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Hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Iron and Steel Federation (JISF) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS G 3321**:2017 is replaced with this Standard.

However, **JIS G 3321**:2017 may be applied in the **JIS** mark certification based on the relevant provisions of Article 19 Clause 1, etc. of the Industrial Standardization Law until March 19, 2020.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

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Hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9364**:2017, Edition 5, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JF. Annex JA to Annex JE are unique to **JIS** and not given in the corresponding International Standard.

1 Scope

This Standard specifies requirements for hot-dip 55 % aluminium-zinc alloy-coated steel sheet (hereafter referred to as sheets), steel strip (hereafter referred to as coils), and corrugated sheet manufactured by processing sheets into the shapes and dimensions specified in **JIS G 3316** (hereafter referred to as corrugated sheets).

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 9364:2017 *Steel sheet, 55 % aluminium-zinc alloy-coated by the continuous hot-dip process, of commercial, drawing and structural qualities* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS G 0320 *Standard test method for heat analysis of steel products*

JIS G 0404 *Steel and steel products—General technical delivery requirements*

JIS G 0415 *Steel and steel products—Inspection documents*

JIS G 3316 *Shapes and dimensions of corrugated steel sheets*

JIS K 0119 *General rules for X-ray fluorescence analysis*

JIS K 8847 *Hexamethylenetetramine (Reagent)*

JIS Z 2241 *Metallic materials—Tensile testing—Method of test at room temperature*

JIS Z 8401 *Guide to the rounding of numbers*

3 Symbol of grade and applicable nominal thickness [1)]

The symbol of grade and applicable nominal thickness shall be as follows.

Note [1)] The nominal thickness indicates the base metal thickness before coating [see **9.1.1 a**)].

a) The sheets and coils are classified into 3 grades of hot-rolled steel strip (hereafter referred to as hot-rolled base metal) and into 7 grades of cold-reduced steel strip (hereafter referred to as cold-reduced base metal). The symbols of grade and applicable nominal thicknesses shall be as given in Tables 1 and 2.

b) The corrugated sheets are classified into 5 grades of commercial quality and high strength commercial quality among those given in Table 2. The symbols of grade and applicable nominal thicknesses shall be as given in Table 2.

c) For sheets, coils and corrugated sheets used for roofing and architectural siding, the symbols shall be as given in Table 3.

d) The classification and symbol of the shape of corrugated sheets and their symbols shall be as given in Table 4.

Table 1 Symbol of grade and applicable nominal thickness (hot-rolled base metal)

Unit: mm

Symbol of grade	Applicable nominal thickness	Application
SGLHC	1.6 or over up to and incl. 2.3	Commercial
SGLH400		High strength commercial
SGLH490		
Unless the use of hot-rolled base metal is specifically required, the cold-reduced base metal which satisfies the specifications for hot-rolled base metal may be used.		

Table 2 Symbol of grade and applicable nominal thickness (cold-reduced base metal)

Unit: mm

Symbol of grade	Applicable nominal thickness	Application
SGLCC	0.24 or over up to and incl. 2.3	Commercial
SGLCD	0.27 or over up to and incl. 1.6	Drawing
SGLCDD	0.40 or over up to and incl. 1.6	Deep drawing
SGLC400	0.25 or over up to and incl. 2.3	High strength commercial
SGLC440		
SGLC490		
SGLC570	0.19 or over up to and incl. 2.0	

Table 3 Symbol for roofing and architectural siding

Application	Symbol
Roofing	R
Architectural siding	A

Table 4 Classification and symbol of shape of corrugated sheet

Shape of corrugated sheet	Symbol
Corrugated sheet No. 1 (long pitch) [a)]	W1
Corrugated sheet No. 2 (short pitch) [a)]	W2
Note [a)] The shapes and dimensions of long pitch and short pitch corrugated sheets shall be as specified in **JIS G 3316**.	

4 Chemical composition

The base metal of sheets, coils and corrugated sheets shall be tested for chemical composition in accordance with **13.1**, and the heat analysis values shall be as given in Table 5.

Table 5 Chemical composition

Unit: %

Symbol of grade	C	Mn	P	S
SGLHC	0.15 max.	0.80 max.	0.05 max.	0.05 max.
SGLH400	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGLH490	0.30 max.	2.00 max.	0.20 max.	0.05 max.
SGLCC	0.15 max.	0.80 max.	0.05 max.	0.05 max.
SGLCD	0.10 max.	0.45 max.	0.03 max.	0.03 max.
SGLCDD	0.08 max.	0.45 max.	0.03 max.	0.03 max.
SGLC400	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGLC440	0.25 max.	2.00 max.	0.20 max.	0.05 max.
SGLC490	0.30 max.	2.00 max.	0.20 max.	0.05 max.
SGLC570	0.30 max.	2.50 max.	0.20 max.	0.05 max.
Alloy elements other than those given in this table may be added as required.				

5 Coating

5.1 Plating bath composition

Plating bath shall be tested for composition in accordance with **13.2** and shall be as given in Table 6.

NOTE In the hot-dip coating process, the base metal is immersed in a molten metal bath at a high temperature, and then cooled to form a coating on the base metal surface. This molten metal bath is called plating bath.

Table 6 Plating bath composition

Unit: %

Al	Si	Elements other than Al, Si and Zn	Zn
50.0 or over up to and incl. 60.0	1.0 or over up to and incl. 3.0	5.0 max. [a)]	Remainder [b)]

Notes [a)] The figure indicates the total amount of elements which are added intentionally.

[b)] The remainder may include elements which are mixed unavoidably.

5.2 Coating mass

5.2.1 Symbol for coating mass

The coating applied shall be of equivalent thickness on both surfaces. The symbols for coating mass shall be as given in Table 7.

5.2.2 Coating mass

The sheets, coils and corrugated sheets shall be tested for coating mass in accordance with **13.3.2** and shall satisfy the following requirements.

a) The coating mass of sheets, coils and corrugated sheets shall be expressed by the total mass on both surfaces and shall meet the minimum triple-spot average coating mass value and the minimum single-spot coating mass value given in Table 7. The minimum triple-spot average coating mass shall apply to the average of the measured values of three test pieces taken from the sample, and the minimum single-spot coating mass shall apply to the smallest value among the measured values of the three test pieces of which the average value is obtained. When coating mass is measured in accordance with Annex JD, the minimum coating mass values in the table shall apply to the average coating mass and minimum coating mass obtained according to **JD.6.5**.

NOTE It is desirable that the coating mass on one side be not less than 40 % of the required value for the minimum single-spot coating mass (total mass on both surfaces).

b) For sheets and coils used for roofing and architectural siding, the coating mass shall be as given in Table JA.1.

c) The coating mass for corrugated sheets shall apply to pre-corrugated sheets. The coating mass applied to corrugated sheets shall be as given in Table JB.1.

d) The upper limit value of the coating mass (total mass on both surfaces) of sheets, corrugated sheets and coils may be as agreed between the purchaser and the manufacturer.

Table 7 Coating mass (total mass on both surfaces)

Unit: g/m^2

Symbol for coating mass	Minimum triple-spot average coating mass	Minimum single-spot coating mass
AZ70 [a)]	70	60
AZ90	90	76
AZ120	120	102
AZ150	150	130
AZ170	170	145
AZ185 [a)]	185	160
AZ200 [a)]	200	170
The coating masses corresponding to the designations AZ170, AZ185 and AZ200 shall not apply to SGLCD and SGLCDD.		
Note [a)] Applicable by agreement between the purchaser and the manufacturer		

5.3 Coating surface finishes

5.3.1 Coating surface finishes

The coating surface finish shall be regular spangle. Regular spangle means a surface finish with coating formed as a result of growth of alloy crystals (spangle) during normal solidification.

5.3.2 Skin pass

When requested by the purchaser, skin-pass treatment, designated as S, shall be performed.

NOTE Skin-pass treatment is usually performed to produce smooth surfaces.

5.4 Coating adherence

The coating adherence shall be as follows.

a) Sheets and coils, when tested for coating adherence in accordance with **13.3.3** under the bend test conditions given in Tables 8 and 9, shall be free from flaking of the coating on the external surface of the test piece (not less than 7 mm from both side edges of test piece).

b) The requirements for coating adherence shall not apply to SGLC570.

c) In the case of corrugated sheets, requirements in **a**) and **b**) shall apply to pre-corrugated sheets.

d) The coating adherence may be evaluated by other evaluation test methods than that specified in **13.3.3**, instead of fulfilling the requirement in **a**), at the discretion of the manufacturer. In this case, the evaluated coating adherence shall be at least equivalent to that obtained by the test method specified in **13.3.3**.

Table 8 Coating adherence and bendability (hot-rolled base metal)

Symbol of grade	Bend angle	Internal spacing [a] Number of sheets	
		Symbol for coating mass	
		AZ90	AZ120 AZ150
SGLHC	180°	1	2
SGLH400		2	3
SGLH490		3	4
Note [a] The figures indicate the number of sheets of nominal thickness. The test piece shall be bent with the internal spacing not more than the total layer thickness of indicated number of sheets.			

