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Hot-dip zinc-aluminium-magnesium
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 based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by The Japan Iron and Steel Federation (JISF), an accredited standards development organization. This edition replaces the previous edition (**JIS G 3323** : 2019), which has been technically revised.

However, **JIS G 3323** : 2019 may be applied in the **JIS** mark certification based on the relevant provisions of Article 30, paragraph (1), etc. of the Industrial Standardization Act until 19 December 2023.

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Hot-dip zinc-aluminium-magnesium alloy-coated steel sheet and strip

1 Scope

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

NOTE A new standard specifying the requirements common to **JIS G 3302**, **JIS G 3314**, **JIS G 3317**, **JIS G 3321** and **JIS G 3323** is planned to be established at the next revision of this Standard (hereafter referred to as the new standard specifying common requirements).

2 Normative references

Part or all of the provisions of the following standards, 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 0201 *Glossary of terms used in iron and steel (Heat treatment)*
- JIS G 0202 *Glossary of terms used in iron and steel (Testing)*
- JIS G 0203 *Glossary of terms used in iron and steel (Products and quality)*
- 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 *Rounding of numbers*

3 Terms and definitions

For the purpose of this Standard, the following term and definition, and those given in **JIS G 0201**, **JIS G 0202** and **JIS G 0203** apply.

3.1

chromate-free conversion

coating not containing hexavalent chromium, which is formed by chemical conversion

4 Symbols of grades and applicable nominal thicknesses

The symbols of grades and applicable nominal thicknesses ¹⁾ shall be as follows.

Note ¹⁾ See **10.1.1 a)** for the nominal thicknesses.

- a) The sheets and coils are classified into 8 grades of hot-rolled steel strip (hereafter referred to as hot-rolled base metal) and into 13 grades of cold-reduced steel strip (hereafter referred to as cold-reduced base metal). The symbols of grades and applicable nominal thicknesses shall be as given in Table 1 and Table 2.
- b) The corrugated sheets are classified into 9 grades of commercial quality, commercial hard quality and high strength commercial quality as given in Table 2. The symbols of grades and applicable nominal thicknesses shall be as given in Table A.1. The types of shapes and their symbols for corrugated sheets shall be as given in Table 1 of **JIS G 3316**.
- c) When the symbols of grades in Table 2 are applied for roofing and architectural siding applications, the symbols of grades and applicable nominal thicknesses shall be as given in Table B.1. The symbols for roofing and architectural siding shall be as given in Table 3.

Table 1 Symbols of grades and applicable nominal thicknesses (hot-rolled base metal)

Symbol of grade	Applicable nominal thickness mm	Application (informative)
SGMHC	1.6 or over up to and incl. 9.0	Commercial
SGMH340		High strength commercial
SGMH400		
SGMH400Y		
SGMH440		
SGMH440Y		
SGMH490		
SGMH540		
For those with a nominal thickness of 1.6 mm or over up to and including 3.2 mm, 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 Symbols of grades and applicable nominal thicknesses (cold-reduced base metal)

Symbol of grade	Applicable nominal thickness mm	Application (informative)
SGMCC	0.20 or over up to and incl. 3.2	Commercial
SGMCH	0.20 or over up to and incl. 1.2	Commercial hard
SGMCD1	0.40 or over up to and incl. 2.3	Drawing, Class 1
SGMCD2		Drawing, Class 2
SGMCD3		Drawing, Class 3
SGMCD4		Drawing, Class 4, non-ageing property ^{a)}
SGMC340	0.25 or over up to and incl. 3.2	High strength commercial
SGMC400		
SGMC400Y		
SGMC440		
SGMC440Y		
SGMC490		
SGMC570	0.25 or over up to and incl. 2.0	
Note ^{a)} See JIS G 0203 for its definition.		

Table 3 Symbols for roofing and architectural siding applications

Application	Symbol for roofing/architectural siding
Roofing	R
Architectural siding	A

5 Chemical composition

The base metal of sheets, coils and corrugated sheets shall be tested for chemical composition in accordance with **14.1**, and the heat analysis values shall be as given in Table 4.

