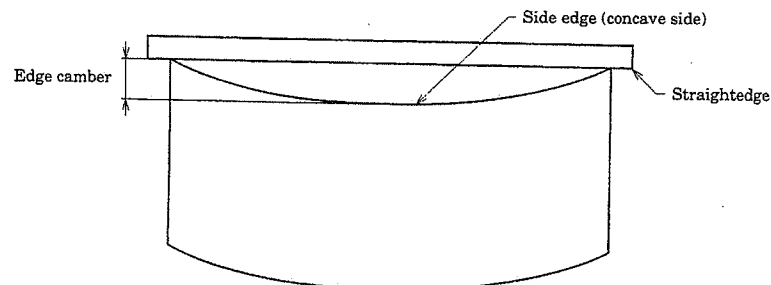
**Annex 4 Table 17 Standard flatness tolerances for structural quality cut lengths<sup>(1)</sup>**

Unit: mm

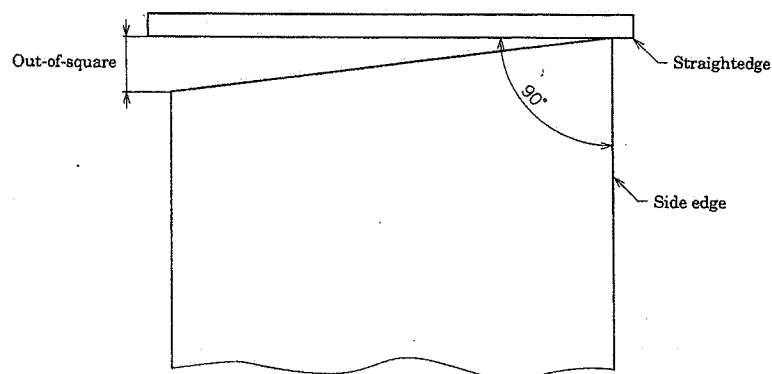
Specified thickness	Specified width	Flatness tolerance
$\leq 0.7$	$\leq 1\ 200$	23 max.
	$> 1\ 200 \leq 1\ 500$	27 max.
	$> 1\ 500$	33 max.
$> 0.7 \leq 1.2$	$\leq 1\ 200$	18 max.
	$> 1\ 200 \leq 1\ 500$	23 max.
	$> 1\ 500$	29 max.
$> 1.2$	$\leq 1\ 200$	15 max.
	$> 1\ 200 \leq 1\ 500$	18 max.
	$> 1\ 500$	26 max.

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 annex 4 figure 3.

Note <sup>(1)</sup> 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  $R_{eL} = 360\text{ N/mm}^2$  and greater increase the flatness tolerances by 25 %. These tolerances are only applicable to sheet  $\leq 5\ 000\text{ mm}$  length when the thickness is 5 mm or less. Tolerances for sheet  $\geq 5\ 000\text{ mm}$  in length shall be agreed by the purchaser and the manufacturer. This table does not apply to full hard sheet (grade 550).



Annex 4 Figure 1 Measurement of camber



Annex 4 Figure 2 Measurement of out-of-square



Annex 4 Figure 3 Measurement of flatness

## 8 Sampling

**8.1 Sampling for mechanical tests** One representative sample for the tensile test required in annex 4 table 2 or table 5 shall be taken from each lot of steel for shipment. A lot consists of 50 t 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 only 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<sup>2</sup>.

**8.2.2 Coated bend test** One representative sample shall be taken from each lot of sheet for shipment, except that bent 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 piece shall be taken midway 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 annex 4 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.

**9.2.5 Bend test (coating)** For commercial and drawing qualities the coated sheet shall be capable of being bent 180° flat on itself in any direction without flaking of the coating on the outside of the bend.

For structural quality grades, coating bend test requirements are as shown in annex 4 table 2. Flaking of coating within 7 mm of the edge of the test piece shall not be cause for rejection.



## 10 Retests

**10.1 General** If a test does not give the specified results, two more test pieces shall be taken at random from the sample lot. Both retests shall conform to the requirements of this annex, otherwise the lot shall be rejected.

**10.2 Machining and flaws** If any test piece shows defective machining or develops flaws, it shall be discarded and another test piece substituted.

**10.3 Additional tests** If a test does not give the specified results, two additional tests shall be carried out on the same lot. Both retests shall conform to the requirements of this annex, otherwise, the lot may be rejected.

## 11 Resubmission

**11.1** The manufacturer may resubmit for acceptance the products that have been rejected during earlier inspection because of unsatisfactory properties, after he has subjected them to a suitable treatment (selection, heat treatment) which, on request, shall be indicated to the purchaser. In this case the tests shall be carried out as if they applied to a new batch.