Table 9 Coating adherence and bendability (cold-reduced base metal)

Symbol of grade	Bend angle	Internal spacing [a] Number of sheets		
		Symbol for coating mass		
		AZ70 AZ90	AZ120 AZ150	AZ170, AZ185, AZ200
SGLCC	180°	1	2	2
SGLCD		0 (flat on itself)	1	—
SGLCDD		0 (flat on itself)	1	—
SGLC400		2	3	3
SGLC440		3	4	4
SGLC490		3	4	4
Note [a] The figures indicate the number of sheets of nominal thickness. The test piece shall be bent with the internal spacing not more than the total layer thickness of indicated number of sheets.				

6 Chemical treatment

The classification and symbols of chemical treatment for sheets, coils and corrugated sheets shall be as given in Table 10. Unless otherwise specified, the chromate-free treatment [2] shall be applied.

Note [2] Chromate-free indicates that the coating formed by chemical treatment is free from hexavalent chromium.

Table 10 Classification and symbols of chemical treatment

Classification of chemical treatment	Symbol
Chromate-free treatment	[a]
Untreated	M
Note [a] The symbol of chromate-free treatment shall be as agreed between the purchaser and the manufacturer. The symbol NC may be used for chromate-free treatment that is specified in **JIS G 3321**:2012.	

7 Oiling

The classification and symbols of oiling for sheets, coils and corrugated sheets shall be as given in Table 11. Unless otherwise specified, the sheets, coils and corrugated sheets shall be unoiled.

Table 11 Classification and symbol of oiling

Classification of oiling	Symbol
Oiled	O
Unoiled	X

8 Mechanical properties

8.1 Applicable mechanical properties

Mechanical properties applicable to sheets and coils shall be as given in Table 12. The mechanical properties of the corrugated sheets shall apply to pre-corrugated sheets and shall be as given in Table 12.

Table 12 Applicable mechanical properties

Symbol of grade	Bendability	Tensile test characteristics
SGLHC	○	–
SGLH400	○	○
SGLH490	○	○
SGLCC	○ [a)]	–
SGLCD	○	○
SGLCDD	○	○
SGLC400	○	○
SGLC440	○	○
SGLC490	○	○
SGLC570	–	○
Note [a)] In the case of corrugated sheets, the bendability does not apply.		

8.2 Bendability

When sheets, coils and pre-corrugated sheets are tested for bendability in accordance with **13.4.2**, the external surface of the test piece (not less than 7 mm from both side edges of test piece) shall be free from cracks and breakage that are visible to the naked eye.

NOTE For the details of bend test, see **13.4.2**.

8.3 Tensile test characteristics

The sheets, coils and pre-corrugated sheets shall be tested for tensile test characteristics in accordance with **13.4.3** and shall satisfy the requirements given in Table 13 or

Table 14. The values given in Table 13 or Table 14 shall apply to those which undergo delivery inspection [3].

Note [3] Age-hardening of sheets, coils and corrugated sheets may cause an increase in yield point or proof stress and a decrease in elongation.

Table 13 Tensile test characteristics (hot-rolled base metal)

Symbol of grade	Yield point or proof stress N/mm²	Tensile strength N/mm²	Elongation %	Test piece and direction
SGLHC	—			
SGLH400	295 min.	400 min.	18 min.	No. 5 in rolling direction or perpendicular to rolling direction
SGLH490	365 min.	490 min.	16 min.	
NOTE 1 For SGLHC, a yield point or proof stress of 205 N/mm² or over and a tensile strength of 270 N/mm² or over may be used. NOTE 2 1 N/mm² = 1 MPa				

Table 14 Tensile test characteristics (cold-reduced base metal)

Symbol of grade	Yield point or proof stress N/mm²	Tensile strength N/mm²	Elongation %					Test piece and direction
			Nominal thickness mm					
			0.25 or over to and excl. 0.40	0.40 or over to and excl. 0.60	0.60 or over to and excl. 1.0	1.0 or over to and excl. 1.6	1.6 or over up to and incl. 2.3	
SGLCC	—							
SGLCD	—	270 min.	[a]	27 min.	31 min.	32 min.	33 min.	No. 5 in rolling direction
SGLCDD	—	270 min.	—	29 min.	32 min.	34 min.	35 min.	
SGLC400	295 min.	400 min.	16 min.	17 min.	18 min.	18 min.	18 min.	No. 5 in rolling direction or perpendicular to rolling direction
SGLC440	335 min.	440 min.	14 min.	15 min.	16 min.	18 min.	18 min.	
SGLC490	365 min.	490 min.	12 min.	13 min.	14 min.	16 min.	16 min.	
SGLC570	560 min.	570 min.	—					
NOTE 1 For SGLCC, a yield point or proof stress of 205 N/mm² or over and a tensile strength of 270 N/mm² or over may be used. NOTE 2 1 N/mm² = 1 MPa Note [a] Applicable by agreement between the purchaser and the manufacturer								

9 Dimensions

9.1 Expression of dimensions

9.1.1 Denomination of thickness

The denomination of thickness of sheets, coils and corrugated sheets shall be as follows. For corrugated sheets, the following denominations of thickness shall be applied to pre-corrugated sheets.

a) The thickness of base metal before coating shall be taken as the nominal thickness.

b) The thickness of base metal after coating shall be taken as the product thickness. The product thickness, which is the base of tolerances, shall be the nominal thickness plus the equivalent coating thickness and shall be obtained by adding the equivalent coating thickness given in Table 15 to the nominal thickness expressed to the third decimal place. The resultant value shall be rounded to the second decimal place according to Rule A of **JIS Z 8401**.

Table 15 Equivalent coating thickness

Unit: mm

Symbol for coating mass	AZ70	AZ90	AZ120	AZ150	AZ170	AZ185	AZ200
Equivalent coating thickness	0.026	0.033	0.043	0.054	0.062	0.067	0.072

9.1.2 Unit of dimensions

The unit of dimensions for sheets, coils and corrugated sheets shall be as follows.

a) For sheets and corrugated sheets, the nominal thickness, width and length shall be expressed in millimetres.

b) For coils, the nominal thickness and width shall be expressed in millimetres. If theoretical mass is used as the mass of coil, the length of the coil shall be expressed in metres.

9.2 Standard dimensions

9.2.1 Standard dimensions of sheets and coils

The standard dimensions of sheets and coils shall be as follows.

a) **Standard nominal thickness** The standard nominal thickness of sheets and coils shall be as given in Table 16.

Table 16 Standard nominal thickness

Unit: mm

Standard nominal thickness															
0.27	0.30	0.35	0.40	0.50	0.60	0.70	0.80	0.90	1.0	1.2	1.4	1.6	1.8	2.0	2.3

b) **Standard width and standard length of sheets** The standard width of sheets and coils and the standard length of sheets shall be as given in Table 17.

Table 17 Standard width and standard length of sheet

Unit: mm

Standard width	Standard length of sheet						
762	1 829	2 134	2 438	2 743	3 048	3 353	3 658
914	1 829	2 134	2 438	2 743	3 048	3 353	3 658
1 000	2 000						
1 219	2 438	3 048	3 658				
For coils, a standard width of 610 mm is also permitted.							

9.2.2 Standard dimensions of corrugated sheets

The standard dimensions of corrugated sheets shall be as specified in **JB.2**.

9.3 Dimensional tolerances

9.3.1 Tolerances on product thickness

The tolerances on product thickness of sheets, coils and corrugated sheets shall be as follows.

a) The tolerances on product thickness shall apply to the thickness specified in **9.1.1 b**).

b) The tolerances on product thickness shall be as given in Table 18, Table 19 or Table 20.

c) The tolerances on product thickness shall apply to the thickness at a position not less than 25 mm inside from each edge (end part in the width direction).

d) In the case of coils, the tolerances on thickness shall not apply to the irregular portions such as surface flaws and breaks.

Table 18 Tolerances on product thickness (applicable to SGLHC)

Unit: mm

Nominal thickness	Width	
	Under 1 000	1 000 or over up to and incl. 1 250
1.60 or over to and excl. 2.00	±0.17	±0.18
2.00 or over up to and incl. 2.30	±0.18	±0.20

Table 19 Tolerance on product thickness (applicable to SGLH400 and SGLH490)

Unit: mm

Nominal thickness	Width
	1 250 max.
1.60 or over to and excl. 2.00	± 0.20
2.00 or over up to and incl. 2.30	± 0.21

Table 20 Tolerances on product thickness (applicable to symbols of grade given in Table 2)

Unit: mm

Nominal thickness	Width			
	Under 630	630 or over to and excl. 1 000	1 000 or over to and excl. 1 250	1 250 or over up to and incl. 1 400
Under 0.25	± 0.04	± 0.04	± 0.04	± 0.04
0.25 or over to and excl. 0.40	± 0.05	± 0.05	± 0.05	± 0.06
0.40 or over to and excl. 0.60	± 0.06	± 0.06	± 0.06	± 0.07
0.60 or over to and excl. 0.80	± 0.07	± 0.07	± 0.07	± 0.07
0.80 or over to and excl. 1.00	± 0.07	± 0.07	± 0.08	± 0.09
1.00 or over to and excl. 1.25	± 0.08	± 0.08	± 0.09	± 0.10
1.25 or over to and excl. 1.60	± 0.09	± 0.10	± 0.11	± 0.12
1.60 or over to and excl. 2.00	± 0.11	± 0.12	± 0.13	± 0.14
2.00 or over up to and incl. 2.30	± 0.13	± 0.14	± 0.15	± 0.16

9.3.2 Tolerances on width

The tolerances on width of sheets and coils shall be as follows.

a) The tolerances on width shall be as given in Table 21, Table 22 or Table 23.

b) The tolerances on width shall not apply to the irregular portions of coils.

c) The tolerances on width given in Table 22 may be shifted to the minus side within the same range as the overall range of tolerances specified in Table 22 by agreement between the purchaser and the manufacturer. In this case, the upper limit value of agreed tolerance shall not be lower than zero.

d) The tolerances on width of corrugated sheets shall be in accordance with **4.5** of **JIS G 3316**.