Table 4 Chemical composition

Unit: %

Symbol of grade	C	Mn	P	S
SGMHC	0.15 max.	0.80 max.	0.05 max.	0.05 max.
SGMH340	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGMH400 SGMH400Y	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGMH440 SGMH440Y	0.25 max.	2.00 max.	0.20 max.	0.05 max.
SGMH490	0.30 max.	2.00 max.	0.20 max.	0.05 max.
SGMH540	0.30 max.	2.50 max.	0.20 max.	0.05 max.
SGMCC	0.15 max.	0.80 max.	0.05 max.	0.05 max.
SGMCH	0.18 max.	1.20 max.	0.08 max.	0.05 max.
SGMCD1	0.12 max.	0.60 max.	0.04 max.	0.04 max.
SGMCD2	0.10 max.	0.45 max.	0.03 max.	0.03 max.
SGMCD3	0.08 max.	0.45 max.	0.03 max.	0.03 max.
SGMCD4	0.06 max.	0.45 max.	0.03 max.	0.03 max.
SGMC340	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGMC400 SGMC400Y	0.25 max.	1.70 max.	0.20 max.	0.05 max.
SGMC440 SGMC440Y	0.25 max.	2.00 max.	0.20 max.	0.05 max.
SGMC490	0.30 max.	2.00 max.	0.20 max.	0.05 max.
SGMC570	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.				

6 Coating

6.1 Plating bath composition

The plating bath composition shall be analysed in accordance with 14.2, and shall be as given in Table 5.

NOTE 1 In the hot-dip coating process, a base metal is immersed in a molten metal bath (plating bath) at a high temperature, and then cooled to form a coating on the base metal surface.

NOTE 2 See 14.2 for the analysis for composition of plating bath.

Table 5 Plating bath composition

Unit: %

Al	Mg	Elements other than Al, Mg and Zn	Zn
5.0 or over up to and incl. 13.0	2.0 or over up to and incl. 4.0	1.0 max. ^{a)}	Remainder ^{b)}
Note ^{a)} The figure indicates the total amount of elements which are added intentionally.			
Note ^{b)} The remainder may include elements which are mixed unavoidably.			

6.2 Coating mass

6.2.1 Symbols for coating masses

The symbols for coating masses shall be as follows.

- a) The coating applied shall be of equivalent thickness on both surfaces. The symbols for coating masses shall be as given in Table 6.
- b) The applicable symbols for coating masses of corrugated sheets shall be as given in Table A.2.
- c) The applicable symbols for coating masses for roofing and architectural siding applications shall be as given in Table B.2.

Table 6 Coating masses (total mass on both surfaces)

Unit: g/m²

Symbol for coating mass	Minimum triple-spot average coating mass	Minimum single-spot coating mass
K06 ^{a)}	60	51
K08	80	68
K10	100	85
K12	120	102
K14	140	119
K18	180	153
K20	200	170
K22	220	187
K25	250	213
K27	275	234
K35 ^{a), b)}	350	298
K45 ^{a), b)}	450	383
Note ^{a)} Applicable by agreement between the purchaser and the manufacturer.		
Note ^{b)} Not applicable to SGMCD1, SGMCD2, SGMCD3 and SGMCD4.		

6.2.2 Coating mass

The sheets, coils and corrugated sheets shall be tested for coating masses in accordance with 14.3 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 6. The minimum triple-spot average coating mass shall apply to the average of the measured values of three test pieces taken from the specimen, 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 the coating mass is measured in accordance with Annex D, the minimum triple-spot average coating mass value and the minimum single-spot coating mass value shall apply to the average coating mass value and the minimum coating mass value, respectively, which are obtained in accordance with D.6.5.

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) The coating mass of corrugated sheets shall apply to pre-corrugated sheets.
- c) The upper limit value of the coating mass (total mass on both surfaces) of sheets, coils and corrugated sheets may be as agreed between the purchaser and the manufacturer.

6.3 Skin-pass treatment

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.