**11.2** The manufacturer has the right to present the rejected products for a new examination for compliance with the requirements for another quality or grade.

**12 Workmanship** The aluminium/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 readily observe or to remove defective portions as can be carried out in the cut-length product.

## 13 Inspection and acceptance

**13.1** While not usually required for products covered by this annex, 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 annex.

**13.2** 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.

**14 Coil size** When aluminium/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.

**15 Marking** Unless otherwise stated, the following minimum requirements for identifying the steel shall be legibly stencilled 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 the International Standard on which this annex is based, i.e. **ISO 9364**;
- c) the designation (coating, coating mass, coating condition, surface treatment and quality or grade of the base metal);
- d) the order number;
- e) the product dimensions;
- f) the lot number;
- g) the mass.

**16 Information to be supplied by the purchaser** To specify adequately requirements under this annex, inquiries and orders should include the following information:

- a) the number of the International Standard on which this annex is based, i.e. **ISO 9364**;
- b) the name and designation of the material, i.e. the letters AZ, coating mass designation, coating type, surface treatment, base metal quality; e.g. aluminium/zinc-coated steel sheet, commercial quality, normal spangle, passivated and oiled AZ165NC01B (see clause 4);
- c) coil or cut length, and the dimensions of the product in the sequence: thickness, width, length and bundle mass (for cut lengths) and the total quantity required. If the nominal thickness relates to the thickness before coating (refer to the note in each thickness tolerance table), it shall be agreed upon between the interested parties;
- d) the application (name of part), if possible;
- e) whether or not mill passivation is required (see 5.2);
- f) whether or not oiling is required (see 5.4);
- g) the coil size requirements (see clause 14);
- h) report of heat analysis and/or mechanical properties, if required (see 6.3.1 and clause 9);
- i) details of fabrication, special requirements or application [i.e. coating performance, non-fluting, paintability, weldability, exposure environment, etc. (see 6.7)];
- j) inspection and tests for acceptance prior to shipment from the producer's works, if required (see 13.1).

NOTE: A typical ordering description is as follows:

**ISO 9364**, aluminium/zinc-coated steel sheet, commercial quality, designation AZ165NC01, 1 × 1 200 mm × coil, 20 000 kg, exhaust pipe tubing, No. 6201.

Annex 4 Attached Table 1 Total theoretical thickness for coating mass

Coating designation	Coating mass limits and equivalent thickness <sup>(1)</sup>	
	Single spot	
	g/m <sup>2</sup>	mm
AZ090	75	0.020
AZ100	85	0.023
AZ150	130	0.035
AZ165	140	0.038
AZ185	160	0.043
AZ200	170	0.046

Note <sup>(1)</sup> The equivalent thickness values in this table are for information only.

### Bibliography

- [1] ISO 1460:1992 *Metallic coatings—Hot dip galvanized coatings on ferrous materials—Gravimetric determination of the mass per unit area*
- [2] ISO 7438:1985 *Metallic materials—Bend test*

Annex 5 (informative)  
Comparison table between JIS and corresponding International Standard