Table 21 Tolerances on width A

Unit: mm

Applicable symbol of grade		
SGLHC, SGLH400, SGLH490		SGLCC, SGLCD, SGLDD, SGLC400, SGLC440, SGLC490, SGLC570
Tolerance 1	Tolerance 2	
$^{+25}_{0}$	$^{+10}_{0}$	$^{+7}_{0}$
NOTE 1 This table generally applies to hot-rolled and cold-reduced base metals with mill edges or those cut by a regular method.		
NOTE 2 Generally, Tolerance 1 applies to hot-rolled base metals with mill edges, and Tolerance 2 applies to those cut by a regular method.		

Table 22 Tolerances on width B

Unit: mm

Width	
Under 1 250	1 250 or over
$^{+3}_{0}$	$^{+4}_{0}$
NOTE This table generally applies to hot-rolled and cold-reduced base metals recut or cut precisely.	

Table 23 Tolerances on width C

Unit: mm

Nominal thickness	Width			
	Under 160	160 or over to and excl. 250	250 or over to and excl. 400	400 or over to and excl. 630
Under 0.60	±0.15	±0.20	±0.25	±0.30
0.60 or over to and excl. 1.00	±0.20	±0.25	±0.25	±0.30
1.00 or over to and excl. 1.60	±0.20	±0.30	±0.30	±0.40
1.60 or over up to and incl. 2.30	±0.25	±0.35	±0.40	±0.50
NOTE This table generally applies to hot-rolled and cold-reduced base metals with a slit.				

9.3.3 Tolerances on length

The tolerances on length of sheets and corrugated sheets shall be as given in Table 24.

Table 24 Tolerances on length

Unit: mm

Tolerance on length
$^{+15}_{0}$

10 Shape

10.1 Camber

The camber of sheets, coils and corrugated sheets shall be as follows.

a) The measurement of camber shall be as shown in Figure 1.

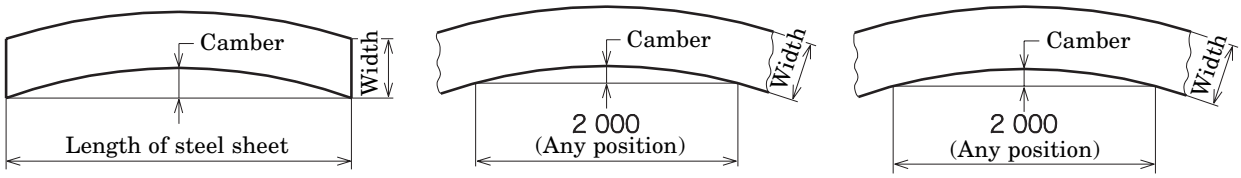
b) The camber shall be as given in Table 25 or Table 26. For corrugated sheets, these tables shall apply to pre-corrugated sheets.

c) The requirements for camber shall not apply to the irregular portions of coils.

d) The measurement of camber may be omitted [4]; however, when specified by the purchaser, the measurement shall be performed.

Note [4] The measurement of camber may be omitted at the discretion of the manufacturer provided that the products satisfy the requirements for camber.

Unit: mm



a) Sheets under 2 000 mm in length **b) Sheets 2 000 mm or over in length** **c) Coils**

Figure 1 Camber

Table 25 Camber (applicable to symbols of grade given in Table 1)

Unit: mm

Width	Sheet			Coil
	Length			
	Under 2 500	2 500 or over to and excl. 4 000	4 000 or over	
Under 630	5 max.	8 max.	12 max.	5 max. in any 2 000 length
630 or over to and excl. 1 000	4 max.	6 max.	10 max.	
1 000 or over	3 max.	5 max.	8 max.	

Table 26 Camber (applicable to symbols of grade given in Table 2)

Unit: mm

Width	Sheet and corrugated sheet		Coil
	Length		
	Under 2 000	2 000 or over	
Under 630	4 max.	4 max. in any 2 000 length	
630 or over	2 max.	2 max. in any 2 000 length	

10.2 Squareness

The squareness of sheets and corrugated sheets shall be in accordance with either of the following. For corrugated sheets, it applies to pre-corrugated sheets.

In the case of dispute, the method given in **a**) shall apply.

a) **Method using perpendicular line** The squareness of sheets and corrugated sheets shall be expressed by the ratio (A/W), where A indicates the distance between a perpendicular line from an edge drawn at a corner point and the corner point of the opposite edge, and W indicates the length of the perpendicular line, as shown in Figure 2, and this value shall not exceed 1.0 %.

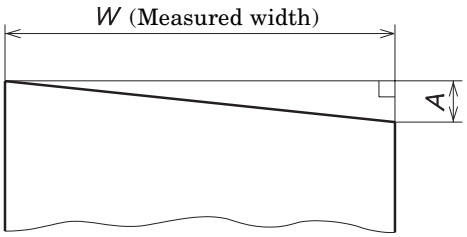


Figure 2 Squareness of sheets and corrugated sheets (method using perpendicular line)

b) **Method using diagonal lines** Half of the absolute value of the difference between the lengths of two diagonal lines (X_1 and X_2 in Figure 3) of the sheet and corrugated sheet shall be obtained, and this value ($|X_1 - X_2|/2$) shall not exceed 0.7 % of the measured width W of the sheet and corrugated sheet.

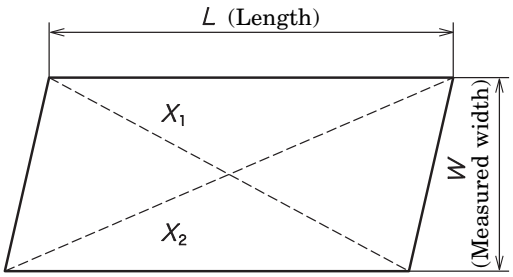


Figure 3 Squareness of sheets and corrugated sheets (method using diagonal lines)

10.3 Flatness

The flatness of sheets and coils shall be as follows.

a) **Flatness of sheet** The flatness of sheets shall be as given in Table 27 or Table 28. The flatness shall be obtained as follows: place a sheet on a surface plate; measure the maximum strain of the sheet; from the measured value subtract the product thickness of the sheet, to take as the value for the top surface of sheet.

Table 27 Flatness (applicable to symbols of grade given in Table 1)

Unit: mm

Width	Flatness
1 250 max.	16 max.

Table 28 Flatness (applicable to symbols of grade given in Table 2)

Unit: mm

Width	Type of strain [a)]		
	Bow	Edge wave	Centre buckle
Under 1 000	12 max.	8 max.	6 max.
1 000 or over to and excl. 1 250	15 max.	9 max.	8 max.
1 250 or over up to and incl. 1 400	15 max.	11 max.	8 max.

Note [a)] The strain is categorized as follows, according to its shape and location of occurrence.

Bow: curvature in the overall steel sheet, either in the rolling direction or in the direction perpendicular to the rolling direction

Edge wave: wave appearing on the edge of steel sheet (end part in the width direction)

Centre buckle: wave appearing at the centre of the steel sheet

b) **Flatness of coil** The flatness of coils shall be as given in Table 27 or Table 28, however, the requirements for bow do not apply. In addition, the flatness of coils shall not apply to the irregular portions of coils. The flatness of coils shall be inspected on the inspection station installed on the production line. When the measured values are required to be reported, the measurement shall be performed after the purchaser and the manufacturer agree upon the measurement including the measurement method.

The measurement of flatness of coils may be omitted [5)].

Note [5)] The measurement of flatness may be omitted at the discretion of the manufacturer provided that the coils satisfy the requirements for flatness.

11 Mass

11.1 Mass of sheet and corrugated sheet

Unless otherwise specified, the mass of sheets and corrugated sheets shall generally be given in the theoretical mass in kilogrammes.

11.2 Mass of coil

The mass of coils shall be given in either the actual mass or theoretical mass in kilogrammes.

11.3 Calculation of mass

The calculation method of mass of sheets, coils and corrugated sheets shall be as given in Table 29.

Table 29 Calculation of mass

Items (calculated in the order given)		Calculation	Number of figures in resultant values [a]
Basic mass of base metal kg/(mm · m²)		7.85 [b]	—
Unit mass of base metal kg/m²		Basic mass of base metal [kg/(mm · m²)] × nominal thickness (mm)	Rounding off to 4 significant figures
Unit mass after coating kg/m²		Unit mass of base metal (kg/m²) + coating mass constant (kg/m²) [c]	Rounding off to 4 significant figures
Sheet and corrugated sheet	Area of sheet and corrugated sheet [d] m²	Width (mm) × length (mm) × 10^{-6}	Rounding off to 4 significant figures
	Mass of a single sheet kg	Unit mass after coating (kg/m²) × area (m²)	Rounding off to 3 significant figures
	Mass of a single bundle [e] kg	Mass of a single sheet (kg) × number of sheets of same dimensions in a single bundle	Rounding off to an integer in kg
	Total mass kg	Total mass of each bundle (kg)	An integer in kg
Coil	Unit mass of coil kg/m	Unit mass after coating (kg/m²) × width (mm) × 10^{-3}	Rounding off to 3 significant figures
	Mass of a single coil kg	Unit mass of coil (kg/m) × length (m)	Rounding off to an integer in kg
	Total mass kg	Total mass of each coil (kg)	An integer in kg

Notes [a] The rounding of numerical values shall be in accordance with Rule A of **JIS Z 8401**.