6.4 Coating adherence

The coating adherence shall be as follows.

- a) Sheets and coils, when tested for coating adherence in accordance with 14.3 under the bend test conditions given in Table 7 and Table 8, 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 SGMCH and SGMC570.
- c) For 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 14.3, 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 14.3.

Table 7 Coating adherence and bendability (hot-rolled base metal)

Symbol of grade	Bend angle	Internal spacing ^{a)} Number of sheets					
		Nominal thickness 1.6 mm or over to and excl. 3.0 mm			Nominal thickness 3.0 mm or over up to and incl. 9.0 mm		
		Symbol for coating mass			Symbol for coating mass		
		K06 to K27	K35	K45	K06 to K27	K35	K45
SGMHC	180°	1	2	2	2	2	2
SGMH340		1	1	2	2	2	3
SGMH400 SGMH400Y		2	2	2	3	3	3
SGMH440 SGMH440Y SGMH490 SGMH540		3	3	3	3	3	3
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 8 Coating adherence and bendability (cold-reduced base metal)

Symbol of grade	Bend angle	Internal spacing ^{a)} Number of sheets								
		Nominal thickness 0.20 mm or over to and excl. 1.6 mm			Nominal thickness 1.6 mm or over to and excl. 3.0 mm			Nominal thickness 3.0 mm or over up to and incl. 3.2 mm		
		Symbol for coating mass			Symbol for coating mass			Symbol for coating mass		
		K06 to K27	K35	K45	K06 to K27	K35	K45	K06 to K27	K35	K45
SGMCC	180°	1	1	2	1	2	2	2	2	2
SGMCD1		1	—	—	1	—	—	—	—	—
SGMCD2 SGMCD3 SGMCD4		0 (flat on itself)	—	—	0 (flat on it- self)	—	—	—	—	—
SGMC340		1	1	2	1	1	2	2	2	3
SGMC400 SGMC400Y		2	2	2	2	2	2	3	3	3
SGMC440 SGMC440Y SGMC490		3	3	3	3	3	3	3	3	3
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.										

7 Chemical conversion

The classification and symbols for chemical conversion for sheets, coils and corrugated sheets shall be as given in Table 9.

Other chemical conversion may apply as agreed between the purchaser and the manufacturer.

Table 9 Classification and symbols for chemical conversion

Classification of chemical conversion	Symbol for chemical conversion
Chromate-free conversion	^{a)}
No conversion	M
Note ^{a)} The symbol for chromate-free conversion shall be as agreed between the purchaser and the manufacturer.	

8 Oiling

The classification and symbols for oiling for sheets, coils and corrugated sheets shall be as given in Table 10. Unless otherwise specified, the sheets, coils and corrugated sheets shall be unoiled.

Table 10 Classification and symbols for oiling

Classification of oiling	Symbol for oiling
Oiled	O
Unoiled	X

9 Mechanical properties

9.1 Applicable mechanical properties

The mechanical properties applicable to sheets and coils shall be as given in Table 11. The mechanical properties of the corrugated sheets shall apply to pre-corrugated sheets and shall be as given in Table 11.

Table 11 Applicable mechanical properties

Symbol of grade	Bendability	Yield point or proof stress, tensile strength and elongation
SGMHC	○	—
SGMH340	○	○
SGMH400, SGMH400Y	○	○
SGMH440, SGMH440Y	○	○
SGMH490	○	○
SGMH540	○	○
SGMCC	○ ^{a)}	—
SGMCH	—	—
SGMCD1	○	○
SGMCD2	○	○
SGMCD3	○	○
SGMCD4	○	○
SGMC340	○	○
SGMC400, SGMC400Y	○	○
SGMC440, SGMC440Y	○	○
SGMC490	○	○
SGMC570	—	○
Note ^{a)} If used for corrugated sheets, the bendability shall not apply.		

9.2 Bendability

When the sheets, coils and corrugated sheets are tested for bendability in accordance with 14.4, the external surface of the test piece (not less than 7 mm from both side edges of test piece) shall be free from visible cracks and breakage of base metal.