JIS G 3321:2005 Hot-dip 55 % aluminium-zinc alloy-coated steel sheets and coils		ISO 9364:2001 Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, drawing and structural qualities	
(I) Requirements in JIS		(IV) Classification and details of technical deviation between JIS and the International Standard by clause	
Clause	Content	Classification by clause	Detail of technical deviation
1 Scope	The sheets and coils (including corrugated sheets) which are coated by the hot-dip process in a coating bath containing about 55 % aluminium and 1.6 % silicon, with the balance being zinc, as a standard composition are specified.	MOD/ alteration	In ISO Standard the product application is also explained.
2 Normative references	12 standards in total, such as JIS Z 2201, JIS Z 2241, JIS G 0404.		
		(II) International Standard number	(V) Justification for the technical deviation and future measures
		ISO 9364	The range of products covered coincides. There are some differences in specified items and content between JIS and ISO Standard in the field of this product owing to the difference of technical base and commercial practice. Efforts such as an international proposal toward further conformity are currently being made.
		(III) Requirements in International Standard	
		Clause	Content
		1.1	The characteristics of steel of commercial, drawing, and structural qualities which are coated by the hot-dip process in a coating bath containing about 55 % aluminium and 1.6 % silicon, with the balance being zinc, as a standard composition are specified.
		2	ISO 6892, ISO 3497
			ISO 2178
		MOD/ alteration	The matter referred to from JIS is equivalent to the matter concerned in the corresponding International Standard.
		MOD/ deletion	Based on the difference of market demands, and the alteration is left as it is.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
3 Grade and symbol	Symbols of 5 grades for hot-rolled base metal used and 7 grades for cold-reduced base metal used are specified.	ISO 9364	1.3 1.4 1.5	Symbols of each grade are classified into commercial, drawing and structural qualities according to applications.	MOD/ addition	In JIS classified by base metal.	Although the addition of division of base metal thickness was proposed to be adopted in ISO Standard, for the time being, it is difficult to unify.
	Range of thickness (0.25 mm to 2.3 mm)		1.2	Thickness: 5 mm or less Width: 600 mm or more	MOD/ alteration	The range of thickness differs between both Standards.	Based on the difference of market demands, and the alteration is left as it is.
4 Chemical composition	The test method for the measurement of chemical composition of base metal of the sheet and coil and the upper limits of the cast analysis (C, Mn, P and S) for each type of base metal are specified.		6.2	The chemical composition (C, Mn, P and S) for every application and the upper limits of the added chemical composition (Cu, Ni, etc.) are specified.	MOD/ alteration	The method for division differs between both Standards.  The upper limits of cast analysis are altered.	Although the addition of division of base metal thickness was proposed to be adopted in ISO Standard, for the time being, it is difficult to unify.  The upper limits of cast analysis were specified according to the actual circumstances of market.
					MOD/ deletion	The specification of added chemical composition is deleted.	The specification of added chemical composition was postponed owing to the difference of the technology base and commercial practice.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
5 Coating surface finishes	5.1 Normal spangle A coating having spangles as a result of the growth of alloy crystals.  5.2 Skin pass The purpose of skin pass is explained.	ISO 9364	3.2.1	normal spangle coating	IDENT	—	—
			3.2.2 3.3	smooth finish The purpose of skin pass is described.			
6 Coating mass	The test method for the measurement of coating mass, and the minimum coating mass on both equally coated surfaces and coating mass symbols (7 symbols of AZ70 to AZ200) are specified.		4.2	Coating mass for every coating mass symbol (6 symbols of AZ090 to AZ200) is specified.	MOD/ addition	AZ70 is added.	The coating mass which has market needs in Japan was added. The addition to the ISO Standard is scheduled to be proposed.
			6.5	Coating mass is specified.			
7 Chemical treatment	The types of chemical treatment (chromate treatment, untreated) and their symbols are specified.		4.4	The symbol of surface treatment (oiling, mill passivation plus oiling, mill passivation and no surface treatment) is specified.	IDENT	—	Although the expression differs, there is no difference in technical contents.
			5.2	Effects of mill passivation are specified.			

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
8 Oiling	The discrimination of oiling and its symbol are specified (oiled, uncoiled).	ISO 9364	4.4	The symbol of surface treatment (oiling, mill passivation plus oiling, mill passivation and no surface treatment) is specified.	IDT	—	Although the expression differs, there is no difference in technical contents.
			5.4	The effect of oiling and recommendations to the purchaser are specified.			
9 Mechanical properties	9.1 Applicable mechanical properties Applicable mechanical properties tested for every steel grade (bendability, tensile strength) are specified. 9.2 Bendability The test method to adhere to and specified values for bendability of the sheet and coil are specified.		6.8	Mechanical properties: (yield stress, tensile strength and elongation) and bendability for every application are specified.	MOD/alteration	—	One item specified in the ISO Standard is divided into three items in JIS. The specified content with respect to the test item coincides.
					MOD/alteration	The applicable types of bend test (thickness of metal base, grade, division of hot-rolled base metal and cold-reduced base metal) and their specified values differ between both Standards.	The revision draft of ISO Standard in conformity with JIS was proposed by Japan, and was adopted at ISO/TC17/SC12 (June 2002).