[b] Basic mass of base metal per thickness 1 mm × area 1 m²

[c] The coating mass constants shall be as given in Table 30.

[d] The width dimensions used for the calculation of the area of corrugated sheet shall be those before corrugation

[e] When the mass of a bundle is specified, the number of sheets shall be obtained by dividing the specified mass by the mass of a single sheet of the same shape, dimensions and coating mass, to be rounded off to an integer.

Table 30 Coating mass constant for mass calculation

Unit: kg/m²

Symbol for coating mass	AZ70	AZ90	AZ120	AZ150	AZ170	AZ185	AZ200
Coating mass constant	0.095	0.120	0.160	0.200	0.230	0.250	0.270

11.4 Tolerances on theoretical mass of sheet and corrugated sheet

The tolerances on the theoretical mass of sheets and corrugated sheets shall be calculated by dividing the difference between the actual mass and the theoretical mass obtained in accordance with **11.3** by the theoretical mass, expressed as the percentage, and shall be as given in Table 31.

Table 31 Tolerances on theoretical mass

Theoretical mass of a single lot [a)] kg	Tolerance %
Under 600	± 10
600 or over to and excl. 2 000	± 7.5
2 000 or over	± 5

Note [a)] Sheets or corrugated sheets of the same quality, shape, dimensions and coating mass are considered as a single lot of sheets or corrugated sheets for the value of theoretical mass.

12 Appearance

The sheets, coils and corrugated sheets shall be free from defects detrimental to use. Coils may contain some irregular portions or welds because the inspection usually does not afford the manufacturer the opportunity to readily detect and remove defective portions over the entire length. Treatment of coil defective portions, if necessary, may be agreed upon between the purchaser and the manufacturer.

The requirements for surface defects shall apply to one surface [6)] of sheets, coils and corrugated sheets, unless otherwise specified.

NOTE Defects include holes, laminations and surface flaws.

Note [6)] One surface generally refers to the upper surface of package for sheets and corrugated sheets, and the outside surface for coils.

13 Tests

13.1 Chemical analysis

13.1.1 General requirements for chemical analysis and sampling method

The chemical composition of sheets, coils and corrugated sheets shall be determined by heat analysis, and the general requirements for chemical analysis and the sampling method shall be as given in Clause **8** of **JIS G 0404**.

13.1.2 Analytical method

The analytical method shall be in accordance with **JIS G 0320**.

13.2 Plating bath composition test

The test method of plating bath composition shall be determined at the discretion of the manufacturer. The test of plating bath composition may be omitted [7)]; however, if requested by the purchaser, the test shall be performed by the method agreed upon between the purchaser and the manufacturer.

Note [7)] The test may be omitted at the discretion of the manufacturer provided that the requirements for plating bath composition are satisfied.

13.3 Coating test

13.3.1 Sampling method

A sample shall be taken from each 50 t or its fraction of products of the same size and coating mass.

For corrugated sheets, the sample shall be taken from the pre-corrugated sheet.

13.3.2 Coating mass determination

The coating mass shall be determined as follows.

a) **Test method** Coating mass shall be measured on both surfaces of the test piece, in accordance with any one of Annex JC, Annex JD or Annex JE. In the case of dispute, Annex JE shall apply.

For the tests in accordance with Annex JD, the measurement shall be performed for every 50 t or its fraction of products of the same size and coating mass.

b) **Sampling of test pieces** The test pieces shall be sampled as follows.

1) For the tests in accordance with Annex JC, the sampling position, size and number of test pieces shall be as specified in **JC.5**.

2) For the tests in accordance with Annex JD, the coating mass of the product shall be measured on the production line without sampling a test piece.

3) For the tests in accordance with Annex JE, the sampling position and number of test pieces shall be as specified in **JC.5.2**. The size of the test piece shall be 1 200 mm^2 or over.

13.3.3 Coating adherence determination

The coating adherence determination by the bend test shall be as follows.

a) **Sampling position and size of test piece** The test piece shall be taken at any position of the sample. The test piece shall have a width of 75 mm to 125 mm and a suitable length of about twice the width. Unless otherwise specified, one test piece shall be taken from the sample in the direction parallel to the rolling direction of the base metal.

b) **Test method** The test piece shall be bent manually using a vice at 180° in the longitudinal direction of the test piece, as shown in Figure 4, with the specified number of sheets being sandwiched. The number of sheets is specified in Table 8 or Table 9 as the internal spacing of bend. When a vice is not available, testing by other suitable means may be adopted. After the bending, the test piece shall be examined for flaking of the coating.

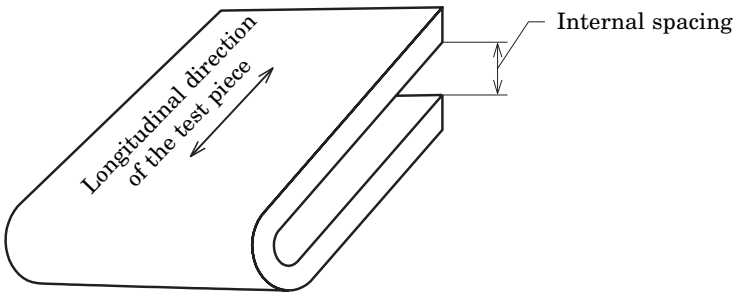


Figure 4 Direction of bend test

13.3.4 Corrosion resistance test of coating

The corrosion resistance test of coating may be performed as agreed between the purchaser and the manufacturer. The acceptance criteria applied to the test results shall be as agreed between the purchaser and the manufacturer.

NOTE Examples of test methods of corrosion resistance of coating are as follows.

Examples
- — **JIS G 0594**
- — **7.3** of **JIS H 8502**
- — Clause **8** of **JIS H 8502**
- — Annex 1 (Cycle D) of **JIS K 5600-7-9**
- — Neutral salt spray test of **JIS Z 2371**
- — Method B of **ISO 16539**

13.4 Mechanical test

13.4.1 General requirements

General requirements for mechanical tests shall be as specified in Clauses **7** and **9** of **JIS G 0404**. In this case, the sampling method shall be that of Class A specified in **7.6** of **JIS G 0404**. For corrugated sheets, samples shall be taken from pre-corrugated sheets. The number of test pieces and sampling position shall be as follows.

a) **Number of test pieces** One bend test piece and one tensile test piece shall be taken from every 50 t or its fraction of products of the same grade, thickness and coating mass.

b) **Sampling position of test piece** The centre of the test piece shall be located at a quarter-width position or at a position closest possible to this.

13.4.2 Bend test

The bend test shall be performed in accordance with **13.3.3**. After the bending, the surface of the test piece shall be examined for cracks and breakage which are visible to the naked eye.

The bend test may be omitted[8)]. If specified by the purchaser, however, the test shall be performed.

Note [8)] The bend test may be omitted at the discretion of the manufacturer provided that the requirements for bendability are satisfied.

13.4.3 Tensile test

The tensile test shall be as follows.

a) **Test piece** Take one Test piece No. 5 specified in **JIS Z 2241** from the sample, in the direction given in Tables 13 and 14.

b) **Test method** The test method shall be in accordance with **JIS Z 2241**.

c) **Thickness used for calculation of yield point or proof stress, and tensile strength** The thickness used for calculation of yield point or proof stress, and tensile strength shall be any one of the following.

— Actual measured thickness after the removal of coating

— Thickness obtained by subtracting the equivalent coating thickness from the actual measured thickness including the coating

— Thickness obtained by subtracting the coating thickness obtained through conversion of the actual measured coating mass [9)] from the actual measured thickness including the coating

Note [9)] The converted coating thickness is obtained by dividing the actual measured coating mass by the density of coating (3.69 g/cm^3). The resultant value is rounded to three decimal places and expressed in millimetres.

14 Inspection and reinspection

14.1 Inspection

The inspection shall be as follows.

a) Chemical composition shall conform to Clause **4**.

b) Plating bath composition shall conform to **5.1**.

c) Coating mass shall conform to **5.2**.

d) Coating adherence shall conform to **5.4**.

e) Mechanical properties shall conform to Clause **8**.

f) Dimensions shall conform to Clause **9**.

g) Shapes shall conform to Clause **10**.

h) Mass shall conform to Clause **11**.

i) Appearance shall conform to Clause **12**.

14.2 Reinspection

The sheets, coils and corrugated sheets having failed the coating mass determination, coating adherence determination, bend test or tensile test, may be subjected to the retest according to **9.8** of **JIS G 0404** for further acceptance judgement.

15 Marking

The sheets, coils and corrugated sheets having passed the inspection shall be marked with the following items by a suitable means on each package or bundle. Part of items may be omitted by agreement between the purchaser and the manufacturer.