NOTE For the details of bend test, see 14.4.2.

9.3 Yield point or proof stress, tensile strength and elongation

The sheets, coils and pre-corrugated sheets shall be tested for yield point or proof stress, tensile strength and elongation in accordance with 14.4, and shall satisfy the requirements given in Table 12 or Table 13. The values given in Table 12 or Table 13 shall apply to those which undergo delivery inspection ²⁾.

Note ²⁾ Age-hardening of sheets, coils and pre-corrugated sheets may cause an increase in yield point or proof stress and a decrease in elongation.

Table 12 Yield point or proof stress, tensile strength and elongation (hot-rolled base metal)

Symbol of grade	Yield point or proof stress	Tensile strength	Elongation %						Test piece and direction
			Nominal thickness mm						
			1.6 or over to and excl. 2.0	2.0 or over to and excl. 2.5	2.5 or over to and excl. 3.2	3.2 or over to and excl. 4.0	4.0 or over up to and incl. 6.0	Over 6.0 up to and incl. 9.0	
SGMHC	N/mm ²	N/mm ²	—						
SGMH340	245 min.	340 min.	20 min.	20 min.	20 min.	20 min.	20 min.	20 min.	No. 5 in rolling direction or perpendicular to rolling direction
SGMH400	295 min.	400 min.	18 min.	18 min.	18 min.	18 min.	18 min.	18 min.	
SGMH400Y	235 min.	400 min.							
SGMH440	335 min.	440 min.							
SGMH440Y	275 min.	440 min.							
SGMH490	365 min.	490 min.	16 min.	16 min.	16 min.	16 min.	16 min.		
SGMH540	400 min.	540 min.							
NOTE 1	For SGMHC, a yield point or proof stress of 205 N/mm ² or over and a tensile strength of 270 N/mm ² or over may be as agreed between the purchaser and the manufacturer.								
NOTE 2	1 N/mm ² = 1 MPa								

Table 13 Yield point or proof stress, tensile strength and elongation (cold-reduced base metal)

Symbol of grade	Yield point or proof stress N/mm ²	Tensile strength N/mm ²	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 to and excl. 2.5	2.5 or over up to and incl. 3.2	
SGMCC			—						
SGMCH			—						
SGMCD1	—	270 min.	—	30 min.	33 min.	36 min.	38 min.	—	No. 5 in rolling direction
SGMCD2	—	270 min.	—	36 min.	38 min.	39 min.	40 min.	—	
SGMCD3	—	270 min.	—	38 min.	40 min.	41 min.	42 min.	—	
SGMCD4 ^{a)}	—	270 min.	—	40 min.	42 min.	43 min.	44 min.	—	
SGMC340	245 min.	340 min.	20 min.	20 min.	20 min.	20 min.	20 min.	20 min.	No. 5 in rolling direction or perpendicular to rolling direction
SGMC400	295 min.	400 min.	18 min.	18 min.	18 min.	18 min.	18 min.	18 min.	
SGMC400Y	235 min.	400 min.	18 min.	18 min.	18 min.	18 min.	18 min.	18 min.	
SGMC440	335 min.	440 min.	18 min.	18 min.	18 min.	18 min.	18 min.	18 min.	
SGMC440Y	275 min.	440 min.	18 min.	18 min.	18 min.	18 min.	18 min.	18 min.	
SGMC490	365 min.	490 min.	16 min.	16 min.	16 min.	16 min.	16 min.	16 min.	
SGMC570	560 min.	570 min.	—						
NOTE 1 For SGMCC, a yield point or proof stress of 205 N/mm ² or over and a tensile strength of 270 N/mm ² or over may be as agreed between the purchaser and the manufacturer.									
NOTE 2 SGMCH, as it is not subjected to annealing, usually has a Rockwell hardness of 85 HRBW or over, or a Vickers hardness of 170 HV or over.									
NOTE 3 1 N/mm ² = 1 MPa									
Note ^{a)} The sheets and coils of SGMCD4 shall be free from stretcher strain marks when being formed, for a period of six months after manufacture.									