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause		(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation	
9 Mechanical properties (concluded)	9.3 The test methods of yield point or proof stress, tensile strength, elongation are specified. The specified values for each item are specified by hot-rolled base metal, cold-reduced base metal, and steel type.	ISO 9364	6.8	Mechanical properties (yield stress, tensile strength and elongation) and bendability for every application are specified.	MOD/alteration	— In JIS there is the division of hot-rolled base metal and cold-reduced metal base. — The division of steel grades differs between both Standards. — Specified values differ between both Standards.	Although the addition of base metal division to the ISO Standard was proposed, for the time being, it is difficult to unify.
10 Presentation of dimensions	The dimensions of sheet and coil (thickness, width and length) are expressed in millimetre. The thickness is expressed by that of the base metal prior to coating.		7.1	The thickness is expressed by the total of the base metal and the coating.	MOD/alteration	—	Although presentation of dimensions is not provided as the specified item, also in ISO Standard dimensions are expressed in millimetre. To express the thickness by that of the base metal prior to coating will be proposed to ISO.
11 Standard dimensions	The standard dimensions of the sheet and coil (the standard nominal thickness, and standard width and length) are specified.		—	—	MOD/addition	—	The standard dimension is used in terms of the commercial practice of Japan.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content		
12 Dimensional tolerances	Dimensional tolerances are specified.	ISO 9364	7	Almost identical with JIS.	Some specified values differ between both Standards.	The revision draft of ISO Standard which nearly conforms to JIS is scheduled to be proposed, and adopted.
13 Shapes	Shapes are specified.		—	(Although not specified,) the measured mass is used.	In JIS measured mass or theoretical mass is used.	
14 Mass and tolerances	Mass of sheet, mass of coil, the calculation method of mass, tolerances for theoretical mass of sheet are specified.	ISO 9364	12	Identical with JIS.	—	For the time being, it is difficult to unify owing to the difference in the commercial practice.
15 Appearance	The sheet and coil shall be free from defects detrimental to practical use.		6.3	6.3.1 Heat analysis 6.3.2 Product analysis	MOD/ addition	
16 Tests	16.1 Analysis test of chemical composition General matter of analysis test and sampling method of analysis sample, and analytical method are specified.				MOD/ addition	The specification of test method is required because of the JIS-designated product.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content		
16 Tests (concluded)	16.2 Coating mass test Sampling of test specimen, sampling of test piece, test method are specified. The test method shall be in accordance with either JIS H 0401 or annex 3.	ISO 9364	8.2	Sampling for coating tests	MOD/ addition	The specification of test method is required because of the JIS-designated product.
	16.3 Corrosion resistance test of coating		—	—	MOD/ addition	
	16.4 Bend test General requirements for test, sampling of test specimen, test piece and bending of test piece are specified.		9.2.5	Identical with JIS.	IDT	
	16.5 Tensile test General requirements for test, sampling of test specimen, test piece and test method (JIS Z 2241) are specified.		8.1	Sampling of test specimen	MOD/ alteration	
			9.1	Tensile test (ISO 6892)		
						Although the realization in ISO Standard of conformity of the tensile test specified in relevant national standard was proposed, the conclusion was that for the time being it was difficult to realize it.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation
17 Inspection	17.1 Six inspection items of coating mass, mechanical properties, dimensions, shape, mass and appearance and their compatibility conditions are specified.	ISO 9364	13	Identical with JIS.	IDT	—
	17.2 Reinspection is specified (in accordance with JIS G 0404).		10 11	Retests Resubmission	IDT	—
18 Markings	Items to be marked for the sheet and coil that have passed inspection are specified.		15	Identical with JIS.	IDT	—
19 Items to be confirmed at the time of order	The information to be included in an inquiry sheet and an order sheet is described.		16	Identical with JIS.	IDT	—
20 Report	The inspection document to be submitted by a request of the purchaser is specified.		—	—	MOD/ addition	Added in consideration of commercial practice in Japan.
Annex 1 (normative)	Nominal thickness and coating mass symbols for sheets and coils for roofing and architectural siding.		—	—	MOD/ addition	The necessary specification in consideration of commercial practice in Japan.

(I) Requirements in JIS		(II) International Standard number	(III) Requirements in International Standard		(IV) Classification and details of technical deviation between JIS and the International Standard by clause	(V) Justification for the technical deviation and future measures
Clause	Content		Clause	Content	Classification by clause	Detail of technical deviation
Annex 2 (normative)	Nominal thickness, coating mass symbols and standard dimensions for corrugated sheets.	ISO 9364	—	—	MOD/ addition	—
Annex 3 (normative)	Test method for the coating mass of hot-dip 55 % aluminum-zinc alloy-coated steel sheets and coils using fluorescent X-rays.		—	—	MOD/ addition	—
Annex 4 (informative)	ISO 9364 Continuous hot-dip 55 % aluminum/zinc-coated steel sheet of commercial, drawing and structural qualities		—	Identical with JIS.	IDT	—

Designated degree of correspondence between JIS and International Standard: MOD

Remarks 1 Symbols in sub-columns of classification by clause in the above table indicate as follows:

- IDT: Identical in technical contents.
- MOD/deletion: Deletes specification item(s) or content(s) of International Standard.
- MOD/addition: Adds specification item(s) or content(s) which are not included in International Standard.
- MOD/alteration: Alters the specification content(s) which are included in International Standard.

2 Symbol in column of designated degree of correspondence between JIS and International Standard in the above table indicates as follows:

- MOD: Modifies International Standard.