When agreed between the purchaser and the supplier, the following items may be marked on each sheet or corrugated sheet.

a) Symbol of grade

b) For those for roofing or architectural siding, the symbol given in Table 3 which is suffixed to the symbol of grade

c) For corrugated sheets, the symbol given in Table 4 which is suffixed to the symbol of grade. For corrugated sheets for roofing or architectural siding, the symbol given in Table 4 is suffixed to the symbol given in Table 3.

d) Symbol for skin-pass treatment and/or symbol for chemical treatment, and symbol for oiling, all of which are marked when specified by the purchaser

e) Symbol for coating mass

f) Dimensions (See **9.1**. For one sheet, only the nominal thickness is marked.)

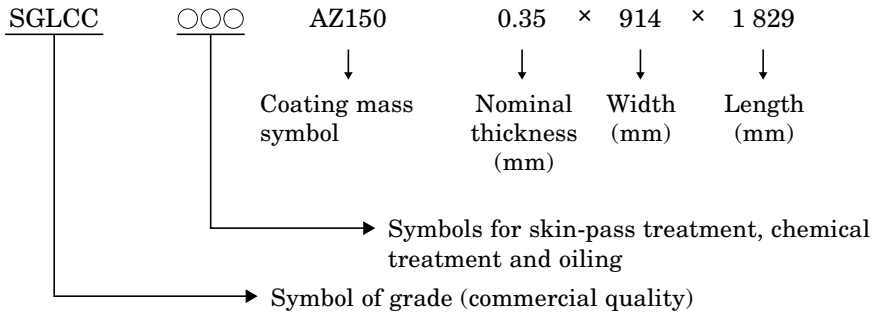
g) Product identification number

h) Number of sheets or mass (For one sheet, this item may be omitted.)

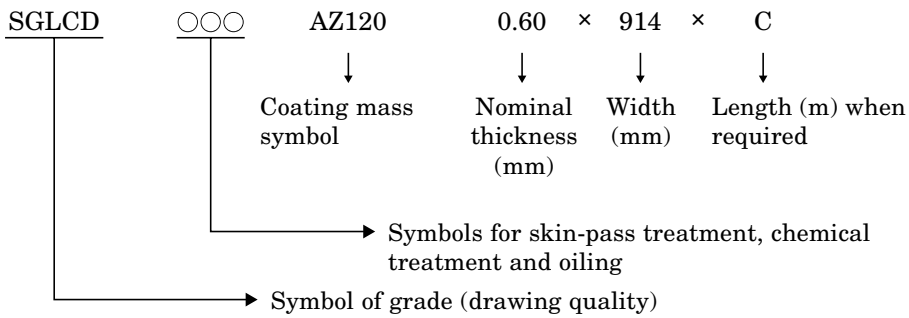
i) Manufacturer's name or its identifying brand

Marking examples are as follows.

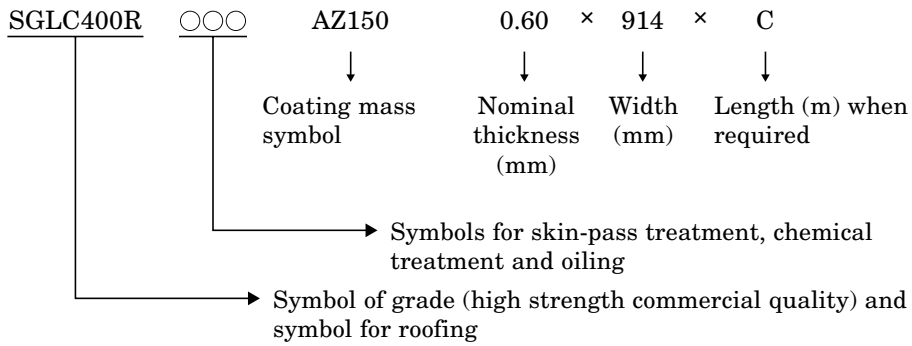
Example 1 **Sheet**



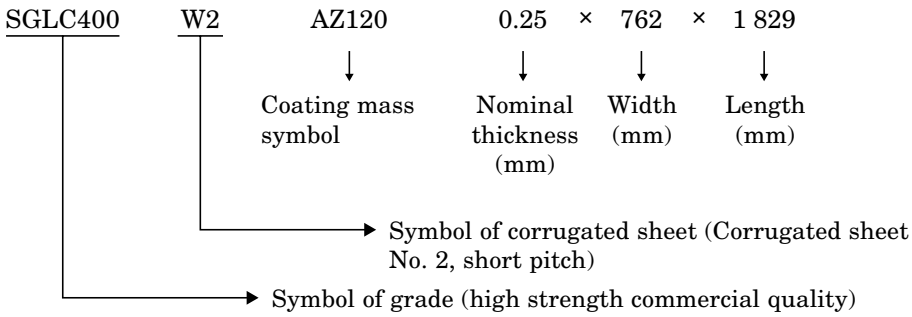
Example 2 **Coil**



Example 3 **Coil for roofing**



Example 4 **Corrugated sheet using sheet of high strength commercial quality**



16 Items to be confirmed at the time of ordering

The purchaser and the manufacturer shall confirm the following items at the time of ordering so as to ensure that the supplied product is in conformance with this Standard.

a) Symbol of grade (Tables 1 and 2)

b) Dimensions (Clause **9**)

c) Necessity of skin-pass treatment or symbol (**5.3.2**)

d) Symbol for coating mass (Table 7)

e) Classification or symbol of chemical treatment (Table 10)

f) Classification or symbol of oiling (Table 11)

g) Tolerances on width (Table 21, Table 22 or Table 23)

17 Report

The manufacturer shall submit an inspection document to the purchaser when the document is previously requested by the purchaser. In this case, the report shall conform to the requirements in Clause **13** of **JIS G 0404**. The measured values of carbon, phosphor and sulfur among chemical compositions may be expressed to three decimal places in the report. Unless otherwise specified, the type of the inspection document to be submitted shall be in accordance with **5.1** of **JIS G 0415**.

Annex JA (normative)
Coating mass of sheet and coil for roofing and architectural siding

JA.1 Coating mass

Coating mass applied to sheets and coils for roofing and architectural siding varies depending on the nominal thickness. Classification of nominal thickness and the symbol for coating mass applied to the classification shall be as given in Table JA.1.

Table JA.1 Nominal thickness and symbol for coating mass (applicable to symbols of grade given in Table 2)

Application	Nominal thickness mm	Symbol for coating mass [a)]
Roofing	0.35 or over	AZ150
Architectural siding	0.27 or over up to and incl. 0.50	AZ90, AZ120, AZ150
	Over 0.50 up to and incl. 1.0	AZ120, AZ150
	Over 1.0	AZ150
Note [a)] AZ170, AZ185 and AZ200 may be applied if agreed between the purchaser and the manufacturer.		

Annex JB (normative)
Coating mass and standard dimensions of corrugated sheet

JB.1 Coating mass

Coating mass applied to corrugated sheets varies depending on the nominal thickness. Classification of nominal thickness and the symbol for coating mass applied to the classification shall be as given in Table JB.1.

Table JB.1 Nominal thickness and symbol for coating mass (applicable to symbols of grade given in Table 2)

Nominal thickness mm	Symbol for coating mass [a)]
0.25 or over up to and incl. 0.50	AZ90, AZ120, AZ150
Over 0.50 up to and incl. 1.0	AZ120, AZ150
Note [a)] AZ170, AZ185 and AZ200 may be applied if agreed between the purchaser and the manufacturer.	

JB.2 Standard dimensions

JB.2.1 Standard nominal thickness

The standard nominal thickness of corrugated sheets shall be as given in Table JB.2.

Table JB.2 Standard nominal thickness

Unit: mm

Standard nominal thickness								
0.25	0.27	0.30	0.35	0.40	0.50	0.60	0.80	1.0

JB.2.2 Standard width and length before corrugation

The standard width and length of pre-corrugated sheets shall be as given in Table JB.3.

Table JB.3 Standard width and length

Unit: mm

Standard width before corrugation	Standard length						
762	1 829	2 134	2 438	2 743	3 048	3 353	3 658
914	1 829	2 134	2 438	2 743	3 048	3 353	3 658
1 000	2 000						

JB.2.3 Standard width after corrugation

The standard width of corrugated sheets shall be as specified in **4.3** of **JIS G 3316**.

Annex JC (normative)
Off-line coating mass determination of hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip by fluorescent X-ray method

JC.1 Outline

The coating mass of a test piece is determined using an off-line fluorescent X-ray test apparatus.

JC.2 Principle of measurement

The coating mass is obtained by measuring the intensity of fluorescent X-ray which is emitted from the coating when the specimen is irradiated by X-ray and by comparing this intensity with that of a test piece of known coating mass.

JC.3 Apparatus

The apparatus shall be as specified in Clause **5** of **JIS K 0119**.

JC.4 Fluorescent X-ray to be measured

The fluorescent X-ray to be measured shall be the primary ray of ZnK_{α} (wavelength 0.143 5 nm).

JC.5 Test pieces

JC.5.1 Size of test pieces

The test piece shall be of such size that it can be installed in the sample chamber of the fluorescent X-ray test apparatus in which the area of the test piece irradiated by X-ray is controlled to be a minimum size of 314 mm^2.

JC.5.2 Sampling position and number of test pieces

Take a test piece, from the sample obtained in accordance with **13.3.1**, at each of the three points shown in Figure JC.1 or at a closest possible position to them.

Unit: mm

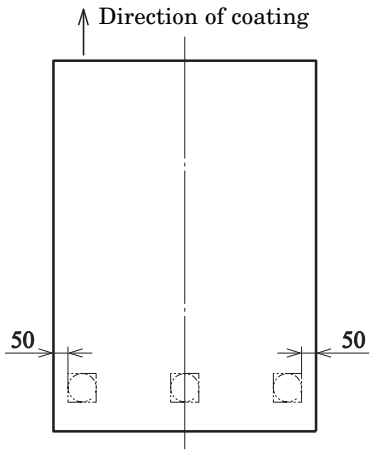


Figure JC.1 Sampling position of test pieces

JC.6 Preparation and correction of calibration curve

JC.6.1 Preparation method of calibration curve

JC.6.1.1 General

The calibration curve shall be prepared by the triple-test-piece method or dual-test-piece method.

JC.6.1.2 Triple-test-piece method

The preparation of the calibration curve by the triple-test-piece method shall be as follows.

a) **Test piece** Sample one test piece for fluorescent X-ray measurement (hereafter referred to as Test piece A), and two test pieces for coating mass determination (hereafter referred to as Test pieces B). Take each test piece from a sheet or coil of the same coating type as that of the measuring object. Take one Test piece A of such size that it fits in the sample chamber of the test apparatus. Take two Test pieces B of at least 1 200 mm^2 in size from each side of Test piece A.

b) **Measurement of fluorescent X-ray intensity** Decide which surface of Test piece A to irradiate with fluorescent X-ray to take as the measurement surface. Irradiate the measurement surface of Test piece A with X-ray under the conditions specified in **JC.7 a**), and measure the intensity of fluorescent X-ray.

c) **Measurement of coating mass** Pretreat Test pieces B so as to prevent the elution of coating from other surfaces than the measurement surface. Prevent the elution of coating in such a way that, on the back of measurement surface, lacquer is applied and then dried, or a wide tape is applied. After pretreatment, measure the coating mass on the surfaces of two Test pieces B, according to Annex JE. Obtain the average coating mass of two Test pieces B to take as the coating mass on the measurement surface of Test piece A.

d) **Preparation of calibration curve** Carry out procedures **a**) to **c**) on test pieces with at least three different levels of coating mass, and prepare the calibration curve

based on the relation between the intensity of fluorescent X-ray and the coating mass.

JC.6.1.3 Dual-test-piece method

The preparation of the calibration curve by the dual-test-piece method shall be as follows.

a) **Test piece** Take two test pieces of at least 1 200 mm^2 in size from the sample for preparing the calibration curve.

b) **Measurement of fluorescent X-ray intensity** Decide which surface of the test piece to irradiate with fluorescent X-ray to take as the measurement surface. Irradiate the measurement surface of the test piece with X-ray under the condition specified in **JC.7 a**), and measure the intensity of fluorescent X-ray. Measure the intensity of fluorescent X-ray of the other test piece on the same surface in the same manner. Obtain the average intensity of fluorescent X-ray of two test pieces to take as the intensity of fluorescent X-ray on the measurement surface.

c) **Measurement of coating mass** Pretreat the test pieces so as to prevent the elution of coating from other surfaces than the measurement surface. Prevent the elution of coating in such a way that, on the back of measurement surface, lacquer is applied and then dried, or a wide tape is applied. After pretreatment, measure the coating mass on the surfaces of two test pieces, according to Annex JE. Obtain the average coating mass of two test pieces to take as the coating mass on the measurement surface.

d) **Preparation of calibration curve** Carry out procedures **a**) to **c**) on test pieces with at least three different levels of coating mass, and prepare the calibration curve based on the relation between the intensity of fluorescent X-ray and the coating mass.

JC.6.2 Correction of calibration curve

Mount the calibration test piece on the test apparatus, periodically [1)] measure the intensity of fluorescent X-ray or obtain the value converted to coating mass, and correct the calibration curve.

Note [1)] This calibration should be performed, for example, every 8 h or 24 h.

JC.7 Procedure

The procedure shall be as follows.

a) Mount on the apparatus the test piece of symbol for the minimum coating mass among all measured coating mass values. Set the apparatus conditions under which the relative standard deviation [2)] after 10 consecutive measurements can be within 1 %, and which the coating mass can be obtained to the nearest 0.1 g/m^2. Repetitive measurements are not required when the X-ray intensity obtained by counting is 10 000 or more.

Note [2)] The term indicates the quotient obtained by dividing the standard deviation of measured values (absolute value of square root of variance) by the average value (see **3.10** of **JIS K 0211**).

When measuring a coating mass smaller than that of the symbol for coating mass used in setting the conditions, confirm that the above conditions are satisfied by using a test piece of the relevant symbol for coating mass. If the above conditions are not satisfied, new conditions shall be defined.

b) Set the test piece properly in the sample chamber.

c) Irradiate the test piece with X-ray under the specified conditions, and measure the intensity of fluorescent X-ray.

d) Convert the intensity of fluorescent X-ray to coating mass per square metre (one side, g/m^2), by using the calibration curve.

e) Repeat procedures **b**) to **d**) on the rear surface of the test piece to determine the coating mass. Take the total of the coating masses on the front surface and rear surface as the coating mass of the test piece (both sides, g/m^2).

JC.8 Checks on apparatus

The apparatus shall be subjected to adequate checks regarding the items listed in Clause **15** of **JIS K 0119**. In addition, the measured value of coating mass and the value obtained in accordance with Annex JE shall be compared to confirm that the measurement result obtained using the apparatus shows no abnormalities.

Annex JD (normative)
Online coating mass determination of hot-dip 55 % aluminium-zinc alloy-coated steel strip by fluorescent X-ray method

JD.1 Outline

Coating mass is measured by means of a fluorescent X-ray test apparatus installed on the production line without taking a test piece from coils.

WARNING Proper safety measures shall be taken in measurement and maintenance of a facility performed in accordance with this Annex. Thorough safety control shall be in place especially to avoid exposure to radiation.

NOTE Examples of laws and regulations regarding the installation and handling of the apparatus used in this test method are the Industrial Safety and Health Act and the Regulation on Prevention of Ionizing Radiation Hazards.

JD.2 Principle of measurement

The coating mass is obtained by measuring the intensity of fluorescent X-ray which is emitted from the coating when the coil is irradiated by the X-ray (including γ ray) and by comparing this intensity with that of a test piece of known coating mass.

JD.3 Apparatus

The apparatus shall be composed of an X-ray generating section; spectroscopy, light scanning and counting sections; and apparatus controlling and data processing sections; and shall be as follows. The apparatus shall be installed in a place where there is no variation of temperature or humidity that may significantly affect the measurement results.

JD.3.1 X-ray generating section The X-ray generating section shall be capable of directly irradiating the position of a coil specified in **JD.6.3** with excited X-ray (including γ ray).

JD.3.2 Spectroscopy, light scanning and counting sections The spectroscopy, light scanning and counting sections shall be capable of measuring the intensity of fluorescent X-ray generated at the measuring point specified in **JD.6.3**.

JD.3.3 Apparatus controlling and data processing sections The apparatus controlling and data processing sections shall be capable of controlling the X-ray generating section and the spectroscopy, light scanning and counting sections for irradiating the position specified in **JD.6.3** with excited X-ray (including γ ray) and measuring the intensity of the resultant emission of fluorescent X-ray, and shall be capable of keeping interrelated records of their irradiating points and the measurement results.

JD.4 Fluorescent X-ray to be measured

The fluorescent X-ray to be measured shall be the primary ray of ZnK_{α} (wavelength 0.143 5 nm). X-ray of other wavelengths may be applied at the same time, for the correction of distance between the measurement surface and the apparatus or for other purposes.

JD.5 Preparation and correction of calibration curve

JD.5.1 Preparation method of calibration curve

The calibration curve shall be prepared in accordance with **JC.6.1**.

JC.5.2 Correction of calibration curve

The correction of calibration curve shall be as specified in **JC.6.2**.

JD.6 Measurement method

JD.6.1 Measurement surface

The surface of the coil on which the coating mass is measured shall be free from contamination and adhesion of metal powder which may significantly influence the measurement results. The distance and inclination between the surface to be measured and the apparatus shall be the same as the distance and inclination obtained at the time of the measurement of the test piece for X-ray measurement. A significant deviation in distance or inclination between the coil and the apparatus which may affect the measurement results shall be corrected, if applicable.

JD.6.2 Measuring mode

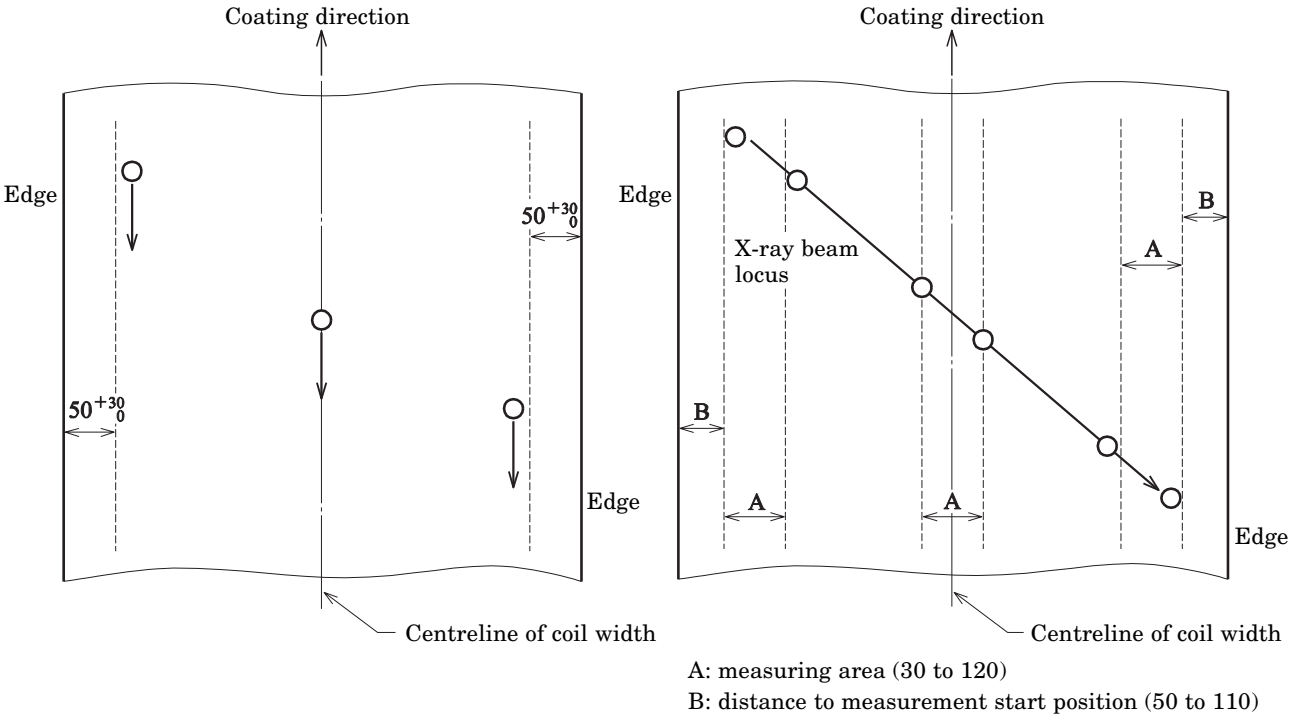
The measuring mode of the coating mass can be either that in which the apparatus is fixed on the specified position of the coil in the width direction (hereafter referred to as fixed-point measurement mode), or that in which the apparatus is moved at a constant speed in the width direction of the coil (hereafter referred to as scanning mode), while the coil is irradiated by the X-ray for the measurement of coating mass. Which of the measuring modes to apply shall be decided at the discretion of the manufacturer.

JD.6.3 Measuring point of coating mass

The measuring point of coating mass of coils in the width direction shall be as shown in Figure JD.1 a) for fixed-point measurement mode, and as shown in Figure JD.1 b) for scanning mode. In the fixed-point measurement mode, the apparatus shall be moved to three points at which the outer edges of the X-ray beam are 50^{+30}_{0} mm from both edges of the coil (ends in width direction) and the centre of the X-ray beam is ± 15 mm from the centre of the coil width, and the coating mass shall be measured at each point. In the scanning mode, the apparatus shall be moved at a constant speed in the width direction of the coil, and the coating mass shall be measured at each of the three measuring areas (A) shown in Figure JD.1 b). In this case, side edge measuring area indicates the positions of the outer edges of X-ray beam and the measuring area at the coil width centre indicates the positions of the centre of X-ray beam.

The coating mass shall be measured on both the front and rear surfaces of the coil. The measuring points of width direction shall be the same for both the front and rear surfaces of the coil, and measuring points of longitudinal directions of the front and rear surfaces of the coil shall be as close as possible.

Unit: mm



A: measuring area (30 to 120)
B: distance to measurement start position (50 to 110)

a) Fixed-point measurement mode **b) Scanning mode**

Figure JD.1 Measuring point of coating mass

JD.6.4 Measurement

The measurement shall be as follows.

a) The measuring time for one point shall be 4 s or less. Mount on the apparatus the test piece of symbol for the minimum coating mass among all coating mass values measured on the production line on which the apparatus is installed. Set the apparatus conditions under which the relative standard deviation [1)] after 10 consecutive measurements in the specified time can be within 1 %, and which the coating mass can be obtained to the nearest 0.1 g/m^2. Repetitive measurements are not required when the X-ray intensity obtained by counting is 10 000 or more.

Note [1)] The term indicates the quotient obtained by dividing the standard deviation of measured values (absolute value of square root of variance) by the average value (see **3.10** of **JIS K 0211**).

When measuring a coating mass smaller than that of the symbol for coating mass used in setting the conditions, confirm that the above conditions are satisfied by using a test piece of the relevant symbol for coating mass. If the above conditions are not satisfied, new conditions shall be defined.

b) Irradiate the coil with X-ray under the set conditions and measure the fluorescent X-ray intensity.

c) Convert the intensity of fluorescent X-ray to coating mass per square metre (one side, g/m^2), by using the calibration curve.

When the coil area changes after measurement of the coating mass due to e.g. skin-pass treatment, correct the coating mass using the rate of change of area.

d) Take the total of the coating masses on the front surface and rear surface as the coating mass at one point of the coil (both sides, g/m^2).

JD.6.5 Measured value of coating mass

Obtain the average coating mass and the minimum coating mass using coating mass values at three points of arbitrary one pass [2)]. The measurement may be performed over more than one pass, in which case the average coating mass shall be the average of all measured coating mass values and the minimum coating mass shall be the minimum value among all measured coating mass values.

Note [2)] One pass means the measurement performed while the X-ray generating section is moved in one direction from a side edge at an arbitrary point of the coil to the other side edge.

JD.7 Checks on apparatus

The apparatus shall be subjected to adequate checks regarding the items listed in Clause **15** of **JIS K 0119** and the following items.

a) The temperature and humidity at the place where the apparatus is installed do not influence the measurement.

b) The distance and angle between the apparatus and the coil is kept constant at the time of measurement.

c) The distance and angle between the test piece and the apparatus at the time of calibration are equivalent to those at the time of measurement of coil.

d) Under scanning mode, the apparatus moves at a constant speed.

e) The apparatus measures the coating mass of coil under the specified conditions.

f) The contamination of the apparatus does not influence the measurement.

g) The coating mass measured with the apparatus according to this method is compared with measurement results obtained by other methods (Annex JC or Annex JE), and the measurement result obtained using the apparatus shows no abnormalities.

Annex JE (normative)
Coating mass determination by gravimetric method

JE.1 Outline

The coated test piece is weighed and then the coating is dissolved in the test solution. The test piece is again weighed, and from the gap between the two masses obtained, the coating mass is determined.

JE.2 Test solution

Dissolve 3.5 g of hexamethylenetetramine specified in **JIS K 8847** in 500 ml of hydrochloric acid not less than 1.18 g/cm^3 in density [35 % (mass fraction)]. Dilute this solution with water twofold and take as a test solution.

JE.3 Cleaning of test piece

As necessary, degrease the test piece with an organic solvent and then dry. The organic solvent to be used shall be harmless to the coating.

JE.4 Procedure

The procedure shall be as follows.

a) Measure the mass of test piece before dissolving the coating. The mass shall be measured to an accuracy within ± 1 % of the estimated coating mass (prospective coating mass).

b) Select the volume of test solution so that at least 10 ml of solution is available for each 100 mm^2 of the coated surface area (one side) of test piece. The test solution may be reused as long as it is capable of easily removing the coating.

c) Immerse the test piece completely in the test solution at ordinary temperature, and leave until the coating thoroughly dissolves. The cessation of originally brisk evolution of hydrogen in the test solution indicates the completion of dissolution. Rinse the test piece in running water, wipe well with cotton cloth and dry sufficiently, or alternatively immerse the test piece in alcohol and dry quickly. Then weigh the mass again. The mass shall be measured to an accuracy within ± 1 % of the estimated coating mass (prospective coating mass).

d) After weighing, determine the area S (mm^2) of the coated surface (one side) of test piece. Measure the surface area to an accuracy within 1 %.

   In the case of known surface area, e.g. punching, the measurement may be omitted.

JE.5 Calculation of coating mass

The coating mass shall be calculated to one decimal place, and rounded to an integer in accordance with Rule A of **JIS Z 8401**.

$$M = \frac{W_1 - W_2}{S} \times 10^6$$

where, M : coating mass (g/m2)

W_1 : mass of test piece before removal of coating (g)

W_2 : mass of test piece after removal of coating (g)

S : coated surface area (one side) of test piece (mm^2)

Bibliography

JIS G 0594 *Methods of accelerated cyclic corrosion resistance tests for anodic coatings with exposure to salt spray, dry and wet conditions*

JIS H 8502 *Methods of corrosion resistance test for metallic coatings*

JIS K 0211 *Technical terms for analytical chemistry (General part)*

JIS K 5600-7-9 *Testing methods for paints—Part 7: Determination of resistance to cyclic corrosion conditions—Section 9: Salt fog/dry/humidity*

JIS Z 2371 *Methods of salt spray testing*

ISO 16539 *Corrosion of metals and alloys—Accelerated cyclic corrosion tests with exposure to synthetic ocean water salt-deposition process—"Dry" and "wet" conditions at constant absolute humidity*

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

JIS G 3321:2019 *Hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip*	**ISO 9364**:2017 *Steel sheet, 55 % aluminium-zinc alloy-coated by the continuous hot-dip process, of commercial, drawing and structural qualities*

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
1 Scope	Hot-dip 55 % aluminium-zinc alloy-coated steel sheet, strip and corrugated sheet		1	Hot-dip 55 % aluminium-zinc alloy-coated steel sheet and strip	Addition	Requirements for corrugated sheets have been added to **JIS**.	**JIS** and **ISO** have different standard structures.
3 Symbol of grade and applicable nominal thickness	Applicable nominal thickness, and symbols of 2 grades of commercial quality, 2 grades of drawing quality and 6 grades of high strength commercial quality		4.1	Applicable thickness, and symbols of 1 grade of commercial quality, 2 grades of drawing quality and 6 grades of structural quality	Alteration	**JIS** specifies classification of hot-rolled and cold-reduced base metal. **JIS** specifies more numbers of grades than **ISO**. The range of applicable thickness in **JIS** is narrower than that in **ISO**.	The difference arises due to the different market needs.
4 Chemical composition	Chemical composition (four elements) of base metal to be coated		5.3	Chemical composition (four elements) of base metal, upper limit value of alloy elements not specified and permissible variation in product analysis	Alteration	Requirements for chemical composition differ between **JIS** and **ISO**. **JIS** does not specify the upper limit value of alloy elements not specified and permissible variation in product analysis.	The difference arises due to the difference in specified mechanical properties between **JIS** and **ISO**. **JIS** does not specify requirements for product analysis due to the lack of market demand.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
5 Coating	5.1 Plating bath composition		—	—	Addition	Requirements for plating bath composition have been added to **JIS**.	Submission of a proposal regarding this addition to **ISO** will be considered.
	5.2 Coating mass		5.5.1	Coating mass	Alteration	**JIS** specifies fewer types of coating mass than **ISO**.	The difference arises due to the different market needs.
	5.3 Coating surface finishes		8.4	Designation by a combination of spangle and skin-pass treatment	Alteration	**JIS** specifies separate symbols for the type of spangle and the application of skin-pass treatment.	**JIS** and **ISO** have different standard structures.
	5.4 Coating adherence		5.5.2	Evaluation of coating adherence by the bend test	Addition	While **JIS** and **ISO** specify the same requirements for the evaluation by the bend test, **JIS** also specifies requirements for the evaluation by other test methods.	Test methods common in Japan have been added to **JIS**.
6 Chemical treatment	Two types of chemical treatments		5.9.1	Chemical treatments, but not the type of chemical treatment	Addition	Requirements for chemical treatment capable of supporting environmentally restricted substances (chromate-free treatment) has been added to **JIS**.	Submission of a proposal regarding this addition of chemical treatment (chromate-free treatment) to **ISO** will be considered.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
8 Mechanical properties	Bendability, tensile test characteristics (yield point or proof stress, tensile strength and elongation) as mechanical properties		5.4	Tensile test characteristics (yield point or proof stress, tensile strength and elongation)	Addition	Requirements for bendability have been added to **JIS**.	The bend test specified in **JIS** may be omitted. This item will be considered for exclusion from **JIS** in the future.
					Alteration	Requirements for tensile test characteristics differ between **JIS** and **ISO**.	The difference arises due to the different market needs.
9 Dimensions	9.1 Expression of dimensions		4.2 Annex A	The ordered thickness shall be either the product thickness or base metal thickness.	Alteration	Base metal thickness applies in **JIS**.	Base metal thickness has been conventionally used in Japan. Although **ISO** used to specify the application of product thickness only, **ISO** then accepted the proposal of addition of the application of base metal thickness and made a modification in the 2005 revision.
	9.2 Standard dimensions		—	—	Addition	Requirements for standard dimensions have been added to **JIS**.	Requirements for standard dimensions is necessary in **JIS** due to business practices performed in Japan.
	9.3 Dimensional tolerances		5.11 Annex A	**ISO** refers to **ISO 16163** for dimensional tolerances.	Alteration	**JIS** and **ISO** specify different dimensional tolerances.	The difference arises due to the different market needs.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
10 Shape	Shape		5.11	Shape tolerances. **ISO** refers to **ISO 16163** for shape tolerances.	Alteration Alteration	**JIS** specifies shape tolerances separately for hot-rolled and cold-reduced base metal. **JIS** and **ISO** specify different values for shape.	**JIS** and **ISO** have different standard structures.
11 Mass	Mass		—	—	Addition	Application of actual mass and theoretical mass are specified in **JIS**.	Requirements for mass are necessary in **JIS** due to business practices performed in Japan.
13 Tests	13.1 Chemical analysis		5.3	Heat analysis shall be performed by the manufacturer. Product analysis shall be performed by the purchaser, where necessary.	Alteration	**ISO** does not specify concrete sampling method or analytical method. **JIS** specifies both concretely.	**JIS** and **ISO** have different standard structures. Concrete specifications are required in **JIS**.
	13.2 Plating bath composition test		—	—	Addition	**JIS** specifies the test method of plating bath composition.	Submission of a proposal regarding this addition, along with the addition of specifications of plating bath composition, to **ISO** will be considered.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
13 Tests (concluded)	13.3 Coating test		6.2 7.2	Coating mass determination and coating adherence determination	Addition	Requirements for corrosion resistance test of coating, as agreed between the purchaser and the manufacturer, have been added to **JIS**.	The item has been added to **JIS** because the purchaser may request the submission of corrosion resistance test data.
					Alteration	**JIS** states coating mass determination, which is specified in **ISO**, in Annex JC to Annex JE.	No technical deviation.
	13.4 Mechanical test		6.1 7.1	Test pieces and test methods for bend test and tensile test	Alteration	Requirements for the shape of tensile test piece and the test method differ between **JIS** and **ISO**.	The shape of tensile test piece specified is unique to **JIS**.
14 Inspection and reinspection	14.1 Inspection		12	Inspection	Alteration	**JIS** specifies requirements for inspection for each item.	**JIS** and **ISO** have different standard structures.
	14.2 Reinspection		9	Reinspection	Alteration	**JIS** specifies that the retest shall be performed in accordance with **9.8** of **JIS G 0404**.	No technical deviation.
15 Marking	Marking		8 14	Marking	Alteration	Symbols for roofing and architectural siding and symbols for corrugated sheets have been added to **JIS**.	**JIS** and **ISO** have different standard structures.
16 Items to be confirmed at the time of ordering	Items to be confirmed at the time of ordering		15	Items to be confirmed at the time of ordering	Alteration	Requirements for dimensions for corrugated sheets have been added to **JIS**.	**JIS** and **ISO** have different standard structures.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
17 Report	Report		—	—	Addition	Report requirements have been added to **JIS**.	Report requirements are necessary in **JIS** because reporting has been conventionally performed in Japan.
Annex JA (normative)	Nominal thickness and symbol for coating mass of sheet and coil for roofing and architectural siding		—	—	Addition	Requirements for sheets and coils for roofing and architectural siding have been added to **JIS**.	Requirements are necessary due to the particular uses.
Annex JB (normative)	Nominal thickness, symbol for coating mass and standard dimensions of corrugated sheets		—	—	Addition	Requirements for corrugated sheets have been added to **JIS**.	Requirements are necessary because corrugated sheet is unique to **JIS**.
Annex JC (normative)	Off-line coating mass determination by fluorescent X-ray method		7.2.1	Coating mass determination	Alteration	While **JIS** specifies requirements for coating mass determination in this Standard, **ISO** refers to **ISO 3497**.	Requirements for coating mass determination are specified in Annexes in **JIS** for the convenience of users.
Annex JD (normative)	Online coating mass determination by fluorescent X-ray method		7.2.1	Coating mass determination	Alteration	While **JIS** specifies requirements for coating mass determination in this Standard, **ISO** refers to **ISO 3497**.	Requirements for coating mass determination are specified in Annexes in **JIS** for the convenience of users.
Annex JE (normative)	Coating mass determination by gravimetric method		7.2.1	Coating mass determination	Alteration	While **JIS** specifies requirements for coating mass determination in this Standard, **ISO** refers to **ISO 1460**.	Requirements for coating mass determination are specified in Annexes in **JIS** for the convenience of users.

(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
No. and title of clause	Content		No. of clause	Content	Classification by clause	Detail of technical deviation	
—	—		3	Terms and definitions	Deletion	The clause has been deleted from **JIS**.	Terms are defined in **JIS G 0203**.
—	—		10	Resubmission for acceptance when products have been rejected during earlier inspection	Deletion	The clause has been deleted from **JIS**.	The item is specified in **JIS G 0404**.
—	—		12	Attendance inspection	Deletion	The clause has been deleted from **JIS**.	The item is specified in **JIS G 0404**.

Overall degree of correspondence between **JIS** and International Standard(s) (**ISO 9364**:2017): MOD

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

— Deletion: Deletes the specification item(s) or content(s) of International Standard.

— Addition: Adds the specification item(s) or content(s) which are not included in International Standard.

— Alteration: Alters the specification content(s) which are included in International Standard.

NOTE 2 Symbol in column of overall degree of correspondence between **JIS** and International Standard(s) in the above table indicates as follows:

— MOD: Modifies International Standard(s).

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